United States Environmental Protection Agency

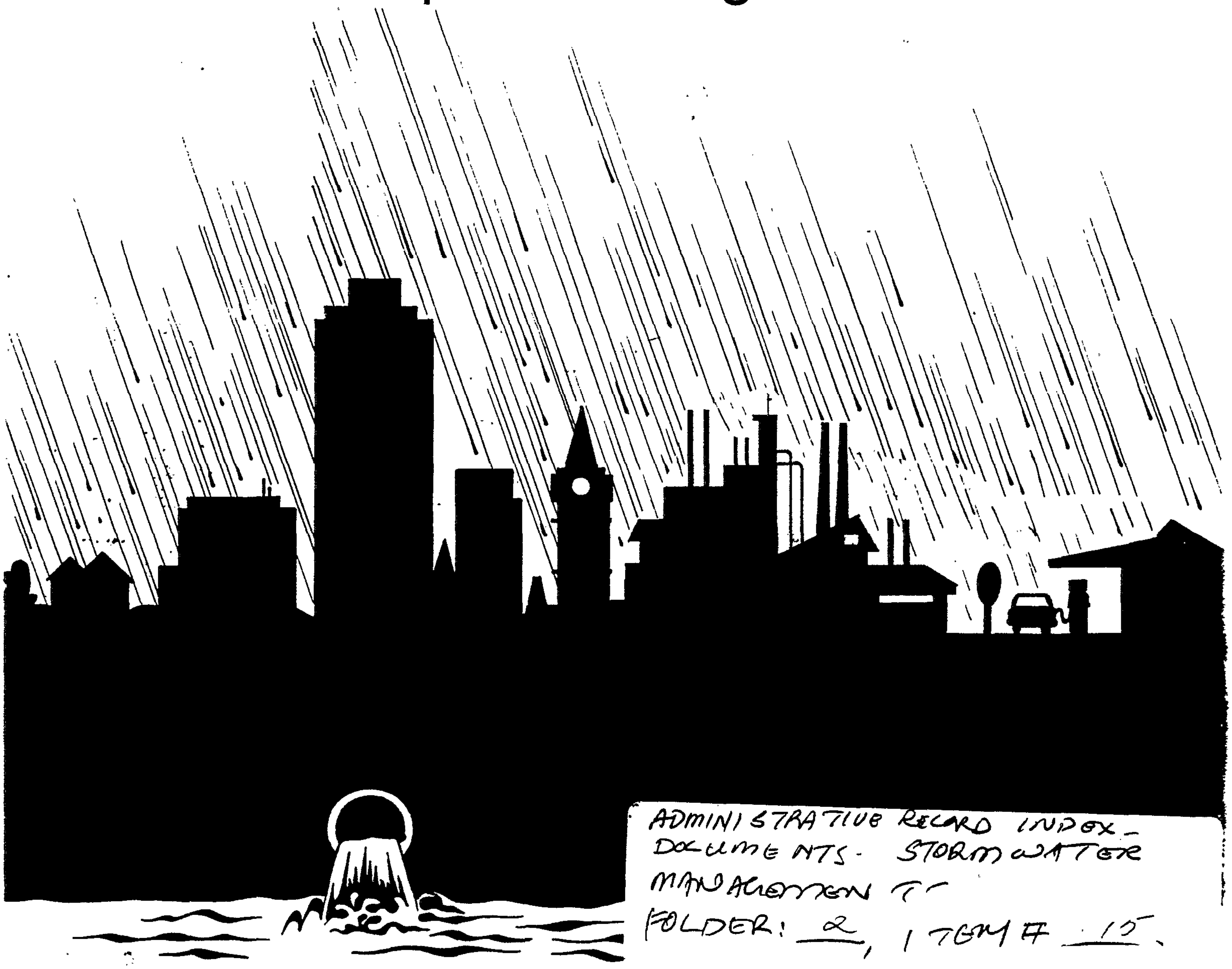
Office Of Water (4203)

EPA 833-K-94-002
March 1995

EPA

Storm Water Discharges Potentially Addressed By Phase II Of The National Pollutant Discharge Elimination System Storm Water Program

Report To Congress



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This report has been prepared by the U.S. Environmental Protection Agency, Office of Wastewater Management, Permits Division (4203), 401 M Street, S.W., Washington, D.C. 20460. Inquiries pertaining to this report should be sent to this address or may be made by calling (202) 260-9545. Copies are available from the Office of Water Resource Center, (202) 260-7786.

March 1995

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON D.C. 20460

MAR 29 1995

THE ADMINISTRATOR

Honorable Albert Gore, Jr.
President of the Senate
Washington, D.C. 20510

Dear Mr. President:

I am pleased to present the Environmental Protection Agency's (EPA) "Report to Congress on Storm Water Discharges Potentially to be Addressed by Phase II of the National Pollutant Discharge Elimination System Storm Water Program." With this Report as a starting point, I believe, together with Congress and our other partners, we can make substantial progress in utilizing more cost-effective and resourceful ways to control storm water pollution and to protect public health and the environment.

This Report responds to Section 402(p)(5) of the Clean Water Act and provides data, analysis, and recommendations concerning the number and type of discharges potentially to be covered by a phase II storm water program. The Report also identifies the nature and extent of these discharges and discusses one possible approach to implementing a phase II storm water program.

Although this Report discusses only one possible approach for a phase II storm water program, EPA looks forward to working with Congress, States, Tribes, local governments, and other stakeholders to identify other options for a phase II program. Already, EPA is taking steps to explore additional possibilities by developing partnerships and seeking ideas from all groups that will be involved. We will draw on our experience with the phase I storm water program and collaborative efforts with our stakeholders to ensure a cost-effective storm water program.

As a first step, EPA is establishing an urban wet-weather advisory group composed of stakeholders from industry, States, municipalities, commercial and retail establishments, environmental groups and others, to address policy and technical issues related to urban wet weather. A storm water phase II subgroup will be formed to consider cost-effective ways of addressing pollution from phase II storm water discharges. We will share the results of these efforts with Congress as they develop.

In addition to the phase II efforts, we plan to review and streamline the phase I storm water program. We will consider changes to existing monitoring and permitting requirements for regulated phase I municipal dischargers and will resolve questions regarding what cities must do under the Act's storm water control "maximum extent practicable" requirements.

I believe this Report responds fully to the mandates of Section 402(p)(5) of the Clean Water Act, and I hope Congress finds it useful in determining how to proceed with the storm water program.

Sincerely,

Carol M. Browner

Enclosure

R0015030

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON D.C. 20460

MAR 29 1995

THE ADMINISTRATOR

Honorable Newt Gingrich
Speaker of the House
of Representatives
Washington, D.C. 20515

Dear Mr. Gingrich:

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Enclosure

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Introduction

Storm water discharges have been linked to one-third of all assessed surface water quality impairments nationwide by transporting large quantities of pollutants to our Nation's waterways.[1] Significant sources of contaminated storm water include urban runoff, industrial activities, construction, mining, other types of resource extraction, and different commercial activities. To address this problem, Congress amended the Clean Water Act (CWA) in 1987 to establish a phased approach for issuing National Pollutant Discharge Elimination System (NPDES) permits for storm water discharges.

Phase I of the storm water program, now underway, controls storm water discharges only from industrial activity and municipal separate storm sewer systems serving populations greater than 100,000. Many other sources of polluted storm water remain unaddressed. To deal with them, Congress required the United States Environmental Protection Agency (EPA) to prepare a study identifying additional sources of storm water contamination and establishing procedures and methods to control these discharges under a Phase II storm water program.

This report presents the results of the study to identify potential sources for consideration in a Phase II program and a discussion of the nature and extent of pollutants in their discharges. This report also contains recommendations for how to control Phase II storm water sources.

[1] This estimate is based on information contained in EPA's *National Water Quality Inventory, 1992 Report to Congress*, prepared pursuant to the Clean Water Act, Section 305(b), which is based on State reports of assessments of surface water impacts.

The storm water sources identified in this report and the recommendations for controlling these sources, represent one possible approach, developed by EPA, to a Phase II storm water program. Other approaches are also feasible and EPA plans to explore these through a broad inclusionary process with stakeholders from industry, municipalities, commercial and retail establishments, environmental groups and other interested parties. This will be done by establishing a Federal Advisory Committee Act (FACA) subcommittee on Phase II. This subcommittee will be tasked with examining the key issues for a Phase II storm water program and with recommending cost-effective ways of addressing pollution from Phase II sources. The outcome of this effort may be the formulation of a Phase II storm water program that will differ in scope and procedure from the approach discussed in this report.

This report includes an introduction to the study (Chapter 1), a description of the approach used (Chapter 2), an analysis of municipal sources to be included in Phase II (Chapter 3), and a review of individual sources to be addressed in Phase II (Chapter 4), as well as numerous appendices, which provide supporting data and information.

Summary of Key Findings

EPA has identified two major classes of potential Phase II storm water discharges that are described in this report: (1) discharges from municipal separate storm sewer systems not subject to Phase I and (2) discharges from individual (industrial, commercial, and institutional) facilities not subject to Phase I.

Based on the identification and analysis of potential Phase II sources and available information on impacts of storm water discharges, this report recommends that Phase II of the storm water program focus on the 405 urbanized areas identified by the Bureau of the Census. As described in *President's Clinton's Clean Water Initiative*, municipalities in these urbanized areas would be authorized to regulate industrial dischargers and to address, as necessary, commercial, institutional, and retail services within their jurisdiction using a flexible approach rather than EPA or the States permitting these sources directly.

Significant environmental benefit, including reduced pollutant loadings from urbanized areas, will be obtained by extension of the storm water program to these areas. As summarized below and explained in detail in this report, urbanized areas contain a large percentage of population and population growth, as well as industrial, commercial, and retail facilities, while constituting only 2 percent of the total land area. Focusing Phase II of the storm water program on urbanized areas thus targets the highest concentration of pollutant sources and maximizes the potential benefits.

Background

Water Quality Impacts

While rainfall and snow are natural events, the nature of runoff and its impact on water resources are highly dependent on human activities and the use of the land. Storm water runoff can affect surface water quality in two basic ways: (1) natural flow patterns can be radically altered; and (2) pollution concentrations and loadings can be highly elevated.

The National Water Quality Inventory, a report prepared every 2 years summarizing biennial State reports required by Section 305(b) of the CWA, provides a national assessment of surface water impacts associated with runoff from various land uses. The most recent report in this series, *The National Water Quality Inventory, 1992 Report to Congress,* concludes that storm water runoff from a number of diffuse sources, including agricultural areas, municipal separate storm sewers, urban runoff, and atmospheric deposition, are the leading cause of surface water quality impairment cited by States. Five leading contributors to use impairment are shown in Table ES-1.

Storm water runoff from urbanized areas and industrial and commercial activities can contain high levels of contaminants, such as sediment, suspended solids, nutrients, heavy metals, pathogens, toxics, oxygen-demanding substances, and floatables.[2] In urban areas,

[2] National Water Quality Inventory: *1992 Report to Congress*, EPA, 1994.

Table ES-1. Five Leading Sources of Water Quality Impairment for Selected Classes of Waters

Rank	Rivers	Lakes	Estuaries
1	Agriculture	Agriculture	Municipal Point Sources
2	Municipal Point Sources	**Urban Runoff / Storm Sewers**	**Urban Runoff / Storm Sewers**
3	**Urban Runoff / Storm Sewers**	Hydrologic / Habitat Modification	Agriculture
4	Resource Extraction	Municipal Point Sources	Industrial Point Sources
5	Industrial Point Sources	Onsite Wastewater Disposal	Contaminated Sediments

Source: *National Water Quality Inventory, 1992 Report to Congress*, EPA, 1994.

the cumulative effect of widespread development will also change natural drainage patterns, causing much higher wet-weather peak flows and reduced dry-weather base flows in urban streams and wetlands. Increased peak flows can cause severe hydromodifications such as stream bank erosion, streambed scour, flooding, channelization, and alteration and/or elimination of habitat.[3] These flows will also accumulate and transport pollutants to receiving waters. These pollutants are generated from the numerous human activities within the urban area. Industrial and commercial operations, which are generally located in urban areas, can be significant sources of storm water contamination because of the nature of activities conducted, and materials stored, outdoors.

Appendix B provides an overview of the impacts associated with different pollutant classes and types of receiving waters and ground water. Pollutants associated with widespread urban development are discussed in Chapter 3. Pollutants associated with selected classes of industrial and commercial activities are discussed in Chapter 4.

Clean Water Act Framework

The 1972 amendments to the Federal Water Pollution Control Act (referred to as the Clean Water Act [CWA]) prohibit the discharge of any pollutant to navigable waters from a

[3] *Environmental Impacts of Storm Water Discharges—A National Profile*, EPA, June 1992, EPA 841-R-92-001.

point source unless the discharge is authorized by a National Pollutant Discharge Elimination System (NPDES) permit issued under Section 402. In 1987, Section 402(p) was added to the CWA to modify the framework for addressing point source discharges composed entirely of storm water ("storm water discharges") under the NPDES program,[4] establishing a phased approach for issuing NPDES storm water permits. Phase I of the program addresses storm water from industrial facilities and discharges from municipal separate storm sewer systems serving populations of 100,000 or more. Section 402(p)(5) of the CWA directs EPA, in consultation with the States, to study additional storm water discharges not addressed by Phase I. Sections 402(p)(5)(A) and (B) direct EPA, in consultation with the States, to:

- Identify those storm water discharges or classes of storm water discharges for which National Pollutant Discharge Elimination System (NPDES) permits are not required under Phase I of the NPDES storm water program
- Determine, to the maximum extent practicable, the nature and extent of pollutants in such discharges.

Section 402(p)(5)(C) of the CWA requires EPA to establish procedures and methods to control Phase II storm water discharges necessary to mitigate impacts on water quality. Recommendations for procedures and methods to control Phase II storm water discharges are summarized in this report and described in detail in *President Clinton's Clean Water Initiative*, which is found in Appendix L. Together, this report, and *President Clinton's Clean Water Initiative*, fulfill the requirements of Section 402(P)(5) of the CWA.

Section 402(p)(6) of the CWA requires EPA, in consultation with State and local officials, to issue regulations for controlling designated Phase II storm water discharges necessary to protect water quality. The regulations must, at a minimum, establish priorities, requirements for State storm water management programs, and expeditious deadlines. The

[4] Storm water is defined in the NPDES regulations as "storm water runoff, snow melt runoff, and surface runoff and drainage." (40 *CFR* 122.26(b)(13))

program may include performance standards, guidelines, guidance, management practices, and treatment requirements, as appropriate.

Findings

Municipal Separate Storm Sewer Systems

The Bureau of the Census estimates that the population of the United States and associated territories was more than 252.2 million in 1990[5]. The concept of urbanized areas as defined by the Bureau of the Census served as an important tool for analyzing potential approaches to a Phase II program that addresses municipal separate storm sewer systems. More than 160 million people (63 percent of the total U.S. population) reside in the 405 urbanized areas, each with a population of 50,000 or more. The Bureau of the Census has defined an urbanized area as a central city (or cities) surrounded by a densely settled area. To meet the Bureau of the Census definition, the population of the entire urbanized area must be greater than 50,000 persons and the closely settled area outside of the city, the urban fringe, must have a population density generally greater than 1,000 persons per square mile (just over 1.5 persons per acre). These areas occupy less than 2 percent of the Nation's total land area and represent the largest, most widespread areas of dense urban development in the country.

The majority of new urban development also occurs in these urbanized areas. Construction activity related to new development is recognized as a significant source of pollution and impairment of waterbodies, providing some of the best opportunities for implementing storm water management controls in a highly cost-effective fashion. Between 1980 and 1990, the population of urbanized areas increased by 21.2 million.[6] Statistics on

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[5] Population estimates based on the 50 States, the District of Columbia, Guam, the Commonwealth of Puerto Rico, the Virgin Islands, American Samoa, and the Commonwealth of the Northern Mariana Islands.

[6] About 7 percent of this increase, (1.5 million people) are associated with the net addition of 30 new urbanized areas between 1980 and 1990.

the population, number of urbanized areas, and estimated pollutant loads in runoff in urbanized areas are summarized in Table ES-2 and discussed below.

Phase I of the NPDES program for storm water discharges addresses 81.7 million people in portions of 136 urbanized areas.[7] EPA estimates that about 40 percent of the pollutant loads in storm water discharged from urbanized areas come from Phase I municipalities.

The portions of these 136 urbanized areas that are not addressed by Phase I had a combined population of 35.8 million people in 1990. EPA estimates that 28 percent of the pollutant loads in storm water discharged from urbanized areas come from these Phase II portions of the 136 urbanized areas with a Phase I municipality.

Of the Census-designated urbanized areas, 269 do not have any municipalities subject to Phase I of the storm water program. EPA estimates that 32 percent of the pollutant loads in storm water discharged from urbanized areas come from these 269 urbanized areas.

In addition to populations within urbanized areas discussed above, the Bureau of the Census has identified an additional urban population of 29 million people that live outside urbanized areas, as well as 62.8 million people classified as rural. Although discharges from municipal separate storm sewers serving these populations are potential Phase II sources, they are not addressed in detail in this report.

Individual Phase II Facilities

The findings of this report are summarized in terms of the identification, nature, and extent of unregulated individual facilities. Due to very limited national data on which to base

[7] There are 621 incorporated places (cities) and portions of 77 counties within these 136 urbanized areas. Of these municipalities, 140 cities and 45 counties are specifically identified in the NPDES regulations that were published in November 1990. EPA and authorized NPDES States have designated an additional 481 cities and 32 counties as Phase I municipalities. In addition, approximately 30 municipalities (located in 21 urbanized areas) have received combined sewer exclusions where the total population served by separate storm sewers is less than 100,000 after subtracting the population served by combined sewers. The methodology used to classify municipalities as Phase I vs. Phase II for the purposes of this report is discussed in Chapter 2.

Table ES-2. Estimated Pollutant Loadings From Urban Runoff

Classification	Population Category	Number of Urbanized Areas*	Population* (millions)	Percentage of Urbanized Area Loading
NATIONAL		405	252.2	NA
ALL URBANIZED AREAS	50,000 - 99,999	176	12.2	12
	100,000 -249,999	125	19.5	16
	Over 250,000	104	128.7	72
	TOTAL	405	160.4	100
URBANIZED AREAS AFFILIATED WITH PHASE I MUNICIPAL SEPARATE STORM SEWER SYSTEMS (MS4)				
- Phase I MS4s within Phase I affiliated Urbanized Areas	50,000 - 99,999	8	0.4	0
	100,000 - 249,999	47	6.3	5
	Over 250,000	81	75.0	35
	SUBTOTAL	136	81.7	40
- Phase II Portions of Phase I affiliated Urbanized Areas	50,000 - 99,999	8	0.2	1
	100,000 - 249,999	47	1.9	2
	Over 250,000	81	33.7	25
	SUBTOTAL	136	35.8	28
	TOTAL	136	117.5	68
URBANIZED AREAS NOT AFFILIATED WITH A PHASE I MS4				
- Urbanized Areas Not Affiliated with Phase I MS4s	50,000 - 99,999	168	11.6	11
	100,000 -249,999	78	11.3	9
	Over 250,000	23	20.0	12
	TOTAL	269	42.9	32
- Urbanized Areas Containing a City with a CSO Exemption**	50,000 - 99,999	0	0	0
	100,000 -249,999	7	1.5	1
	Over 250,000	14	16.0	9
	TOTAL	21	17.5	10
PHASE I MS4s OUTSIDE URBANIZED AREAS		NA	4.3	NA

* Totals are based upon 1990 Census, and include Puerto Rico, Guam, Virgin Islands, American Samoa, and the Commonwealth of the Northern Mariana Islands.

** Some municipalities identified in the November 1990 application regulations (55 *FR* 47990) as Phase I based on 1980 census data received combined sewer exclusions from Phase I where the total population served by separate storm sewers was less than 100,000 after subtracting the population served by combined sewers. (The 21 urbanized areas [with a population of 17.5 million] containing these municipalities are also contained in the above totals and are not in addition to those totals.)

loadings estimates, the discussion of the extent of unregulated storm water discharges is limited to an analysis of the number and geographic distribution of the potential Phase II facilities. In general, the distribution of these facilities follows the distribution of population with a large percentage of facilities concentrated within urbanized areas.

EPA's efforts to identify sources and categories of storm water discharges for Phase II of the storm water program started with an examination of approximately 7.7 million commercial, retail, industrial, and institutional facilities for which permits are not required in Phase I. This examination resulted in the identification of two general classes of facilities with the potential for discharging pollutants to waters of the United States through storm water point sources. The first group (Group A) includes sources that are very similar, or identical, to Phase I activities but that were not included in Phase I due to the specific language of the statute or EPA's regulatory specificity in defining the universe of Phase I industrial activities. The second general class of facilities (Group B) were identified on the basis of potential activities and pollutants that may contribute to storm water contamination.

EPA estimates that there are approximately 100,000 facilities in Group A. Facilities in this group, which may be of high priority for Phase II due to their similarity to Phase I industrial facilities include: auxiliary facilities or secondary activities (i.e., maintenance of construction equipment and vehicles, local trucking for an unregulated facility such as a grocery store); facilities intentionally omitted from Phase I (i.e., treatment works with a design flow of less than 1 MGD, landfills that have not received industrial waste); and facilities exempted by the Intermodal Surface Transportation Efficiency Act of 1991 (most industrial activities owned or operated by municipalities of less than 100,000 people[8]).

Group B consists of nearly one million facilities. These have been organized into 18 Phase II sectors for the purposes of this report. Of these 18 sectors, the automobile service

[8] The Intermodal Surface Transportation Efficiency Act of 1991 exempted industrial activities owned or operated by municipalities of less than 100,000 population from Phase I permitting requirements with the exception of powerplants, airports, and uncontrolled sanitary landfills.

sector (composed of gas/service stations, general automobile repair, car dealers, new and used, car and truck rental, etc.) makes up more than one-third of the total number of facilities identified in all 18 sectors. The 18 Phase II sectors are listed in Table ES-3.

EPA conducted a geographical analysis of these industrial and commercial facilities. The geographical analysis shows that the majority are located in urbanized areas, as presented in Table ES-3. In general, about 30 percent of potential Phase II facilities are found within the geographic jurisdiction of a Phase I municipality. Including the urbanized areas surrounding these Phase I municipalities adds another 12 to 13 percent of potential Phase II facilities. If all urbanized areas are included, an additional 16 percent of potential Phase II facilities are represented. Thus, nearly twice as many industrial facilities are found in all urbanized areas as are found in Phase I municipalities alone.[9]

President Clinton's Clean Water Initiative

President Clinton's Clean Water Initiative provides recommendations on how best to address the additional storm water sources identified by the study in a Phase II NPDES storm water program. The goal of *President Clinton's Clean Water Initiative* is to ensure that future storm water pollution prevention and management programs are focused where the maximum potential benefits can be obtained for the least cost, as well as to provide additional flexibility. A cost-benefit analysis was prepared for the *President's Initiative* and is summarized in Appendix L. No further cost-benefit analyses were conducted for this report.

The *President's Initiative* recommends that Phase II requirements focus on system-wide permits for municipal separate storm sewer systems in Census-designated urbanized areas. These areas consist of only 2 percent of the total land area, yet contain 63 percent of the

[9] Notable exceptions to this generalization include lawn/garden establishments, small currently unregulated feedlots, wholesale livestock, farm and garden machinery repair, bulk petroleum wholesale, farm supplies, lumber and building materials, agricultural chemical dealers, and petroleum pipelines, which can frequently be associated with smaller municipalities or rural areas.

Table ES-3. Geographic Distribution of Potential Phase II Facilities in Relation to Urbanized Areas

Potential Phase II Facilities Identified		Cumulative % of Facilities Located Within:		
Description	Count	Phase I Areas	Phase I Areas + UAs	All UAs
Phase II - Group A	100,000*	32	45	61
Phase II - Group B	1,015,239	28	40	56
Group B Sectors				
Automotive Service	369,870	27	38	55
Machinery & Electrical Repair	135,744	29	40	56
Intensive Ag. Chemical Use	121,861	26	38	54
Wholesale, Machinery	77,562	32	47	65
Laundries	51,376	38	52	71
Wholesale, Wood Products	48,593	26	36	53
Livestock, Feedlots	43,421**	8	11	20
Petrol. Pipelines & Distributors	35,319	16	25	39
Photographic Activities	30,684	40	53	70
Various Utilities	22,242	24	36	53
Extensive Ag Chem Use	18,992	31	42	62
Transport, Rail and Other	14,808	47	64	81
Wholesale, Metal Products	14,303	36	54	75
Wholesale, Food	11,372	36	49	67
Laboratories	10,683	38	56	74
Muni. Services, Vehicle Maint.	4,611	25	35	51
National Security	2,414	34	43	60
Wholesale, Coal & Ores	1,384	23	31	48

* This figure is an approximation based on the total number of facilities in SIC codes 10 through 45 after subtracting an estimate of the number of facilities covered under Phase I. Geographical distribution information is based on all facilities in SIC codes 10 through 45, and may not be representative of all classes of facilities in this group. For the geographic distribution of specific SIC codes, refer to Appendix G.

** This number is based on SIC codes and does not reflect all feedlots potentially subject to Phase II. The United States Department of Agriculture has estimated that there are approximately 378,000 animal feeding operations between 20 and 1000 animal units. The facilities identified here should be representative of feedlots in general and allow estimation of the distribution of these facilities as a class.

total population. Phase II areas account for nearly 60 percent of the loadings from urbanized areas, one and a half times the loadings from Phase I areas. In addition, 57 percent of the national population growth over the past decade has occurred in Phase II areas, compared to 30 percent in Phase I.

The *President's Initiative* contains flexibility in its recommendation that municipalities be authorized to regulate industrial discharges and to address commercial, institutional, and retail sources as necessary within their jurisdiction. This would allow municipalities to control Phase II sources using a flexible approach which would be less costly than having EPA or States permitting individual Phase II sources directly through individual or general permits. Facilities which could certify that there will be no exposure of contaminant sources to rain water and snow melt could be exempted from the storm water program altogether. This change would release low-risk facilities from NPDES requirements, allowing allocation of resources to more critical areas. This would also effectively create incentives for facilities to eliminate exposure of contaminants to rain and snow.

CHAPTER 1. INTRODUCTION

The 1972 amendments to the Federal Water Pollution Control Act (referred to as the Clean Water Act [CWA]) prohibited the discharge of any pollutant to navigable waters from a point source unless the discharge is authorized by a National Pollutant Discharge Elimination System (NPDES) permit. In 1987, Section 402(p) was added to the CWA to modify the framework for addressing point source discharges of storm water under the NPDES program. This provision established a phased approach for issuing NPDES permits for storm water discharges. Phase I of the program addresses storm water from industrial facilities and discharges from municipal separate storm sewer systems serving a population of 100,000 or more. Section 402(p)(5) of the CWA directs the United States Environmental Protection Agency (EPA), in consultation with the States, to study additional storm water discharges not addressed by Phase I of the program. Section 402(p)(5) requires a study for the purpose of:

(A) Identifying those storm water discharges or classes of discharges for which permits are not already required as part of the first phase of the NPDES storm water program, and

(B) Determining, to the maximum extent practicable, the nature and extent of pollutants in such discharges.

(C) Establishing procedures and methods to control storm water discharges to the extent necessary to mitigate impacts on water quality.

Section 402(p)(6) of the CWA provides for EPA to issue regulations that designate additional storm water discharges to be controlled to protect water quality under Phase II of the program and to establish a comprehensive program to regulate such designated sources. The program shall, at a minimum, establish priorities, requirements for State storm water management programs, and expeditious deadlines. The program may include performance standards, guidelines, guidance, and management practices and treatment requirements, as appropriate. This report presents the results of the study required under Section 402(p)(5) of the CWA.

1.1 BACKGROUND ON THE STORM WATER PROBLEM

While rainfall and snow are natural events, the nature of runoff and its impact on water resources is highly dependent on human activities and use of land. Runoff from lands modified by human activities can affect surface water resources in two ways: (1) natural flow patterns can be modified; and (2) pollution concentrations and loadings can be elevated.

Prior to development of land, a natural hydraulic cycle exists. Rainfall infiltrates to recharge ground water supplies and surface runoff drains through the natural streams which flow to form a watershed. Natural flow patterns can be modified by activities that make the land surfaces more impervious. Activities that alter the natural vegetation can change the natural infiltration characteristics of a watershed. This is particularly evident where widespread urban development occurs. Urban land use results in the removal of vegetation cover and the building of impervious structures such as roads, parking lots, sidewalks, and buildings. In urban areas, the cumulative effect of widespread development may bring dramatic changes to natural drainage patterns, which can cause much higher wet-weather peak flows and reduced dry-weather base flows in urban streams and wetlands. Increased peak flows can cause hydromodifications such as stream bank erosion, streambed scour, flooding, channelization, and elimination and/or alteration of habitat.[1] Additional hydromodifications result from engineered activities to accommodate higher peak flows, such as channel excavation, lining (retaining walls, rip-rap), realignment, underground culverts, and draining of wetlands.

Increased imperviousness and loss of wetlands and natural flow channels associated with urban development also decreases the amount of rainwater available for ground water

[1] *Environmental Impacts of Storm Water Discharges—A National Profile*, EPA, June 1992, EPA 841-R-92-001.

recharge. Reduced ground water levels lower base flows in streams during dry weather periods, which impairs the aquatic habitat, impairs riparian wetlands, and makes receiving streams more sensitive to other pollutant inputs and sedimentation.

Different activities and land uses can also contribute a wide variety of pollutants to runoff. Appendix B provides an overview of different types of impacts associated with different pollutant classes and types of receiving waters and ground water. Pollutants associated with widespread urban development are discussed in Chapter 3. Pollutants associated with selected classes of industrial and commercial activities are discussed in Chapter 4. Chapter 2 provides a description of the methodology and analysis used to develop Chapters 3 and 4.

1.1.1 National Summary of Impacts

The National Water Quality Inventory, a report prepared every 2 years summarizing biennial State reports, as required by Section 305(b) of the CWA, provides a national assessment of surface water impacts associated with runoff from various land uses. The most recent report in this series, *The National Water Quality Inventory, 1992 Report to Congress* provides a general assessment of water quality based on State reports indicating the portion of the States' waters that have been assessed that are not supporting designated uses. The report identifies the sources of use impairment for those waters (e.g., diffuse sources, point sources, and natural sources). Based on information from 51 States and Territories that reported on sources of pollution, the 1992 report indicates that roughly 40 to 60 percent of assessed rivers, lakes, and estuaries are not supporting the uses for which they are designated. In addition, 98 percent of the Great Lake shorelines assessed and 20 percent of the Ocean Coastal Waters were not fully supporting designated uses.

The National Water Quality Inventory, 1992 Report to Congress concludes that storm water runoff from a number of diffuse sources, including agricultural areas, separate storm sewers, urban runoff, and atmospheric deposition, is the leading cause of water quality impairment cited by States. Summaries of the major sources contributing to use impairment are provided in Tables 1-1 and 1-2.

The *National Water Quality Inventory* indicates that where impairment occurs, the type of land use (e.g., agriculture, urban, resource extraction) within a watershed is often related to the impairment. Urban land use, while only occupying a small fraction of the total land area of the country,[2] is responsible for a disproportionately high percentage of impairment. Urban land use is expected to be correlated to a number of major sources of impairment identified in the *National Water Quality Inventory*, including municipal point sources, separate storm sewers, urban runoff, combined sewer overflows, and many industrial point sources. At the same time, surface water resources in and near urban populations supply drinking water to 200 million U.S. citizens and provide recreational opportunities for millions more.[3]

The agricultural category listed in the *Inventory* comprises a number of activities, most of which are exempt from the definition of "point source" in Section 502(14) of the CWA which, in part, determines the jurisdiction of the NPDES program. One class of sources related to agriculture that is specifically identified in the statutory definition of point source is concentrated animal feeding operations (CAFOs). As discussed below, EPA has issued regulations to define the scope of the term "concentrated animal feeding operation." Although the contribution of various agricultural activities is difficult to evaluate independently, EPA has estimated that feedlots (which include both CAFOs identified as point sources under the NPDES regulations and other feedlots that are not addressed by the regulatory definition) contribute to 13 percent of impaired river miles, 7 percent of impaired

[2] For example, the 1990 Census indicates that 64 percent of the United States population lives in Census-designated urbanized areas of 50,000 or more. However, these urbanized areas are located on less than 2 percent of the total land area of the country. Other development, including smaller urban populations in areas of 10 acres or more and rural transportation, account for an additional 2 percent of land area. By comparison, agricultural activities, including cropland, pasture land and range land, account for 49 percent of the land in the United States. (See *Summary Report, 1987 National Resources Inventory*, Soil Conservation Service, December 1987).

[3] *President Clinton's Clean Water Initiative*, 1994.

Table 1-1. Major Sources of Water Quality Impairment

	Rivers	Lakes	Estuaries	Great Lake Shorelines	Ocean Coastal Waters
Percent of Waters Assessed	18	46	74	99	6
Percent of Assessed Waters Not Fully Supporting Use	44	57	44	98	20
Percent of Waters Not Fully Supporting Use That is Attributed to Source					
Industrial Point Sources	7		23		29
Municipal Point Sources	15	21	53		
Combined Sewer Overflows				8	59
Separate Storm Sewers/Urban Runoff	11	24	43	11	
Agriculture	72	56	43		
Resource Extraction	11		12		
Hydrologic/Habitat Modification	7	23			
On-Site Wastewater Disposal		16			
Contaminated Sediments				40	25
Land Disposal				31	42
Atmospheric Deposition				50	

Explanation of Pollutant Sources

Industrial Point Sources: Industrial process discharges and cooling water
Municipal Point Sources: Sewage treatment plants, including package plants
Combined Sewer Overflows: Discharges from sewage collection systems of sanitary sewage and runoff
Separate Storm Sewers/Urban Runoff: Discharges from separate storm sewers and other urban runoff
Agriculture: Crop production, pastures, rangeland, feedlots, animal holding/management areas, manure lagoons, aquaculture, and irrigation return flows
Silviculture: Forest management, harvesting, residue maintenance and road construction and maintenance
Resource Extraction: Mining and mine drainage
Hydrologic/Habitat Modification: Channelization, dredging, dam construction, flow regulation, bridge construction, streambank modification/destabilization, drainage/filling of wetlands
Land Disposal: Sludge, wastewater, landfills, industrial land treatment, septic systems, hazardous waste, sewage disposal

Source: *National Water Quality Inventory: 1992 Report to Congress*, EPA, 1994.

Table 1-2. Five Leading Sources of Water Quality Impairment for Selected Classes of Waters

Rank	Rivers	Lakes	Estuaries
1	Agriculture	Agriculture	Municipal Point Sources
2	Municipal Point Sources	Urban Runoff / Storm Sewers	Urban Runoff / Storm Sewers
3	Urban Runoff / Storm Sewers	Hydrologic / Habitat Modification	Agriculture
4	Resource Extraction	Municipal Point Sources	Industrial Point Sources
5	Industrial Point Sources	Onsite Wastewater Disposal	Contaminated Sediments

Source: *National Water Quality Inventory, 1992 Report to Congress*, EPA, 1994.

lake acres, 3 percent of impaired estuary square miles, and negligible amounts of impairment in the Great Lakes and Coastal areas.[4]

1.2 THE NPDES STORM WATER PERMIT PROGRAM

The appropriate means of regulating storm water point sources within the NPDES program has been debated since the establishment of the NPDES program in 1972. Each attempt to devise a workable program has been the focus of substantial controversy concerning the water quality impacts, large number of storm water sources, nature of storm water runoff, and constraints of program priorities and resources.

1.2.1 Early Regulatory Approaches

In 1973, EPA promulgated regulations that exempted a number of categories of point sources from NPDES permit requirements, including: silvicultural point sources; CAFOs below a certain size; irrigation return flows from areas of less than 3,000 contiguous acres or 3,000 noncontiguous acres that use the same drainage system; nonfeedlot, nonirrigation agricultural point sources; and separate storm sewers containing only storm runoff uncontaminated by any industrial or commercial activity (38 *FR* 13530 (May 22, 1973)). The Agency maintained that exemptions were appropriate to conserve the Agency's enforcement resources for more significant point sources of pollution. In addition, the Agency noted that the characteristics of runoff pollution make it difficult to promulgate numeric effluent limitations for most of the point sources exempted by the 1973 regulations.

The Natural Resources Defense Council (NRDC) brought suit in the U.S. District Court for the District of Columbia challenging the Agency's authority to selectively exempt categories of point sources from permit requirements, *NRDC v. Train*, 396 F.Supp. 1393 (D.D.C. 1975), *aff'd, NRDC v. Costle*, 568 F.2d 1369 (D.C. Cir. 1977). The District Court held that EPA could not exempt discharges identified as point sources from regulation under

[4] *The Report of the EPA/State Feedlot Workgroup*, EPA, September 1993.

the NPDES permit program. However, in acknowledging the administrative burden placed on the Agency by requiring individual permits, the court recognized EPA's discretion to use certain administrative devices, such as area or general permits, to help manage its workload. In addition, the court recognized some discretion on EPA's part to define what constitutes a point source.

In response to the District Court's decision in *NRDC v. Train*, EPA issued a series of regulations addressing discharges from separate storm sewers (March 18, 1976, (41 *FR* 11307)), CAFOs (March 18, 1976, (41 *FR* 11458)), agricultural activities (July 12, 1976 (41 *FR* 28493)), silviculture activities (June 18, 1976 (41 *FR* 24709)), and aquaculture projects (May 17, 1977 (42 *FR* 25478)). Each of these regulations defined classes of point source discharges that would be subject to the NPDES permit program and exempted other classes of discharges from NPDES jurisdiction.

The regulations addressing NPDES requirements for agricultural activities defined the term agricultural point source to include any discernible, confined, and discrete conveyance from which any irrigation return flow is discharged into navigable waters. In response to these regulations, Congress amended the CWA in 1977 to specifically exclude return flows from irrigated agriculture from the definition of agricultural point source.[5] In 1987, Congress further amended the CWA to exclude agricultural storm water from the definition of agricultural point source.

The regulations addressing NPDES requirements for silvicultural activities defined the term silvicultural point source to include any discernible, confined, and discrete conveyance related to rock crushing, gravel washing, log sorting or log storage facilities which are

[5] *President Clinton's Clean Water Initiative* (1994) recommends that EPA, with the concurrence of the Departments of Agriculture and the Interior, and after consultation with States and other Federal agencies, should submit a report to Congress within two years after reauthorization of the CWA that evaluates the nature and extent of water quality problems presented by irrigation return flows, identifies the most promising and cost-effective technical and programmatic solutions to these problems, and recommends appropriate actions, including programmatic improvements and necessary legislative changes.

operated in connection with silvicultural activities and from which pollutants are discharged into navigable waters. The regulation clarified that the term did not include nonpoint source activities inherent to silviculture such as nursery operations, site preparation, reforestation and subsequent cultural treatment, thinning, prescribed burning, pest and fire control, harvesting operations surface drainage, and road construction and maintenance from which there is runoff.

The regulations addressing NPDES requirements for CAFOs clarified that CAFOs are point sources. CAFOs are defined as animal feeding operations that discharge to waters of the United States at times other than during events greater than a 25-year, 24-hour storm and that (1) have more than 1,000 animal units; (2) have more than 300 animal units and pollutants are discharged into navigable waters through a man-made flushing system or other man-made device, or pollutants are discharged directly into waters of the United States which originate outside of and pass over, across or through the facility or otherwise come into direct contact with the animals confined in the operation; or (3) are designated by EPA or an authorized NPDES State upon determining that it is a significant contributor of pollution to waters of the United States.

The regulations addressing NPDES requirements for concentrated aquatic animal production facilities (CAAPFs) clarified that CAAPFs are point sources. CAAPFs are defined as a hatchery, fish farm or other facility which harvest fish over specified limits or which is otherwise designated by EPA or an authorized NPDES State upon determining that it is a significant contributor of pollution to waters of the United States.

The regulations addressing separate storm sewers established a comprehensive permit program. This rule substantially increased the number of storm water discharges subject to the NPDES program. Permits continued to be required for conveyances carrying contaminated storm water runoff from areas used for industrial or commercial activities, as well as storm water discharges designated by the permit-issuing authority as significant contributors of pollution. These sources were required to submit individual permit applications required of industrial and commercial process wastewater dischargers. In addition, the 1976 rule brought into the permitting program separate storm sewers defined as "a conveyance or system of conveyances . . . located in an urbanized area and primarily operated for the purpose of collecting and conveying storm water runoff." Channelized storm water runoff from rural areas that did not contain runoff from commercial or industrial activity was not defined as a point source unless designated otherwise by the permitting authority. Permit applications were not required for separate storm sewers at that time. EPA planned to study these discharges and issue general or area permits to address these sources because these discharges were expected to be less significant than runoff from industrial facilities. During this time, permitting efforts for storm water discharges focused on industrial facilities with effluent guideline limitations for their storm water discharges.[6]

On June 7, 1979, and May 19, 1980, EPA published comprehensive revisions to the NPDES regulations (44 *FR* 32854 (June 7, 1979); 45 *FR* 33290 (May 19, 1980)). These rules essentially retained the March 18, 1976, broad definition of storm water discharges subject to NPDES permit requirements but required more stringent application data for storm water point sources. Under these regulations, the same application information required of all industrial and commercial process wastewater dischargers would be required of all storm water point sources. The new requirements included testing under certain circumstances for a substantially greater number of pollutants identified in the 1977 amendments to the CWA.

This regulation brought suits in several Courts of Appeals and District Courts by numerous major trade associations, several of their member companies, NRDC, and Citizens for a Better Environment. The suits challenged many aspects of the NPDES regulations, including the storm water provisions. Eventually all petitions for review were consolidated

[6] The following effluent limitations guidelines address storm water or a combination of storm water and process water: cement manufacturing (40 *CFR* Part 411); concentrated animal feeding operations (40 *CFR* Part 412); fertilizer manufacturing (40 *CFR* Part 418); petroleum refining (40 *CFR* Part 419); phosphate manufacturing (40 *CFR* Part 422); steam electric (40 *CFR* Part 423); coal mining (40 *CFR* Part 434); mineral mining and processing (40 *CFR* Part 436); ore mining and dressing (40 *CFR* Part 440); and asphalt emulsions (40 *CFR* Part 443).

in the U.S. Court of Appeals for the D.C. Circuit (*NRDC v. EPA*, 673 F.2d 392 (DC Cir. 1980)).

After 2 years of intensive settlement negotiations with representatives of most of the petitioners, the Agency and industry petitioners signed a settlement agreement on July 7, 1982, which addressed a number of issues relating to the NPDES program, including storm water. Under the terms of the agreement, EPA agreed to changes to the storm water regulations which were finalized on September 26, 1984 (49 *FR* 37998).

The 1984 final rule recognized two fundamental issues regarding the NPDES regulation of storm water: (1) which storm water discharges should be classified as point sources, and, therefore, within the NPDES program and (2) what is the best way to regulate these sources. On the first issue, data available to EPA, such as the Nationwide Urban Runoff Program (NURP) study, indicated that there are water quality problems associated with storm water runoff. The final rule retained the broad coverage of the 1980 rule in mandating the permitting of all storm water point sources that discharge pollutants into waters of the United States. The September 26, 1984, rule defined a storm water point source as a channelized conveyance of storm water runoff that (1) is located in an urbanized area, as defined by the Bureau of the Census, (2) discharges from lands or facilities used for industrial or commercial activities, or (3) is designated by the Director of the NPDES Program.

To address the second issue of how to regulate these sources administratively, the final rule set forth two categories of storm water point sources, each with different application requirements. Group I storm water point sources were defined as sources either subject to effluent limitations guidelines, located at an industrial plant, or plant-associated area, or designated by the Director. All other storm water point sources were classified as Group II. Group I dischargers were required to submit the NPDES application form for industrial and commercial process wastewater discharges, including certain sampling and testing data. The application requirements for Group II were significantly reduced. Group II sources were required to submit only Form 1 and a narrative description of the drainage area, receiving water, and any treatment applied to the discharge.

These storm water regulations generated considerable controversy (through post-promulgation comment) and, once again, suits were filed. The 1984 rules deleted the term "contaminated" and relied instead on geographic criteria to define sources subject to permitting. Some commenters claimed that the new definitions would subject thousands of discharges to the program for the first time. However, in EPA's view, the scope of coverage of storm water point sources under the NPDES program was essentially unchanged by the September 26, 1984, rulemaking.

Upon consideration of post-promulgation comments, EPA concluded that it would be appropriate to obtain additional data on storm water discharges to assess their significance as an environmental problem and to identify the best means of control. Although the number of dischargers required to submit quantitative testing data had been reduced by the 1984 rule, tens of thousands of storm water point sources remained to be identified, tested, and analyzed. Despite the improvements made in the 1984 regulation, EPA realized it was appropriate to request comments on whether the collection of data from each individual Group I discharger was necessary and efficient. In addition, EPA realized that new deadlines would need to be established. EPA published proposed changes to the storm water regulations on March 7, 1985, at 50 *FR* 9362 and on August 12, 1985, at 50 *FR* 27354. These proposals were not finalized because of the passage of the Water Quality Act of 1987.

1.2.2 Water Quality Act of 1987

Section 402(p) was added to the CWA in 1987 to require implementation of a comprehensive two-phased approach for addressing storm water discharges under the NPDES program. Section 402(p)(1) prohibits EPA or NPDES States from requiring permits for discharges composed entirely of storm water ("storm water discharges") until October 1, 1992 (this deadline was later extended to October 1, 1994, by the Water Resources

Development Act of 1992), except for the following five classes of Phase I storm water discharges specifically listed under Section 402(p)(2):

- Storm water discharges issued a permit before February 4, 1987
- Storm water discharges associated with industrial activity
- Discharges from a municipal separate storm sewer system serving a population of 250,000 or more
- Discharges from a municipal separate storm sewer system serving a population of 100,000 or more but less than 250,000
- Storm water discharges that EPA or an NPDES State determine to be contributing to a violation of a water quality standard or a significant contributor of pollutants to the waters of the United States.

Section 402(p)(3)(A) of the CWA requires storm water associated with industrial activity to meet all applicable provisions of Sections 402 and 301 of the CWA, including technology-based requirements and any necessary water quality-based requirements. Section 402(p)(3)(B) makes significant changes to the permit standards for discharges from municipal separate storm sewer systems.[7] Permits for discharges from municipal separate storm sewers:

- May be issued on a system- or jurisdiction-wide basis
- Shall include a requirement to effectively prohibit non-storm water discharges into the storm sewers
- Shall require controls to reduce pollutant discharges to the maximum extent practicable, including management practices, control techniques and system, design and engineering methods, and such other provisions determined appropriate for the control of such pollutants.

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[7] The 1987 amendments to the CWA did not specifically address requirements for water quality-based permit conditions in NPDES permits for discharges from municipal separate storm sewer systems. EPA interprets the Act to require that permits for discharges from municipal separate storm sewers include any requirements necessary to achieve compliance with water quality standards.

Section 402(p)(4) of the CWA establishes statutory deadlines for the initial steps in implementing the Phase I program. Deadlines are established for the development of permit application regulations, submission of permit applications, issuance of permits for Phase I sources, and compliance with permit conditions.

The 1987 amendments did not identify what sources would be subject to the NPDES program after the temporary moratorium on permit requirements of Section 402(p)(1) expired. Rather, the amendments established a process for EPA to evaluate potential Phase II sources and designate sources for regulation to protect water quality. Section 402(p)(5) of the CWA requires EPA, in consultation with the States, to conduct a study of storm water discharges other than Phase I sources (i.e., potential Phase II sources). The study is to identify storm water discharges not covered under Phase I and determine, to the maximum extent practicable, the nature and extent of pollutants in such discharges. The study is also to establish procedures and methods to control storm water discharges to the extent necessary to mitigate impacts on water quality.

Section 402(p)(6) of the CWA requires EPA, in consultation with State and local officials, to issue regulations designating additional Phase II storm water discharges to be regulated to protect water quality and to establish a comprehensive program to regulate such designated sources. The comprehensive program to regulate such designated sources must, at a minimum, establish priorities, requirements for State storm water management programs, and expeditious deadlines. The program may include performance standards, guidelines, guidance, management practices, and treatment requirements, as appropriate.

1.2.3 Phase I Regulatory Framework

EPA promulgated regulations for Phase I storm water discharges on November 16, 1990 (55 *FR* 47990). These regulations clarified the scope of the Phase I storm water program by providing regulatory definitions for the major classes of storm water discharges identified under Section 402(p)(2)(B), (C), and (D) of the CWA:

- Storm water discharges associated with industrial activity
- Discharges from municipal separate storm sewer systems serving a population of 100,000 or more.[8]

In addition, the November 16, 1990, regulations established permit application requirements, including submittal deadlines, for these classes of discharges.

The November 16, 1990, regulations define municipal separate storm sewer systems serving a population of 100,000 or more to include municipal separate storm sewers within the boundaries of 173 incorporated cities and within unincorporated portions of 47 counties with populations of 100,000 or more in their unincorporated areas.[9] The regulations allowed for additional municipal separate storm sewers to be designated by the NPDES permitting authority (EPA or an authorized NPDES State) as being part of a municipal separate storm sewer system subject to Phase I requirements. In addition, the regulations established comprehensive two-part permit applications for discharges from municipal separate storm sewer systems serving a population of 100,000 or more. Among other things, the permit applications require municipal applicants to propose municipal storm water management programs to control pollutants to the maximum extent practicable and to effectively prohibit non-storm water discharges to the municipal system.[10] Municipal storm water management programs are a combination of source controls and management practices that address targeted sources within the boundaries of the municipal system. Under this program, EPA has defined the role of municipalities in a flexible manner that allows local governments to assist in defining priority pollutant sources within the municipality and to develop and

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[8] Consistent with Section 402(p)(2) of the CWA, the November 16, 1990, regulations address two subclasses of municipal separate storm sewer systems serving a population of 100,000 or more. Large municipal separate storm sewer systems are defined as systems serving a population of 250,000 or more (40 *CFR* 122.26(b)(4)). Medium municipal separate storm sewer systems are defined as systems serving a population of 100,000 or more, but less than 250,000 (40 *CFR* 122.26(b)(7)).

[9] See Appendices F, G, H, and I to 40 *CFR* 122.

[10] See 40 *CFR* 122.26(d)(2)(iv).

implement appropriate controls for such discharges. Municipal programs can establish requirements for the control of discharges to the municipal system from privately owned lands (e.g., sediment and erosion control for construction sites) and can address municipal activities that affect storm water quality (e.g., maintenance of leaking sanitary sewers, road de-icing and maintenance, operation of municipal landfills, and some flood control efforts).

Moreover, the November 16, 1990, regulations defined the term "storm water discharges associated with industrial activity" to include 11 categories of industrial facilities (see 40 *CFR* 122.26(b)(14)) and established application requirements for such discharges.[11] In light of concerns raised by the industrial community about the complexity of the November 1990 storm water regulations, the difficulty in determining whether particular facilities were subject to the new rules, and administrative delays in permit issuance, EPA issued a series of extensions to permit application deadlines for discharges associated with industrial activity.[12] With these extensions, October 1, 1992, was established as the date by which any facility with a storm water discharge associated with industrial activity must submit either an individual or group application or obtain coverage under an applicable general permit.

Congress also has acted to grant extensions to the application deadlines for selected classes of discharges associated with industrial activity. In March 1991, Congress adopted Section 307 of the Dire Emergency Supplemental Appropriations Act of 1991, which ratified EPA's extension of Part I of the group applications to September 30, 1991. On December 18, 1991, the Intermodal Surface Transportation Efficiency Act of 1991 (or Transportation Act), extended NPDES permit application deadlines for storm water discharges associated with industrial activity from facilities that are owned or operated by municipalities. In addition, Section 1068(c) of the Transportation Act amended the Clean Water Act to provide

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[11] As discussed below, on June 4, 1992, the U.S. Court of Appeals for the Ninth Circuit found EPA's rationale for exempting construction sites of less than 5 acres and certain uncontaminated storm water discharges from light industrial facilities from Phase I of the storm water program to be invalid and has remanded these exemptions for further proceedings (see *NRDC v. EPA*, 966 F.2d 1292 (9th Cir. 1992)).

[12] See 56 *FR* 12098 (March 21, 1991), 56 *FR* 56548 (November 5, 1991), 57 *FR* 11524 (April 2, 1992).

that EPA shall not require any municipality with a population of less than 100,000 to apply for or obtain a permit for any storm water discharge associated with industrial activity other than an airport, power plant, or uncontrolled sanitary landfill owned or operated by such municipalities before October 1, 1992. In response to this provision, EPA has reserved application deadlines for these facilities.[13]

EPA also has modified the NPDES regulations to provide a greater degree of emphasis on site inspections as an alternative or supplement to discharge monitoring in permits for storm water discharges associated with industrial activity.[14]

On June 4, 1992, the United States Court of Appeals for the Ninth Circuit issued an opinion granting in part a petition for review of EPA's 1990 storm water regulations (*NRDC* v. *EPA*, 966 F.2d 1292 (9th Cir. 1992)). The court upheld several provisions of the regulations, including the definition of municipal separate storm sewer system, the standards for municipal storm water controls, the scope of the permit exemption for oil and gas operations, and EPA's decision not to provide public comment on Part 1 of the group applications for storm water discharges associated with industrial activity.

The Court did declare EPA's extension of the statutory deadlines for storm water permit applications to be unlawful, but declined to strike down the deadlines as the plaintiff had requested. In addition, the Court struck down and remanded two exemptions from the definition of storm water discharges associated with industrial activity.

One of the remanded exemptions addressed construction activities that result in the disturbance of less than 5 acres of total land area which are not part of a larger common plan of development or sale. EPA noted that State and local sediment and erosion controls may

[13] See 57 *FR* 11524 (April 2, 1992), 40 *CFR* 122.26(e)(1)(ii).

[14] See 57 *FR* 11524 (April 2, 1992), 40 *CFR* 122.44(i).

address construction activities of less than 5 acres and that the acreage limit reflected land disturbances that were industrial in magnitude because disturbances on large tracts of land will employ more heavy machinery and industrial equipment. The Court noted that EPA had proposed to exempt only sites for commercial and industrial construction smaller than 1 acre and sites for residential construction smaller than 5 acres. In the final rule, the exemption was increased to 5 acres for all construction sites, based on the Agency's determination that smaller sites would not have levels of activity similar to other industrial activities. The court ruled, however, that the record did not indicate "that construction sites on less than five acres are non-industrial in nature" (966 F.2d at 1306). The court rejected EPA's argument that the 5-acre cutoff constituted a *de minimis* exemption, because the record lacked information to suggest whether smaller discharges would be *de minimis*.

A second remanded exemption addressed light manufacturing facilities where material handling equipment or activities, raw material, intermediate products, final products, waste materials, byproducts, or industrial machinery are not exposed to storm water. With respect to the light industry category, EPA had adopted the exemption based on the belief that if (1) the activities in the selected facilities are undertaken in buildings; (2) emissions from stacks are minimal or nonexistent; (3) there is no unhoused manufacturing and heavy industrial equipment, outside storage, disposal, or handling of raw, finished, or waste materials; (4) and the activities being performed do not generate significant dust or particulates, the facility posed a much smaller risk of storm water contamination. Based on these factors, the Agency believed that these facilities were similar to commercial businesses, such as retail and service facilities.

The court noted, however, that the statutory term associated with industrial activity was very broad and concluded that Congress intended only to exempt discharges from non-industrial facility areas such as parking lots. The court rejected EPA's argument that industrial pollutant levels in storm water would be minimal at light industrial facilities, finding nothing in the record to support that conclusion. Therefore, the court found this exemption to be arbitrary and capricious (966 F.2d at 1304-05).

In response to the Ninth Circuit decision, EPA promulgated rules on December 18, 1992, specifying dates for permit approval or denial and permit compliance. In the December 18, 1992, notice, EPA also noted that it did not believe that the court's opinion had the effect of automatically subjecting small construction sites and light industries to the existing application requirements and deadlines for storm water discharges associated with industrial activity. The Agency also indicated that it believed that additional notice and comment rulemaking was necessary to clarify the status of these facilities under the storm water program.

1.2.4 Phase I Implementation Activities

The initial efforts to implement the Phase I storm water program have focused on reviewing group applications for industrial storm water, issuing general permits for industrial storm water, publishing draft general permits for storm water discharges from 29 industrial sectors, reviewing applications for municipal separate storm sewer systems, issuing permits for municipal separate storm sewer systems, and conducting outreach activities. In addition, the Agency, in conjunction with the Rensselaerville Institute, completed a study to develop recommendations for making Phase I of the program more effective.

1.2.4.1 General Permits

In September 1992 (April 1993 for Puerto Rico) EPA issued general permits for storm water discharges associated with industrial activity in the 11 States without NPDES authority, as well as for Territories, States where EPA issues permits for Federal facilities, and Federal Indian Reservations. Unlike traditional NPDES permits, these permits generally do not establish numeric effluent limitations for most discharges authorized by the permits.[15] Rather, the permits establish requirements for notices of intent, site inspections conducted by dischargers, and site-specific pollution prevention plans. The requirements for pollution prevention plans provide a framework for dischargers to identify sources of pollution and best management practices to prevent, reduce and/or control such pollutant sources. In addition, targeted facilities are required to sample and analyze their storm water discharges.

When the storm water application rules were issued in November 1990, only 17 out of the 39 authorized States authorized to administer the NPDES program were also approved to issue NPDES general permits. Since then, an additional 21 States have requested and received EPA approval to issue general permits, and one additional State has received NPDES authorization, including general permit authority. All but one of the States that now have general permit authority have issued general permits for storm water discharges.

1.2.4.2 Group Applications

EPA has received more than 1,200 Part I group applications representing more than 60,000 industrial facilities with storm water discharges. EPA has requested public comment on draft permits to address discharges identified in these applications that are in States without authorized NPDES programs.[16] The draft general permits contain requirements for 29 different industrial sectors.

1.2.4.3 Municipal Applications

Permit applications have been received for almost all municipal separate storm sewer systems serving a population of 100,000 or more. This represents a substantial initial

[15] The permits do establish numeric effluent limitations for some classes of storm water discharges. These limitations are either based on best available technology or established pursuant to State certifications under Section 401 of the CWA.

[16] See 58 *FR* 61146 (November 19, 1993).

investment into Phase I of the storm water program by municipalities.[17] At the heart of these applications are proposed municipal storm water management programs, which will identify a variety of site-specific pollution prevention measures, source controls, and best management practices to control pollutants from targeted sources within the municipality.[18] EPA and authorized NPDES States have started to issue permits for these municipal separate storm sewer systems. The Agency estimates that 263 permits will be issued for Phase I municipal separate storm sewer systems; as of May 1994, 24 permits have been issued.

1.2.4.4 Rensselaerville Phase I Effort

In 1992 EPA completed a study, in conjunction with the Rensselaerville Institute, to obtain direct public input and develop recommendations for improving Phase I of the storm water program. These studies are discussed in more detail in Appendix I. The study raised five key issues relating to Phase I sources:

- Study participants thought that EPA has not been clear enough about the intended goals of the regulations and should communicate storm water risks, objectives, and requirements more clearly to the general public, as well as to the regulated community.
- Participants noted that the cost of program implementation is significantly higher than original EPA estimates and that there is great concern regarding the real costs of the program and of achieving compliance.
- Participants agreed that EPA and States must accelerate general permit issuance and focus on general permits to achieve efficient implementation of the program.

[17] The National Association of Flood and Stormwater Management Agencies estimates based on a 1992 survey that municipalities have spent more than $130 million on preparing NPDES permit applications for discharges from Phase I municipal separate storm sewer systems.

[18] A review of cost estimates for proposed municipal storm water management programs provided in 20 applications indicates that municipalities estimate the cost of program implementation (excluding permit application costs) to range from $23.91 to $37.00 per person. (See draft *Review of Program Costs in Part 2 NPDES Municipal Storm Water Permit Applications*, EPA, 1993.)

- Participants felt that technical outreach should be targeted at the State and local level rather than the national level and should provide better guidance on the regulations and their implementation.
- Participants noted that coverage under certain industrial storm water categories should be clarified.

EPA agreed with these recommendations and has taken steps to follow up in each area.

1.2.5 September 9, 1992 Notice—Phase II Issues

On September 9, 1992, EPA published a notice requesting information and public comment on the Phase II program. The notice is included in Appendix H of this report. The notice identified three sets of issues associated with developing Phase II regulations:

- How should sources that are to be subject to Phase II regulations be identified?
- What types of control strategies should be developed for these sources?
- What are appropriate deadlines for implementing Phase II requirements?

The September 9, 1992, notice presented a range of alternatives under each issue in an attempt to illustrate, and obtain input on, the full range of potential approaches for a Phase II strategy. The notice recognized that potential sources for coverage under Phase II fall into two main categories: municipalities; and individual sources (commercial and residential) activities. EPA recognized that a major distinction between most options for identifying Phase II commercial/residential sources was either to require targeted municipalities to develop source controls and management programs for storm water discharges within their jurisdictions or to require permits for discharges from individual facilities.

EPA received more than 130 comments on the September 9, 1992, notice. Approximately 43 percent of the comments were from municipalities, 29 percent from trade groups or industries, 24 percent from State or Federal agencies, and approximately 3 percent

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from other miscellaneous sources.[19] No comments were received from environmental groups. Appendix J contains a detailed summary of comments received as they relate to the specific issues raised in the notice.

1.2.6 Rensselaerville Phase II Effort

In early 1993, the Rensselaerville Institute and EPA held public and expert meetings to assist in developing and analyzing options for identifying Phase II sources and controls. These meetings and the resulting options are discussed in more detail in Appendix I of this report. The report on the effort indicates that the two options most favored by the various groups participating were:

- A program where States would select sources to be controlled in a manner that was consistent with criteria developed by EPA. The Phase II program would provide States with flexibility to either rely on NPDES requirements or other frameworks to control targeted sources.
- A tiered approach that would provide for EPA selection of high priority sources for control by NPDES permits and State selection of other sources for control under a State program other than the NPDES program.

1.2.7 President Clinton's Clean Water Initiative

On February 1, 1994, *President Clinton's Clean Water Initiative* was issued. The *President's Initiative* addresses a number of issues associated with NPDES requirements for storm water discharges, including:

- Compliance of discharges from municipal separate storm sewer systems with water quality standards
- Industrial facilities with no activities or significant materials exposed to storm water
- Deadline extensions for Phase II of the storm water program

[19] Percentages have been rounded off, and hence may not total 100 percent.

- Phase II storm water program requirements, including regulation of storm water from industrial facilities by municipalities
- Control of discharges from inactive and abandoned mines (IAMs) located on Federal lands.

To address municipal compliance with water quality standards, the *President's Initiative* recommends that the CWA be amended to establish a phased permit compliance approach that requires best management practices in first-round municipal storm water permits and improved best management practices in second-round permits, where necessary, to move towards compliance with water quality standards. In later permits, compliance with water quality standards will occur using water quality-based effluent limits, where necessary. This would give EPA and municipalities additional time to evaluate the technical feasibility of establishing numeric effluent limits to meet water quality standards and give States time to develop specific water quality standards appropriate for storm water discharges, if necessary. The *President's Initiative* further supports clarifying authority under section 402(p)(3)(B) concerning "maximum extent practicable" (MEP).

The *President's Initiative* recommends that EPA be authorized to exempt from individual storm water permitting requirements facilities that can certify that there is no—nor will there be—exposure of industrial or other activities or significant materials to rain water and snow melt. This change would ensure that several hundred thousand low-risk facilities are not subject to NPDES requirements, allowing allocation of resources to more critical areas. This would also effectively create incentives for facilities to eliminate contamination of storm water.

The *President's Initiative* recommends that the statutory deadline for EPA to issue Phase II regulations be extended. The *President's Initiative* also recommends that the deadline for Phase II sources to obtain a permit be extended. The *President's Initiative* indicated that extensions would allow EPA to work with States and municipalities in developing workable, effective regulations. A new deadline for permits would give municipalities an opportunity to begin to build institutional frameworks and provide the funding necessary to implement storm water management programs. It would also allow permits to be issued to Phase II municipalities at the same time Phase I permits are expiring. This would promote regional and watershed-wide permitting by allowing different municipalities to be co-applicants and to coordinate their storm water programs.

With respect to NPDES requirements for Phase II storm water discharges, the *President's Initiative* recommends[20] that NPDES Phase II requirements for storm water focus on system-wide permits for municipal separate storm sewer systems in Census-designated urbanized areas.[21] The *President's Initiative* recommends tiered permitting requirements. Storm water management programs would be developed for municipal separate storm sewer systems located within an urbanized area in which a municipal separate storm sewer system is already addressed under Phase I. The programs would, at a minimum, address non-storm water discharges into storm sewers and storm water runoff from growth and development and significant redevelopment. NPDES permitting authorities should be encouraged to implement watershed approaches which implement a more comprehensive municipal storm water management program where appropriate based on water quality impairments or other factors for municipal separate storm sewer systems in these urbanized areas. In the remaining Census-designated urbanized areas, municipal storm water management programs would be required which focus only on controlling non-storm water discharges into storm sewers and storm water runoff from growth, development, and significant redevelopment activities. The *President's Initiative* recommends that Phase II of the NPDES program not directly regulate Phase II light industrial, commercial, retail, and

[20] While the *President's Initiative* generally speaks to recommended statutory changes, EPA notes that under the existing CWA, with the exception of extending the deadline for permits for discharges from municipal separate storm sewer systems to comply with water quality-based requirements, EPA could issue Phase II regulations covering the same facilities to the same extent as suggested in the *President's Initiative*.

[21] The Bureau of the Census defines urbanized areas as a central city (or cities) with a surrounding area that is densely settled (i.e., urban fringe). The population of the entire urbanized area must be greater than 50,000 persons, and the urban fringe must have a population density generally greater than 1,000 persons per square mile (approximately 1.5 persons per acre). A complete description of the Bureau of the Census definition is provided in Chapter 3.

institutional storm water discharges, and municipalities outside of Census-designated urbanized areas unless designated by the permitting authority for inclusion in the NPDES program under Section 402(p)(2)(E) of the CWA. Rather, such discharges, if a targeted source, should be addressed by Nonpoint Source programs.

The *President's Initiative* recommends authorizing municipalities to directly control Phase I industrial storm water facilities within their jurisdictions under the NPDES program. This recommendation is similar to the industrial pretreatment program currently authorized under the CWA. The *President's Initiative* recommends clarifying authority to issue permits on a statewide basis for IAMs, allowing Federal land managers to establish priorities and make the most effective use of available resources. Land managers would be allowed up to 10 years to meet appropriate water quality standards, while continuing to identify additional impacts from IAMs and implementing targeted controls once identified. A cost-benefit analysis was prepared for the *President's Initiative* and is summarized in Appendix L. No further cost-benefit analyses were conducted for this report.

1.2.8 NPDES Watershed Strategy

EPA issued the NPDES Watershed Strategy in March 1994. The Strategy discusses integration of NPDES program functions into a broader watershed protection approach and areas for coordination with stakeholders to promote implementation of the approach. The NPDES Watershed Strategy is based on the following principles:

- Watershed protection approaches may vary in terms of specific elements, timing, and resources, but all should share a common emphasis and insistence on integrated actions, specific action items, and measurable environmental and programmatic milestones.

- Related activities within a basin or watershed must be coordinated to achieve the greatest environmental benefit and most effective level of stakeholder involvement.

- Actions relating to restoration and protection of surface water, ground water, and habitat within a basin should be based upon an integrated decision-making process, a common information base, and a common understanding of the roles, priorities, and responsibilities of all stakeholders within a basin.
- Staff and financial resources are limited and must be allocated to address environmental priorities as effectively and efficiently as possible.
- Program requirements that interfere or conflict with environmental priorities should be identified and revised to the extent possible.
- Accurate information and high quality data are necessary for decision-making and should be collected on an incremental basis; interim decisions should be made based on available data to prevent further degradation and promote restoration of natural resources.

1.3 RELATED NONPOINT SOURCE PROGRAMS

1.3.1 Section 319 of the CWA

In 1987, Section 319 was added to the CWA to provide a framework for funding State and local efforts to address pollutant sources not addressed by the NPDES program (e.g., nonpoint sources). To obtain funding, States were required to submit Nonpoint Source Assessment Reports identifying State waters that, without additional control of nonpoint sources of pollution, could not reasonably be expected to attain or maintain applicable water quality standards or the goals and requirements of the CWA. States were also required to prepare and submit for EPA approval a statewide Nonpoint Source Management Program for controlling nonpoint source water pollution to navigable waters within the State and improving the quality of such waters. State program submittals were to identify specific best management practices (BMPs) and measures that the State proposes to implement in the first 4 years after program submission to reduce pollutant loadings from identified nonpoint sources to levels required to achieve the stated water quality objectives.

State programs funded under Section 319 can include both regulatory and nonregulatory State and local approaches. Section 319(b)(2)(B) specifies that a combination of "non-regulatory or regulatory programs for enforcement, technical assistance, financial assistance, education, training, technology transfer, and demonstration projects" may be used, as necessary, to achieve implementation of the BMPs or measures identified in the Section 319 submittals.

Although most States have generally emphasized the use of voluntary approaches in their 319 programs, some States and local governments have implemented regulations and policies to control pollution from urban runoff. States such as Delaware and Florida, as well as local jurisdictions such as the Lower Colorado River Authority, are pursuing storm water management goals through numerical treatment standards for new development. Many States and local governments have enforceable erosion and sediment control regulations. On a broader scale, nonpoint source pollution is being addressed at the watershed level by programs such as those being implemented by the State of Wisconsin, the Puget Sound Water Quality Authority, the States that are parties to the Great Lakes Water Quality Agreement, and other States. A number of individual States and local communities have adopted legislation or regulations similar to Maryland's Critical Areas Act, which limits development and/or requires special management practices in areas surrounding water resources of special concern.

1.3.2 Section 6217 of CZARA

Section 6217 of the Coastal Zone Act Reauthorization Amendments (CZARA) of 1990 provides that States with approved coastal zone management programs must develop and submit coastal nonpoint pollution control programs to EPA and the National Oceanic and Atmospheric Administration (NOAA) for approval. Failure to submit an approvable program will result in a reduction of Federal grants under both the Coastal Zone Management Act and Section 319 of the CWA.

State coastal nonpoint pollution control programs under CZARA must include enforceable policies and mechanisms that ensure implementation of the management measures throughout the coastal management area. Section 6217(g)(5) defines management measures as "economically achievable measures for the control of the addition of pollutants from existing and new categories and classes of nonpoint sources of pollution, which reflect the greatest degree of pollutant reduction achievable through the application of the best available nonpoint pollution control practices, technologies, processes, siting criteria, operating methods, or other alternatives." Congress mandated a technology-based approach based on technical and economic achievability under the rationale that neither States nor EPA have the money, time, or other resources to create and expeditiously implement a program that depends on establishing cause and effect linkages among particular land use activities and specific water quality problems. If this technology-based approach fails to achieve and maintain applicable water quality standards and to protect designated uses, CZARA Section 6217(b)(3) requires additional management measures.

EPA issued *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters* under Section 6217(g) in January 1993. The Guidance identifies management measures for five major categories of nonpoint source pollution: Agriculture, Forestry, Urban, Marinas and Recreational Boating, and Hydromodification. The management measures reflect the greatest degree of pollutant reduction that is economically achievable for each of the listed sources. These management measures provide reference standards for the States to use in developing or refining their coastal nonpoint programs. In general, the management measures were written to describe systems designed to reduce the generation of pollutants. A few management measures, however, contain quantitative standards that specify pollutant loading reductions.[22] The management measures approach was adopted to provide State officials flexibility in selecting strategies and management systems and practices that are appropriate for regional or local conditions, provided that equivalent or higher levels of pollutant control are achieved. Appendix K of this report summarizes the management measures for urban areas, animal feedlots, and marinas that were identified in the guidance.

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[22] For example, the New Development Management Measure, which is applicable to construction in urban areas, requires: (1) that by design or performance that the average annual total suspended solid loadings be reduced by 80 percent; and (2) to the extent practicable, that the predevelopment peak runoff rate and average volume be maintained.

Storm water discharges regulated under Phase I of the NPDES program, such as discharges from municipal separate storm sewers serving a population of 100,000 or more and construction activities that disturb 5 or more acres, do not need to be addressed in Coastal Nonpoint Pollution Control Programs. However, potential Phase II sources, such as urban development adjacent to or surrounding Phase I municipal systems, smaller urbanized areas, and construction sites that disturb less than 5 acres, that are identified in management measures under Section 6217 guidance need to be addressed in Coastal Nonpoint Pollution Control Programs until such discharges are issued an NPDES permit. EPA and NOAA have worked, and continue to work, together in their activities to ensure that there is not an overlap of authorities between NPDES and CZARA.

EPA and NOAA published *Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance*, which addresses such issues as the basis and process for EPA/NOAA approval of State Coastal Nonpoint Pollution Control Programs; how EPA and NOAA expect State programs to implement management measures in conformity with EPA guidance; and procedures for reviewing and modifying State coastal boundaries to meet program requirements. The guidance clarifies that States generally must implement management measures for each source category identified in the guidance developed under Section 6217(g). This guidance sets quantitative performance standards for some measures. Coastal Nonpoint Pollution Control Programs are not required to address sources that are clearly regulated under the NPDES program as point source discharges. The guidance also clarifies that regulatory and nonregulatory mechanisms may be used to meet the requirement for enforceable policies and mechanisms, provided that nonregulatory approaches are backed by enforceable State authority ensuring that the management measures will be implemented. Backup authority can include sunset provisions for incentive programs. For example, a State may provide additional incentives if too few operators participate in a tax incentive program or develop mandatory requirements to achieve the necessary implementation of management measures.

1.3.3 President Clinton's Clean Water Initiative—Nonpoint Source Programs

President Clinton's Clean Water Initiative proposes a fundamental restructuring and strengthening of the nonpoint source pollution (NPS) control programs under Section 319 of the CWA. The *President's Initiative* proposes legislative changes that will result in upgraded and strengthened existing State NPS management programs within seven and one-half years of reauthorization of the CWA. These programs will implement best available management measures for nonpoint sources causing, contributing to, or threatening water quality impairments and for new nonpoint sources, except for new sources in States with an approved watershed management program. The *President's Initiative* recommends that the initial implementation period be followed by a second, five-year period to implement further measures where necessary (considering the actual and expected environmental benefits of the original management measures) to achieve water quality standards.

The *President's Initiative* recommends that strengthened Section 319 State programs rely on a mix of voluntary and regulatory approaches and that State programs include enforcement authorities to be used as needed to ensure implementation of management measures. Under the proposal, State authorities will be backed by Federal enforcement authorities to be exercised if a State should fail to implement the management measures. Where States do not develop an approvable program, Section 319 grants will be withheld from the State and EPA will be authorized to establish enforceable minimum NPS controls. The *President's Initiative* proposes that funding be increased for State implementation of NPS programs and that State revolving loan fund eligibility be clarified for NPS projects whose principal purpose is protecting and improving water quality. The *President's Initiative* also proposes that the CWA be clarified to require that Federal agencies comply with State or local requirements in nonpoint source programs to the same extent as non-Federal parties.

1.3.4 President Clinton's Clean Water Initiative—Watershed Management

President Clinton's Clean Water Initiative proposes that provisions for comprehensive watershed management be added to the CWA. Under the proposal, States can choose to implement comprehensive watershed programs which will be approved by EPA after conference with other Federal agencies. The States will determine the boundaries for all watersheds in the State and set a schedule for addressing them. States will oversee watershed management entities with appropriate representation of stakeholder interests and approve their watershed management plans. State watershed plans will include rankings based on environmental objectives as well as evidence of enforceable policies and mechanisms needed to implement the plans.

The *President's Initiative* proposes other changes to the CWA that: (1) provide guidelines for States wishing to adopt market-based approaches to point and NPS pollution controls within watersheds; (2) promote the development of wetland management plans that lead to increased flexibility and predictability of the wetlands permit process on a watershed basis; and (3) create comprehensive State inventories of waters that are threatened, impaired, or in need of special protection. The *President's Initiative* also recommends that States give urban watersheds a high level of priority in their State-wide ranking of watershed initiatives.

1.4 DEVELOPMENT OF THIS REPORT

A Draft of this report was circulated extensively in November 1993. Copies were distributed to States, EPA Regions, the Association of State and Interstate Water Pollution Control Administrators (ASIWPCA), and other interested parties. Comments received on that draft have been reviewed and appropriate changes to the Report have been made.

1.5 ORGANIZATION OF THIS REPORT

Chapter 2 of this report presents the approach and methodology for identifying categories of storm water sources and methods for estimating the distribution and content of these discharges. The next two chapters identify storm water discharges not regulated by the current program and discusses the nature of such discharges and the extent of pollutant loadings from these sources, as well as their geographic distribution for municipalities (Chapter 3) and industrial and commercial facilities (Chapter 4).

CHAPTER 2. APPROACH

This chapter describes the approach taken by the U.S. Environmental Protection Agency (EPA) to identify and characterize storm water discharges that are not subject to the first phase of the National Pollutant Discharge Elimination System storm water permit requirements under Section 402(p) of the Clean Water Act (CWA).

The study considered two major classes of storm water discharges: (1) discharges from municipal separate storm sewer systems (addressed in Section 2.2) and (2) industrial and commercial discharges (Section 2.3). EPA relied on existing information and data, particularly the 1990 U.S. census, and on a number of previous studies, as described in the literature review (Section 2.4). As a part of this study, EPA developed estimates of annual loadings for discharges from municipal separate storm sewer systems. Section 2.1 gives a brief overview of the approach.

2.1 OVERVIEW OF APPROACH

A main purpose of this report is to identify storm water discharges not addressed by Phase I of the NPDES program for storm water discharges and to determine the nature and extent of pollutants in these discharges. The analytical approach to this objective followed two separate paths—one for Phase II discharges from municipal separate storm sewer systems and another for individual Phase II sources. This section briefly summarizes both aspects of the approach. Sections 2.2 and 2.3 provide more detailed explanation.

In the analysis of municipal separate storm sewer systems, municipal systems addressed by Phase I of the NPDES program had to be identified to allow identification of the remaining potential Phase II municipal systems. EPA limited the analysis of potential Phase II municipal separate storm sewer systems to those municipalities that had populations that were classified as urban by the Bureau of the Census. Census information was used to identify the type of municipality, geographic location, and urban population. Selected geographic areas of potential concern, such as urbanized areas, coastal areas, and fast growing areas, were identified and evaluated following the procedures described below.

Pollutant loading estimates were developed for populations located in urbanized areas that were designated by the Bureau of the Census, including both Phase I and Phase II discharges. Pollutant loadings were estimated by using a simplified loadings model described in Section 2.2.2. Pollutant concentration data for seven pollutants, including conventional pollutants, nutrients, and metals, were taken from the results of the National Urban Runoff Program (NURP) (EPA, 1983). Runoff volume was estimated as the product of land area, the annual amount of precipitation, and the "runoff coefficient" (a fraction that indicates the proportion of precipitation that runs off the land and enters receiving waters). Land area for urbanized areas was provided by the 1990 U.S. census. Precipitation estimates were based on the rainfall zones established in the NPDES Permit Application Requirements for Storm Water Discharges (November 16, 1990). The runoff coefficient is a function of the imperviousness of the land surface, which is related to the density of roads, buildings, and other paved surfaces in an urban area. The amount of impervious area in urban settings can be estimated from population densities. The runoff coefficient used in this analysis was estimated by using a relationship based on population density (calculated from census data) that was published in the technical literature and in EPA documents (Heaney et al., 1977).

In the analysis of individual Phase II sources, identification of potential sources also proceeded in two steps. First, a review of the regulatory definition identified which types of facilities were clearly regulated under Phase I. This review aided the development of a list of facilities similar or identical to Phase I industrial facilities that were not covered under Phase I for a variety of statutory and regulatory reasons. Second, a literature review (see Section 2.4) identified, in general terms, additional commercial and retail sources of potential concern, based on the types of pollutants used or activities conducted. These potential Phase II sources were specified in detail using the Standard Industrial Classification (SIC) code system of the Office of Management and Budget. The use of SIC codes for identification of potential Phase II sources also facilitated the quantitative analysis performed in Chapter 4. Thus, the identification step covered the full range of industrial and commercial business activities that may be contributing to storm water pollution. A complete listing of industries classified within the SIC code system is provided later in this section.

The nature and extent of pollutants from individual Phase II sources were determined in two parts. The nature of pollutants was addressed qualitatively in two steps. First, pollutant sampling data from Phase I industrial sources was evaluated, summarized, and compared to previous studies of urban storm water content. This formed a basic reference on the nature of discharges from a wide variety of specific industrial categories. Second, potential Phase II sources were classified into groups and compared with Phase I sectors, where possible, to enable comparison to the pollutant concentration data from Phase I facilities and to determine the types and quantities of pollutants likely to be associated with unregulated discharges. This qualitative assessment of potential pollutant associations was supplemented with information documented in State and local nonpoint source programs, urban runoff programs, estuary programs, and technical articles identified through the literature review.

The extent of potential Phase II individual discharges was addressed by determining the geographic location and distribution of facilities that may contribute pollutants to storm water, rather than calculating pollutant loads as in the municipal analysis. The analysis focused on location rather than loadings because data on industrial and commercial pollutant discharges was insufficient to allow estimation of loadings on a national basis. Moreover, an attempt to estimate loads for industrial and commercial sources would lead to double counting, because many potential Phase II facilities are located in municipal or urban areas and the loading analysis for municipal sources already accounts for some of their contributions.

Using EPA's Facility and Company Tracking System (FACTS) computer file based on Dun & Bradstreet information about economic activity, the number of facilities in each SIC code was found for each county in the country.[1] From the 1990 census for each county, the proportion of population associated with geographic jurisdictions of interest was calculated. For each county and each SIC code, the number of facilities was multiplied by the proportion of population in each geographic area to yield an estimate of the number of facilities in that portion of the county. Summing over all counties provides an estimate of the proportion of facilities in each SIC code nationally that are located in the geographic jurisdictions of interest.

The two paths, municipal separate storm sewer systems and individual sources, were related through the geographical analysis of extent of discharges, which shows the proportion of pollutant loadings from municipal separate storm sewers and the proportion of individual facilities associated with various areas of concern. Although the effect cannot be quantified, the nature and extent of pollutants from industrial and commercial sources overlaps with the nature and extent of pollutant loadings calculated in the municipal analysis.

2.2 ANALYSIS OF MUNICIPAL SEPARATE STORM SEWER SYSTEMS

This section describes the procedure used to identify potential Phase II municipal separate storm sewer systems. The section also explains how the pollutant load estimates were developed for discharges from municipal separate storm sewer systems in urbanized areas.

2.2.1 Identifying Municipal Separate Storm Sewer Systems

Municipal separate storm sewer systems addressed by Phase I of the NPDES program had to be identified to allow identification of the remaining potential Phase II municipal systems. EPA limited the analysis of potential Phase II municipal separate storm sewer

[1] The FACTS data base is leased by EPA from Dun & Bradstreet Information Services, which created, maintains, and annually updates the information based on State and industry reports and on primary data collection in the business community, including detailed surveys and personal interviews. It has been estimated that this data base accounts for more than 96 percent of the U.S. Gross National Product (Caskins, 1992). FACTS was made available for this study through EPA's National Computer Center in North Carolina.

systems to populations that were classified as urban by the Bureau of the Census. The only other population classification available from the Bureau of the Census was rural populations. Rural populations and rural areas were generally excluded from this part of the analysis because the Agency was generally unable to tie these areas to development patterns and demographics that were thought to result in the installation of municipal separate storm sewer systems. Census information was used to identify the type of municipality, geographic location, and urban population.

2.2.1.1 Phase I Definitions

Section 402(p) of the CWA identifies discharges from municipal separate storm sewer systems serving a population of more than 100,000 people as requiring permit coverage under the first phase of the NPDES program. Phase I municipal systems are defined in the NPDES regulations at 40 *CFR* 122.26(b)(4) and (7) and explained in the preamble to include:

- Incorporated cities with populations greater than 100,000 served by separate storm sewers, according to the latest Decennial Census by the Bureau of the Census
- Counties with a population of 100,000 or more in unincorporated, urbanized areas, according to the latest Decennial Census by the Bureau of the Census (excluding the population of towns and townships)
- Municipalities that are designated by EPA or an authorized NPDES State.[2]

Phase I municipal systems also include systems that are designated by EPA or an authorized NPDES State under section 402(p) of the CWA as needing an NPDES permit because they are significant contributors of pollutants to waters of the United States or contribute to a violation of water quality standards.

[2] Designation of a Phase I municipal system is based on one of the following factors: physical interconnections with a municipal separate storm sewer system serving a population of 100,000 or more identified in the NPDES regulations, discharges from several municipal separate storm sewer systems, the quantity and nature of pollutants in the discharge, and the nature of the receiving waters.

For the purposes of determining Phase I populations, the NPDES regulations allow municipalities to reduce the population of the municipality to account for populations served by combined sewers.[3]

Census definitions data from the 1990 census was used to identify urban populations of potential Phase II municipal separate storm sewer systems. The Bureau of the Census organizes population information according to political and demographic factors. Political jurisdictions include entities with governmental structures, such as States, counties, incorporated places (e.g., cities, towns, villages), and minor civil divisions (MCDs), which include towns and townships in 20 States. Table 2-1 summarizes the definitions of these political entities.

Table 2-1. Bureau of the Census Definitions of Municipal Entities

Incorporated Places—Places incorporated under the laws of their States as cities, boroughs, towns, and villages, with the following exceptions: boroughs in Alaska and New York, and towns in the six New England States, New York, and Wisconsin.
Minor Civil Divisions—Minor civil divisions are primary divisions of counties established under State law in 20 States. Townships are minor civil divisions in 12 States (Illinois, Indiana, Kansas, Michigan, Minnesota, Missouri, Nebraska, New Jersey, North Dakota, Ohio, Pennsylvania, and South Dakota). Towns are recognized as minor civil divisions in eight States (Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island, Vermont, and Wisconsin).
Counties—In most States, the primary divisions are termed counties. In Louisiana, these divisions are known as parishes. In Alaska, which has no counties, the county equivalents are the organized boroughs. In four States (Maryland, Missouri, Nevada, and Virginia), there are one or more cities that are independent of any county organization and thus constitute primary divisions of their States.

Source: Census of Population and Housing, 1990.

[3] See 40 *CFR* 122.26(f)(3). Combined sewers are conveyances that are designed to collect and convey both storm water and sanitary sewage. Combined sewers are not regulated under the storm water permitting program because they are regulated as part of the total discharge from the combined system under the existing NPDES permit conditions for that system. Combined sewers are addressed in this report only as an adjustment factor used to estimate storm water flows from urban areas.

Two additional geographical classifications were evaluated in the report, urbanized areas designated by the Bureau of the Census and metropolitan areas (MAs) defined by the Office of Management and Budget (OMB). The definitions of these terms are summarized in Table 2-2. Census-designated urbanized areas are based primarily on demographics and represent densely settled areas of 50,000 or more people. OMB identifies metropolitan areas based on economics and social trends, in addition to population densities. Metropolitan areas are defined based on county boundaries and are significantly more inclusive than urbanized areas, which more closely follow population distributions.

Table 2-2. Population Classifications of Bureau of the Census

URBANIZED AREAS—An urbanized area (UA) comprises an incorporated place and adjacent densely settled surrounding area that together have a minimum population of 50,000. The densely settled surrounding areas consists of:

1. Contiguous incorporated places or census designated places having:
   a. A population of 2,500 or more; or
   b. A population of fewer than 2,500 but having either a population density of 1,000 persons per square mile, a closely settled area containing a minimum of 50 percent of the population, or a cluster of at least 100 housing units.

2. Contiguous unincorporated area which is connected by road and has a population density of at least 1,000 persons per square mile.

3. Other contiguous unincorporated area with a density of less than 1,000 per square mile, provided that it:
   a. Eliminates an enclave of less than 5 square miles which is surrounded by built-up area.
   b. Closes an indentation in the boundary of the densely settled area that is no more than 1 mile across the open end and encompasses no more than 5 square miles.
   c. Links an outlying area of qualifying density, provided that the outlying area is:
      (1) Connected by road to, and is not more than 1.5 miles from, the main body of the UA.
      (2) Separated from the main body of the UA by water or other undevelopable area, is connected by road to the main body of the UA, and is not more than 5 miles from the main body of the UA.

4. Large concentrations of nonresidential urban area (such as industrial parks, office area, and major airports) which have at least one-quarter of their boundary contiguous to a UA.

URBAN POPULATIONS—All persons living in urbanized areas and in places of 2,500 or more inhabitants outside of urbanized areas. The urban population consists of all persons living in (1) places of 2,500 or more inhabitants incorporated as cities, villages, boroughs (except in Alaska and New York), and towns (except in the New England States, New York, and Wisconsin), but excluding those persons living in the rural portions of extended cities; (2) census designated places of 2,500 or more inhabitants; and (3) other territory, incorporated or unincorporated, included in urbanized areas.

RURAL POPULATIONS—Population not classified as urban.

The following information was obtained from the 1990 census data (Summary Tape File-1A) for all parts of the United States[4]:

- State and County location
- Population
- Land Area
- Population Density
- Growth Projections.

Information on urbanized areas, urban populations, and metropolitan areas was obtained from documents published by the Census Bureau.

2.2.1.2 Identification of Phase I and Phase II Municipalities

The following steps were taken to identify municipalities with Phase I municipal separate storm sewer systems:

- **Cities Specifically Identified in Phase I Regulations:** Based on the 1980 census, 173 cities were originally identified as having populations exceeding 100,000. Of these, a survey of authorized NPDES States and EPA Regions indicated that 30 cities with populations of 100,000 or more have been exempted from Phase I storm water requirements due to populations served by combined sewers. An additional 5 cities' populations dropped below 100,000 based on the 1990 census. Permit applications have not been required from these cities unless they have been designated for inclusion in Phase I by EPA or a State. For the purposes of this report, 140 of the 173 cities identified in the Phase I regulations are considered to be Phase I.
- **Counties Specifically Identified in Phase I Regulations:** Based on the 1980 census, 47 counties were originally identified as having populations in urbanized, unincorporated areas that exceeded 100,000 after the population in the incorporated places, townships, or towns was excluded. Incorporated places with a population of less than 100,000 that were located in these counties were treated as potential Phase II municipalities unless they were identified as being designated into Phase I by an authorized NPDES State or EPA Region. The population of 2 of these counties had

[4] Information obtained for Guam, the Virgin Islands, American Samoa, and the Commonwealth of the Northern Mariana Islands was limited to population and growth projections. For the Commonwealth of Puerto Rico and the District of Columbia, all information described above was obtained and used in the analysis.

dropped below 100,000 based on the 1990 census, leaving 45 Phase I counties specifically identified in Phase I regulations for the purposes of this report.

- **Municipalities Designated by NPDES Authorities:** Authorized NPDES States and EPA Regions have the authority to designate additional municipalities as subject to Phase I. A survey of authorized NPDES States and EPA Regions was used to identify designated municipalities. This report identifies designations that occurred before January 1994 and considers them to be Phase I sources for the purposes of this analysis.

All remaining municipalities with urban populations not identified as a part of Phase I of the NPDES storm water program were considered to be potential Phase II sources. Chapter 3 provides the specific numbers of municipal entities in various categories. Municipalities were differentiated based on characteristics such as size, density, or association with other levels and types of geographical and political jurisdictions. The designation of municipalities as Phase I vs. Phase II in this report is based on a "snapshot" of currently regulated municipalities as of January 1994.

2.2.2 Determining the Nature and Extent of Pollutants Associated With Municipal Separate Storm Sewer Systems

A review of the literature on urban runoff, including past studies conducted by EPA and the USGS, was used to develop a general descriptive profile of the nature of discharges from municipal separate storm sewer systems. Section 2.4 discusses this review.

Estimates of loads were developed for selected pollutants in runoff from urbanized areas. The approach used to estimate loadings of pollutants associated with discharges from municipal separate storm sewer systems was based on existing data and follows standard engineering practice (McCuen, 1989; American Society of Civil Engineers, 1969).

These estimates were developed to provide an overview of the extent of pollutant discharges associated with urban runoff and a relative ranking of the pollution potential from urbanized areas. The results can be used to compare potential Phase II municipal systems in urbanized areas with Phase I municipal systems. This approach was not designed to estimate actual loads for any specific locality.[5] Thus, it would not be appropriate to use load estimates generated as part of this study in assessing potential storm water impacts within a specific receiving water body.

To estimate pollutant loadings from municipal separate storm sewer systems, the following equation was used for each pollutant of concern and for each urbanized area:

Load = Pollutant Concentration × Land Area × Rainfall × Runoff Coefficient × Conversion Factor,

where:

Load = Storm water pollutant load in thousands of pounds per year[6]

Concentration = Mean pollutant concentrations determined from NURP (mg/l)

Area = Land area for the urban site or place from the U.S. census (square miles)

Rainfall = Average annual rainfall, based on rainfall zone (inches per year)

Runoff Coefficient = A fraction that represents the proportion of rainfall that runs off the land to surface waters. It is related to the amount of land covered by impervious surfaces, such as roads and buildings

Conversion Factor = Adjusts units into pounds per year.

2.2.2.1 Pollutant Concentrations

A review of the literature showed that data from NURP (EPA, 1983) are the most frequently cited and often used reference values for urban runoff pollutant concentrations. NURP data were used as the basis for loadings calculations for this study after evaluating the procedures used in NURP and comparing the results with other independent studies of urban runoff undertaken by USGS.

[5] In particular, rainfall and concentration data were not site-specific.

[6] The units of the final loading estimate were converted to thousands of pounds per year so that the results could be simplified.

NURP, which was conducted during the early 1980s, remains the most comprehensive assessment of pollutants in runoff from residential and commercial areas. The program was developed in the late 1970s, after EPA reviewed State 208 Water Quality Management Plan Reports and determined that additional and consistent data were needed to describe pollutants in urban runoff.

Under NURP, EPA provided direction and assistance to 28 planning projects located throughout the United States (Figure 2-1) that were selected from 93 area-wide agencies that had identified urban runoff as a potentially significant problem. (Table 2-3 lists the 28 NURP project locations according to EPA Regions.) Each project was separate and distinct but shared the common goal of conducting field monitoring to characterize pollutants in runoff from residential and commercial areas. The sampling locations within the 28 NURP projects included 81 specific sites and more than 2,300 separate storm events. The resulting data base represented a cross section of regional climatology, residential and commercial land use types, slopes, and soil conditions and, thereby, provided a basis for identifying patterns of similarities or differences and testing their significance.

Table 2-3. NURP Project Locations

EPA Region	NURP Code	Project Name/Location	EPA Region	NURP Code	Project Name/Location
I	MA1	Lake Quinsigamind (Boston Area)	V	IL1	Champaign-Urbana, Illinois
	MA2	Upper Mystic (Boston Area)		IL2	Lake Ellyn (Chicago Area)
	NH1	Durham, New Hampshire		MI1	Lansing, Michigan
				MI2	SEMCOG (Detroit Area)
II	NY1	Long Island (Nassau and Suffolk Counties)		MI3	Ann Arbor, Michigan
				WI1	Milwaukee, Wisconsin
	NY2	Lake George	VI	AR1	Little Rock, Arkansas
	NY3	Irondequoit Bay (Rochester Area)		TX1	Austin, Texas
			VII	KS1	Kansas City
III	DC1	WASHCOG (D.C. Metropolitan Area)	VIII	CO1	Denver, Colorado
	MD1	Baltimore, Maryland		SD1	Rapid City, South Dakota
				UT1	Salt Lake City, Utah
IV	FL1	Tampa, Florida	IX	CA1	Coyote Creek (San Francisco Area)
	NC1	Winston-Salem, North Carolina		CA2	Fresno, California
	SC1	Myrtle Beach, South Carolina	X	OR1	Springfield-Eugene, Oregon
	TN1	Knoxville, Tennessee		WA1	Bellevue (Seattle Area))

Source: U.S. Environmental Protection Agency, 1983

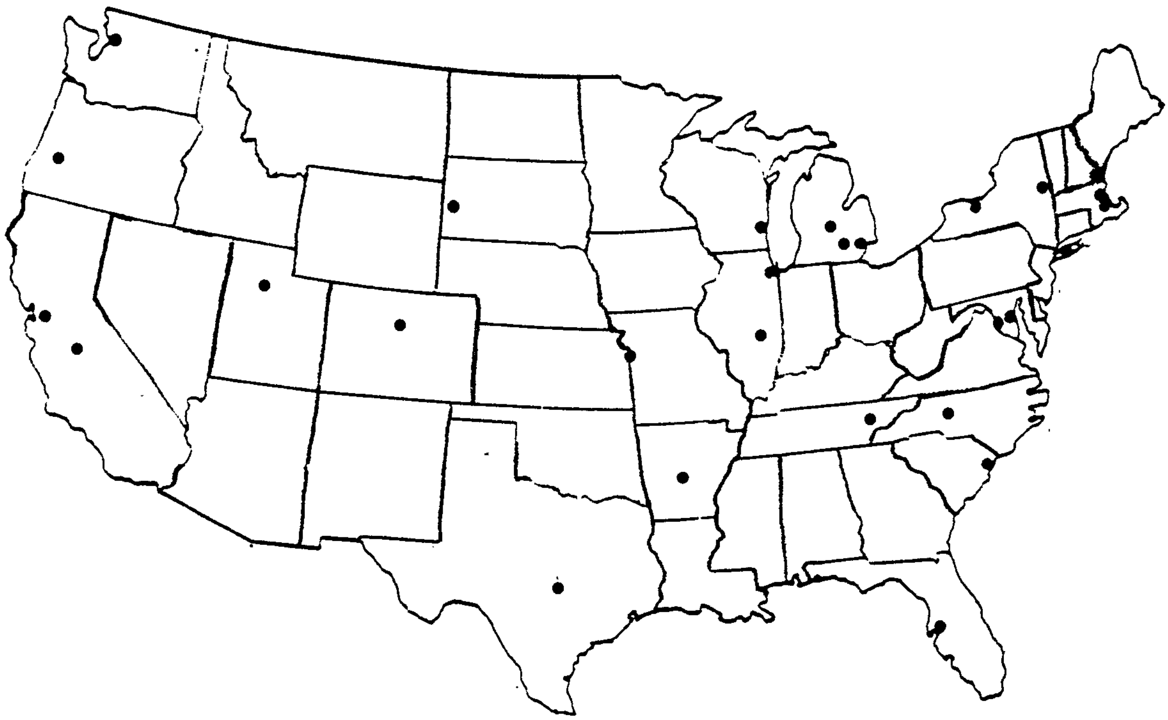


Figure 2-1. Location of NURP Sites

NURP focused on the following ten constituents, which were considered standard pollutants characterizing urban runoff:

- Total Suspended Solids (TSS)
- Biochemical Oxygen Demand (BOD)
- Chemical Oxygen Demand (COD)
- Total phosphorus (TP)
- Soluble phosphorus (SP)
- Total Kjeldahl Nitrogen (TKN)
- Nitrate + nitrite (N)
- Total copper (Cu)
- Total lead (Pb)
- Total zinc (Zn).

These pollutants are commonly associated with urban runoff and are often targets of point and nonpoint source studies. In addition, some of these pollutants can be surrogates for larger categories of pollutants such as oxygen consuming constituents and nutrients. NURP also examined coliform bacteria and priority pollutants (other than oil and grease). However, these parameters were only evaluated for a subset of sites and were not the primary focus of the NURP study. Moreover, they were not presented in a summary fashion suitable for estimating loadings. Soluble phosphorus is not discussed in this report because it was not addressed in USGS results or NPDES permit applications for industrial facilities (addressed later in this chapter).

NURP attempted to characterize the nature of storm water from residential and commercial areas. The data summaries excluded monitoring sites that were downstream of storm water controls. Sites were selected to focus on runoff from residential areas (primarily low density) and to avoid heavy industrial areas. NURP commercial site results did not include heavy industrial sites but in several cases reflected industrial park type use. Sites were also selected so that there were no extraneous sources of pollutants in the storm water discharge, such as illicit connections to the storm sewers. In addition, unusually high pollutant concentrations were eliminated from the data base as being atypical of storm water discharges.

Because of its site selection approach, NURP results represent normal or baseline urban runoff conditions from residential and commercial areas, not actual urban conditions which could include heavy industrial activities which were avoided by NURP. Because the NURP sites represent average runoff conditions from a mix of residential, commercial, and industrial park sites, loading estimates based on the NURP concentrations (described earlier in this Chapter and in Chapter 3) will be influenced by loadings from some of the sources considered in the industrial and commercial analysis (see Section 2.3 and Chapter 4) that were located in the catchments monitored.

NURP showed that the concentrations of pollutants in urban runoff vary considerably from site to site. Concentrations at individual sites also varied through the course of a storm event and between events. This variability is the natural result of variations in rainfall intensity, occurrence, and site-specific factors (e.g., slope, land use) that affect runoff quantity and quality. NURP data were summarized using average values for storm events, with an event mean concentration (EMC, i.e., the total pollutant mass discharged divided by the total runoff volume). To determine typical storm water concentrations, NURP researchers examined the data in various ways using standard statistical procedures, each exploring the effects of different factors (e.g., slope, land use category) on final concentration values. Based on these statistical tests, NURP concluded that geographic location, land use categories, or other factors appear to be of little utility in explaining the overall site-to-site variability, and the best general characterization of urban runoff is obtained by pooling the site data for all sites (except the open/non-urban ones). NURP recommended the total pollutant mass discharged divided by the total runoff volume (i.e., the event mean concentration [EMC]) as the best single measure for characterizing overall storm water pollutant concentrations. The data summarized from NURP are recommended for planning purposes rather than site-specific characterization. Table 2-4 presents summary statistics from NURP for different sites and results from other USGS studies, discussed below.

Comparison to USGS Urban Storm Water Data Base

In addition to EPA's efforts to characterize urban runoff, USGS has collected urban rainfall, runoff, and water quality data nationally for several decades. In the mid-1980s, much of this information was compiled into a national data base. This data base contains information on 717 storms at 99 stations in 22 metropolitan areas throughout the United States (Driver et al., 1985). The USGS examined a set of constituents similar to those used in NURP. The USGS also reported its data in terms of flow-weighted samples so that concentration and loading values could be compared directly to NURP results.

Table 2-4. NURP and USGS Summary Statistics— Water Quality Characteristics of Urban Runoff

		NURP (1983)				USGS (various years)					
		Median Urban Site (d)			Commercial	Residential		Commercial Sites		Industrial Sites	
		EMC Mean	EMC Median	90th%-ile	EMC Median	Mean	Median	Mean	Median	Mean	Median
Pollutant	units/notes	a	b	b	b	c	c	c	c	c	c
BOD5	mg/l	12	9	15	9	12	7	16	8	NR	NR
COD	mg/l	82	65	140	57	NR	NR	NR	NR	NR	NR
NO_2+NOL_3-N	mg/l	0.86	0.68	1.75	0.57	0.57	0.46	0.38	0.25	1.71	1.20
TKN	mg/l	1.90	1.50	3,30	1.18	NR	NR	NR	NR	NR	NR
Total P	mg/l	0.42	0.33	0.70	0.20	0.46	0.36	0.31	0.18	6.61	6.40
TSS	mg/l	180	100	300	69	1163	228	248	109	671	492
Copper	μg/l	43	34	93	29	43	20	28	16	89	74
Lead	μg/l	182	144	350	104	222	120	215	73	97	78
Zinc	μg/l	202	160	500	226	145	100	311	110	706	550

a - EMC mean reported on page 6-60 of NURP report in the context of loading estimate comparisons. EMC should be used when comparing cumulative effects such as WQ impacts in lakes or when comparing loads on a long-term basis.

b - EMC median reported on 6-43 of NURP as the best description of urban runoff characteristics in terms of water assessing short-term water quality impacts in rivers and streams.

c - Simple mean and median calculated from raw data from USGS. Because the data were not normally distributed, the median is the base measure of central tendency.

d - NURP's "median urban site" is a composite of land use types.

NR - Not Reported.

To provide a comparison to the NURP data for this study, the USGS data were analyzed statistically to develop mean and median pollutant concentration values for 7 of the 10 NURP pollutants. (The USGS data did not include COD, TKN, or soluble P. As previously noted, soluble phosphorus is not discussed in this report because it is not addressed in USGS or NPDES permit applications for industrial facilities.) To provide some perspective on NURP, different land use categories (i.e., residential, commercial, and industrial park sites) were analyzed separately. Table 2-4 summarizes the results from the USGS data base next to the NURP results. Although NURP results (for the median) are higher for BOD, nitrate + nitrite, copper, lead, and zinc, most of the results differ by less than 50 percent, except for TSS results, which are highly variable. Both sets of results are in the same range, supporting the idea that these values are representative of the nature of urban runoff. This determination is consistent with the findings of Driver and Lystrom (1986), who also compared certain aspects of the two data sets.

As described in this chapter and in Chapter 3, this report uses historical data, generated by the Nationwide Urban Runoff Program (NURP) and by the U.S. Geological Survey (USGS), to generally and comparatively characterize metal contamination in storm water runoff from urban areas.

Recently, concerns have been raised regarding the validity and use of historical data for metals where adequate QA/QC cannot be properly documented (USGS, 1992). The quality of trace level metal data, especially at levels in the 1-5 part per billion (ppb) range, may be compromised due to contamination of samples during collection, preparation, storage, and analysis. These concerns have also been expressed as applying to the NURP metals data.

EPA believes that the metals data for urban runoff from USGS and NURP as used in this report are valid. Mean concentrations of copper, lead, and zinc observed under NURP and USGS were found to be in the range of 30 to 700 ppb (see Table 2-4), well above the 1-5 ppb range that has been identified as questionable. Furthermore, in dealing with the metals issue generally, EPA believes that most historical data for metals collected and analyzed with appropriate QA and QC at levels of 1 ppb or higher are reliable (EPA, 1993).

It should also be pointed out that the historical sampling data presented in this report is intended to provide a general, qualitative characterization of urban storm water runoff rather than a precise empirical relationship. The metals loadings estimated using NURP data are only used to illustrate relative loadings contributions from different geographical areas of the country. Quantitative loadings estimates, which could possibly be affected by suspect data, have not been presented in this report.

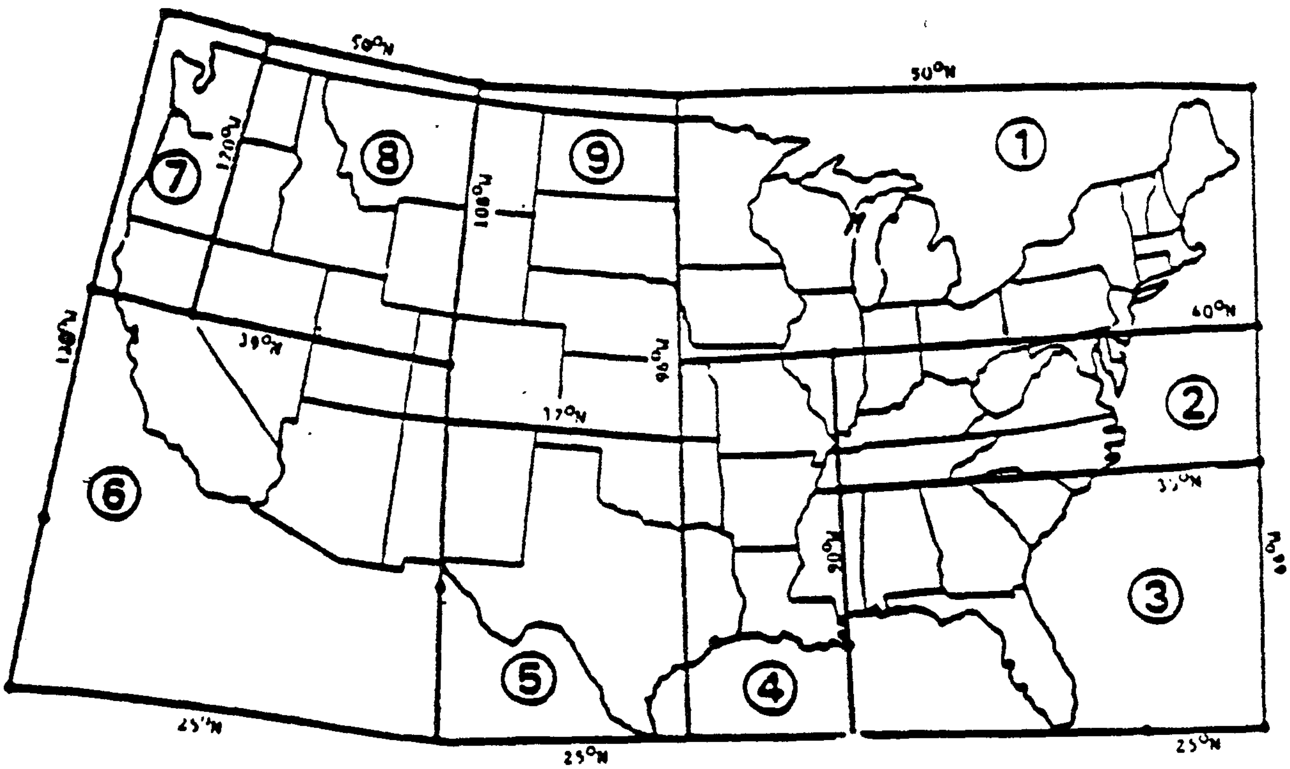
2.2.2.2 Land Area

Population and land area data (or population density) for all urbanized areas were obtained from the 1990 census. Phase I sources and potential Phase II sources were identified based on the procedure described in Section 2.2.1. An adjustment factor was developed to address combined sewer systems. Combined sewer systems are not considered to be part of the storm water regulatory program (although combined sewer overflows from combined sewer systems are addressed by the NPDES program). Therefore, storm water volume estimates in this report were adjusted to account for the flows entering combined sewers. Estimates of the land area served by combined sewer systems were based on data reported by the States for *The 1984 Needs Survey Report to Congress* (EPA, 1985).

2.2.2.3 Rainfall

Annual rainfall estimates were obtained from *Methodology for Analysis of Detention Basins for Control of Urban Runoff Quality* (Driscoll et al., 1986). This document identifies 9 rainfall zones in the United States (see Figure 2-2). Although these rainfall zones have been updated in *Analysis of Storm Event Characteristics for Selected Rainfall Gauges Throughout the United States* (Driscoll et al., 1989), (see Appendix B of this report) to include 15 more precisely defined rainfall zones, the 9 rainfall zones from the earlier report were used to simplify estimation procedures.

For each of the 3,141 counties in the country, the appropriate rainfall zone was identified, along with the average annual rainfall for that zone. This information was merged with the larger census data base at the county level to provide rainfall estimates for each municipality.



Not Shown: Alaska (Zone 7); Hawaii (Zone 7); Northern Mariana Islands (Zone 7); Guam (Zone 7); American Samoa (Zone 7); Puerto Rico (Zone 3); Virgin Islands (Zone 3).

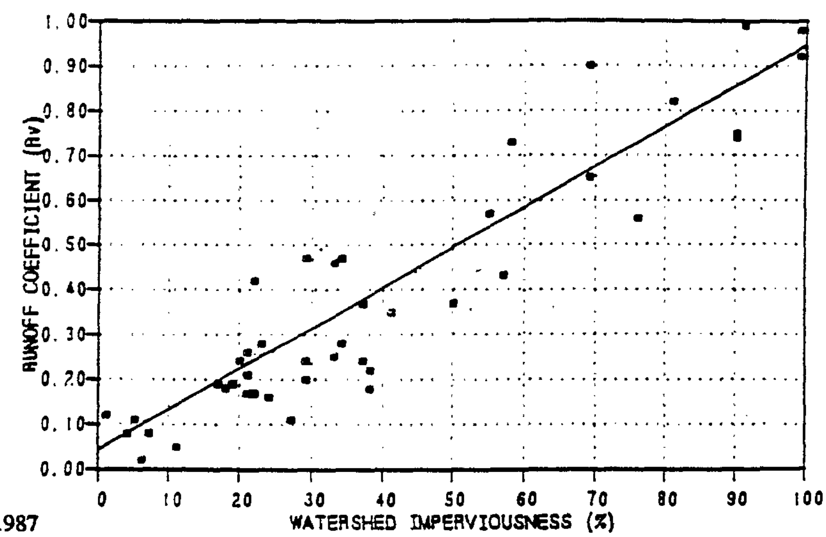
Zone 1	33.1	Zone 4	41.2	Zone 7	23.0
Zone 2	39.6	Zone 5	19.2	Zone 8	11.0
Zone 3	50.9	Zone 6	7.5	Zone 9	14.3

Source: 55 *FR* 47990, 1990
EPA, 1990

Figure 2-2. National Distribution of Rainfall Zones and Average Annual Precipitation (inches/year)

2.2.2.4 Runoff Coefficient

The runoff coefficient represents the portion (percentage) of total precipitation reaching the ground that becomes runoff to surface waters. A number of factors, such as the nature of the soils, topography, and amount or type of vegetative cover, can affect the runoff coefficient. However, the most important factor in determining the quantity of runoff from a given storm in a given area is the amount of impervious area (MWCOG, 1987). Impervious areas include all types of paved areas (e.g., streets, sidewalks, parking lots, driveways), buildings, roof tops, and other similar structures. The extent of impervious area is a function of many local considerations, such as the density and type of development. Generally, the runoff coefficient is directly related to watershed imperviousness, as illustrated in Figure 2-3, which contains data from 44 small urban catchments monitored during the national NURP study.



Source: MWCOG, 1987

NOTE: 44 small urban catchments monitored during the national NURP study.

Figure 2-3. Relationship of Watershed Imperviousness to Runoff Coefficient

The runoff coefficient used in the analysis of this report was estimated as a function of population density, based on equations that are widely used in the engineering literature, in previous studies by EPA's Office of Research and Development, and in the Corps of Engineers' Storage, Treatment, Overflow and Runoff Model (STORM) (which was designed for planning purposes and simulation of storm events [Heaney et al., 1977]). The two equations are:

Impervious Proportion = 0.096 × population density$^{(0.573-.0391 \times \log(\text{Population Density}))}$
Runoff Coefficient = 0.15 (1−impervious proportion) + 0.90 (impervious proportion).

Combining the two equations yields:

Runoff Coefficient = 0.15 + 0.75 × [0.096 × population density$^{(0.573-.0391 \times \log(\text{Population Density}))}$]
where population density is in persons per acre.

The first equation estimates the site-specific level of imperviousness from population density. This empirical equation is based on data from another study of hundreds of municipalities in New Jersey (Stankowski, 1974). The second equation estimates a runoff coefficient from an empirical equation that depends on the level of imperviousness. Using this model, an area with no impervious surfaces would be assigned a runoff coefficient of 0.15, while a completely impervious area would have a runoff coefficient of 0.90. These equations produce results that are similar to those presented in Figure 2-3.

The model can be used to estimate runoff coefficients when only population density is known. Figure 2-4 shows how the model predicts the relationship between population density, expressed in persons per acre and the runoff coefficient. For example, for an urban area with 10 people per acre (or 6,400 people per square mile), the model estimates a runoff coefficient of 0.4, meaning that, on average, 40 percent of the rainfall runs off to surface water. The model estimates that places with higher population densities will have higher runoff coefficients. Although limitations are associated with this relationship (e.g., the original equation is based on land use conditions in the 1960s and the estimates are limited by the uncertainty of the assumed variables), the model can make use of population density data from the 1990 census in estimating runoff coefficients for different municipalities for comparative purposes.

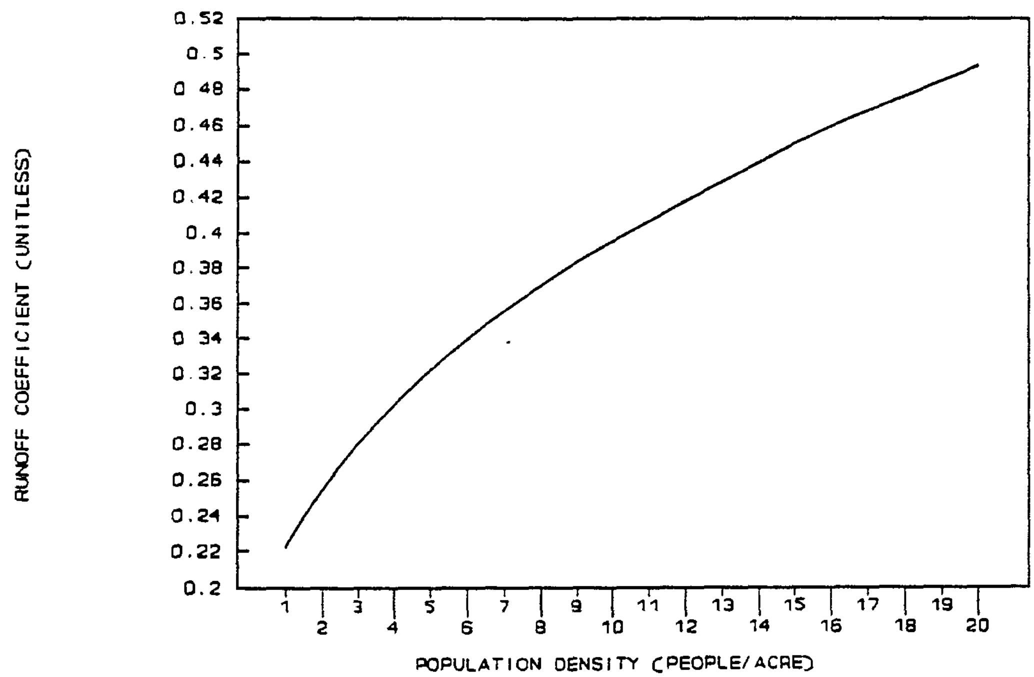


Figure 2-4. Runoff Coefficient Calculated as a Function of Population Density

2.3 ANALYSIS OF INDIVIDUAL PHASE II DISCHARGES

The second major focus of this study was to (1) identify types of industrial, commercial, and institutional storm water discharges for which permits are not already required as part of Phase I and (2) determine, to the maximum extent practical, the nature and extent of pollutants in such discharges. This section explains the approach used to select classes of facilities for study and the data analyses undertaken to develop the information presented in Chapter 4.

To develop information on remaining unregulated sources, sources regulated under Phase I were clearly defined and eliminated from consideration along with sources that have been statutorily exempted from both Phase I and Phase II. Then, from the remaining set of sources and facilities, classes of facilities with the potential to contribute pollutants to storm water discharges were identified. The analysis of the nature and extent of individual Phase II discharges addresses both pollutant concentrations and the geographic distribution of facilities. The geographical analysis was developed to determine the distribution and location of individual Phase II facilities in relation to Urbanized Areas and the Phase II municipalities identified in the first part of this study. Although there was not enough data available on a national basis to estimate pollutant loadings from individual Phase II sources, the approach taken could later be related to an assessment of water quality conditions at the local, regional, or State level.

2.3.1 Identifying Individual Phase II Storm Water Discharges

The storm water discharge regulations (Phase I) require permit applications from facilities with "storm water discharges associated with industrial activity," as defined in 40 *CFR* 122.26(b)(14) (55 *FR* 47990). This definition describes the 11 specific categories of industrial activities which are regulated. For the categories of industries identified, the term includes storm water discharges from:

> . . . industrial plant yards; immediate access roads and rail lines used or created by the facility; material handling sites; refuse sites; sites used for the application or disposal of process waste waters . . .; sites used for the storage and maintenance of material handling equipment; sites used for residual treatment, storage or disposal; shipping and receiving areas; manufacturing buildings; storage areas (including tank farms) for raw materials, and intermediate and finished products; and areas where industrial activity has taken place in the past and significant materials remain and are exposed to storm water [40 *CFR* 122.26(b)(14)].

The definitions of the 11 categories include both narrative descriptions of activities and specific designations of industrial operations based on Standard Industrial Classification (SIC) code.[7] For example, category (i) mentions facilities subject to effluent limitations guidelines

[7] The SIC code is the statistical classification standard underlying all Federal economic statistics classified by industry (OMB, 1987).

developed by EPA, while category (xi) designates many specific SIC codes. Because of the comprehensiveness of the SIC system, even narrative descriptions can be correlated with SIC designations. For example, category (vii) covers steam electric power generating facilities, which are included primarily in SIC 4911, and category (ix) covers domestic treatment works, which are included primarily in SIC 4952. The practical effect of these narrative definitions and specific SIC code designations is that most of the industrial facilities subject to permit application requirements are represented by major SIC groupings 10 through 45.[8]

As a basis for identifying Phase II facilities and obtaining information about their distribution and abundance, this study focused on SIC codes. Major sectors of the economy are defined on the basis of the two-digit SIC code group. The two-digit code is a relatively general categorization of the Nation's economic activity; all industrial, commercial, and retail activities are organized into less than 100 two-digit SIC codes, which are listed in Table 2-5. The more specific four-digit SIC code provides a more detailed breakdown of these enterprises and is much more descriptive of the activities conducted at the establishment. The SIC code identifies facilities based on the "primary activity" in which a facility is engaged. Chapter 4 discusses selected advantages and disadvantages of using the SIC code system for identification of storm water sources. Focusing on SIC codes for the purposes of this study does not imply that EPA must regulate on a SIC code basis. Also, although some potential Phase II categories or concerns may be defined or discussed in terms of narrative descriptions, these can be evaluated in terms of SIC code designations.

Although all unregulated facilities which have point source discharges of storm water are potential Phase II sources, in practical terms, only a subset of four-digit SIC codes have real

[8] The NPDES regulations specifically exempt some categories of activity from the definition of point source, including storm water runoff from agricultural sources and silviculture activities (mostly in SIC codes 01 through 09) (40 *CFR* Part 122.3(e)), irrigation return flows (40 *CFR* Part 122.3(f)), and uncontaminated runoff from mining sites and oil and gas facilities (40 *CFR* 122.26(a)(2)). In addition, construction activities are regulated based on the site where activity is occurring, not based on the SIC code for contractors and builders that may participate in the construction (SIC 15 - 17).

Table 2-5. List of All Two-Digit SIC Code Groups and Industry Description

SIC CODE	DESCRIPTION	SIC CODE	DESCRIPTION
01	Ag. Product.-Crops	50	Wholesale-Durables
02	Ag. Product.-Livestock	51	Wholesale-Nondurables
07	Ag. Services	52	Bldg. & Gard. Mats.
08	Forestry	53	General Stores
09	Fishing, Hunting	54	Food Stores
10	Metal Mining	55	Auto Dealers & Service
12	Coal & Lignite Mining	56	Apparel Stores
13	Oil & Gas Extraction	57	Furniture Stores
14	Nonmetallic Minerals	58	Eat & Drink Places
15	Building Contractors	59	Misc. Retail
16	Heavy Const. Contractors	60	Banking
17	Spec. Trade Contractors	61	Credit Agencies
20	Man. Food, etc.	62	Security Brokers
21	Man. Tobacco	63	Insurance Carriers
22	Man. Textile	64	Insurance Agents
23	Man. Apparel	65	Real Estate
24	Lumber & Wood	67	Investment Offices
25	Furniture & Fixtures	70	Hotels & Lodging
26	Paper & Allied Prod.	72	Personal Services
27	Printing & Publish.	73	Business Services
28	Chemicals & Allied	75	Auto Repair Services
29	Petroleum & Coal	76	Misc. Repair
30	Rubber & Plastic Products	78	Motion Pictures
31	Leather/Products	79	Amusement Services
32	Stone, Clay & Glass	80	Health Services
33	Primary Metal Ind.	81	Legal Services
34	Fab. Metal Products	82	Educational Services
35	Machinery-electric	83	Social Services
36	Electronic Equip.	84	Museums
37	Transportation Equip.	86	Membership Orgs.
38	Instrument & Related	87	Research & Development
39	Misc. Manufacturing	88	Households w/Employees
40	Railroad Transport	89	Services, NEC
41	Local Pass. Transit	91	Executive, Gen'l Govt.
42	Trucking	92	Justice, Public Order
43	U.S. Postal Service	93	Public Finance, Taxes
44	Water Transport	94	Human Resource Admin
45	Air Transport	95	Env. Qual. & Housing Admin.
46	Pipe Lines-Nat. Gas	96	Economic Program Admin.
47	Transport Services	97	National Security
48	Communication	99	Non-Classifiable
49	Electric, Gas & Sanitation		

potential to use, process, or store sources of pollutants, or engage in activities that could lead to contamination of storm water. In addition, there are many general sources of storm water contamination such as parking lots, trash dumpsters, and failing septic systems which could be associated with almost any commercial or residential activity. Some general information on these sources is presented in Chapter 4; however, the focus of this report is in identifying specific classes of facilities with greater than average potential for contribution of pollutants to storm water discharges based on their activities.

EPA identified two major groups of facilities for potential inclusion in Phase II. The first group of potential Phase II facilities identified (Group A) consists of facilities in the same SIC code groups as Phase I facilities (SICs 10-45) that are conducting activities that are essentially the same as Phase I industrial activities but that were not included in Phase I due to the specific language of the statute or EPA's regulatory specificity in defining the universe of Phase I industrial activities. The second major group (Group B) consists of facilities in all other SIC code groups where discharges of pollutants are suspected based on case studies, expert opinions, literature reviews, and other sources of information such as experience with Phase I of the storm water program.[9]

2.3.1.1 Group A Facilities

Group A is comprised of facilities which are generally identical to regulated Phase I industrial activities but that have been excluded from Phase I due to the specific language of the statute or EPA's regulatory specificity. While some of the facilities that make up Group A are obvious, (i.e., those with a specific statutory exemption from Phase I), others are more difficult to identify. Because these facilities may be described by SIC codes identical to Phase I regulated facilities, the FACTS data base was of little use in identifying these

[9] Although some sources similar to Phase I industrial activities were not identified in the 1990 application regulations (55 FR 47990) directly, EPA or an authorized NPDES State has the authority under Section 402(p)(2)(E) to designate individual facilities as needing an NPDES permit. Although some designations of this type have been made, this report bases the distinction of individual Phase I and Phase II facilities based on the regulatory definition and not on any individual designations which may have been made.

facilities. Instead, each of the 11 industrial categories that make up Phase I (see Chapter 4, Table 4-2) was examined for possible omissions and discrepancies. The result of this effort was a list of sources that are *not* covered under Phase I but that are closely related to one of the eleven categories of industrial activity. This list appears in Table 4-3. In order to help define these facilities, sources on the list were categorized into three major groups. Group A sources are described in Chapter 4.

2.3.1.2 Group B Facilities

The second general class of facilities were identified on the basis of potential activities and pollutants that may contribute to storm water contamination (Group B). Unlike Group A facilities which are generally represented by the same range of SIC code groups as Phase I facilities (SICs 10-45), Group B facilities have distinctly different SIC codes but may be performing similar activities or using similar materials as Phase I facilities. Based on the review and analysis of the types of industrial sources not covered under Phase I, several categories of Group B facilities were identified that have activities inherently similar to Phase I but are not currently regulated. Some SIC code groups were also identified using other criteria, described below.

Commercial facilities were specifically excluded from Phase I by Congress. However, many commercial sources represent an important environmental concern. These concerns are documented in State and local nonpoint source programs, urban runoff programs, and estuary programs identified through the literature review (see Section 2.4). The Rensselaerville Study (1992) reflected this view by identifying "gas, auto, service stations, transportation related activities, highway systems, land development, agricultural sources and related activities, commercial activities with industrial components, and large retail complexes" as sources of concern.[10]

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[10] No SIC codes specifically identify all large retail complexes. However, these complexes are partially addressed through the loading analysis of storm water from urban/urbanized areas in the municipal section (Chapter 3).

Another class of facilities included in Group B is commercial agricultural-related activities. Categories that are specifically exempted from regulation under Section 402 of the CWA (or, in certain cases, under existing NPDES regulations) were eliminated from consideration in Group B as potential Phase II sources. (These include agriculture and most silviculture activities generally included in SIC code groups 01, 02, 07, 08, and 09.[11]) However, several specific SIC codes were retained on the list as potential Phase II sources because they are not specifically included under the agricultural exemption. These include nurseries, feedlots (the larger of which are already regulated under the NPDES permitting program),[12] some forestry operations, and miscellaneous others.[13]

A final review of other miscellaneous sources that have been identified as potential contributors to storm water pollution was conducted to reveal any sources not addressed by the criteria discussed above. The facilities identified use or handle materials containing pollutants of concern to publicly owned treatment works (POTWs). To the extent that these materials are used, stored, processed, or disposed of outdoors at Group B facilities, they may also represent a source of storm water contamination.

The procedure used to identify specific SIC codes with significant potential to discharge pollutants to storm water resulted in the identification of 90 categories of facilities. Table 4-4 lists the subset of 90 four-digit SIC codes identified from this analysis. The analysis was comprehensive and inclusive, while at the same time carefully determining whether a category had the potential to contribute pollution to storm water.

[11] The NPDES regulations at 40 *CFR* 122.27 cover discharges from certain types of silviculture activities but do not cover other discharges that are nonpoint in nature.

[12] Feedlots that are not contained within the regulatory definition of concentrated animal feeding operation (CAFO) are not point sources unless designated on a case-by-case basis under 40 *CFR* 122.23(c).

[13] Under 402(p)(6), EPA may establish regulations that could include sources that are not currently defined as point sources or examined as potential Phase II sources in this report, including some operations related to silviculture.

The geographic distribution analysis was completed for all major two-digit SIC code groups and for the 90 specific four-digit SIC codes identified in Table 4-4. Information about the distribution of all facilities is presented in the report, even for categories that are not among the 90 potential Phase II categories, including all Phase I facilities, financial and service groups, and agricultural activities.

2.3.1.3 Service Sectors

Major SIC code groups in the service sectors, such as banking, finance, insurance firms, and food services were not considered to be potential Phase II sources. The activities of these enterprises are generally conducted indoors and do not inherently use or produce contaminants that may enter storm water. Although these facilities may have general sources such as parking lots or trash dumpsters which could contaminate storm water discharges, the municipal analysis considers pollutant loadings from these types of sources. All of the major SIC groups excluded on this basis are listed in Table 4-6. Regardless, the geographic and distributional analysis was conducted for these facilities at the major group (two-digit SIC) level. These results are presented in Appendix G.

2.3.2 Determining the Nature and Extent of Pollutants Associated With Industrial and Commercial Discharges

The nature and extent of discharges from potential Phase II industrial and commercial discharges were analyzed in a manner that allows comparison with the municipal analysis in terms of geographic distribution. The potential pollutant content of storm water from industrial and commercial sites was characterized and the locations of these potential discharges were analyzed with respect to urbanized areas. The nature of discharges was evaluated by comparison to existing studies (i.e., NURP and USGS), by analysis of discharge data from Phase I sources, and by compilation of qualitative information from a literature survey. The geographic extent of discharges was evaluated by analyzing the location of facilities using the FACTS data base in conjunction with information from the census, as explained below.

2.3.2.1 Identifying Pollutants Associated With Industrial and Commercial Discharges

Storm water discharged from industrial, commercial, and retail facilities has the potential to come into contact with raw materials, products, and waste streams, which can result in pollutant contamination of storm water discharges. A number of general categories of activities and conditions that have the potential to generate contaminants in storm water have been identified in both the proposed and final NPDES Permit Application Regulations for Storm Water Discharges (53 *FR* 49416; 55 *FR* 47990):

- Outside loading of dry bulk or liquid materials that may be spilled or accumulated and washed with rainfall into storm sewers or receiving waters
- Outside storage of raw materials, wastes, or products
- Outside processing of materials where rainfall may come into contact with materials in the process stream
- Practices with the potential for spills to the storm sewer or wash down of processing areas to floor drains
- High volume water use in material processing
- Direct application of wastes to the ground
- Dust and particulate generating processes
- Vehicle and equipment maintenance activities.

Most of these activities are specifically mentioned in the definition of discharges associated with industrial activity (40 *CFR* 122.26(b)(14)).

To characterize potential industrial and commercial storm water discharges, data on industrial and commercial sites and land uses were taken from the NURP and USGS studies and analyzed statistically and presented for comparison purposes. Chapter 4 provides further comparison and discussion. The results provide general insight into the nature of storm water runoff from light industrial areas.

The nature of industry-specific storm water quality data was characterized by analyzing sampling data submitted by group permit applicants under Phase I. These sampling results provide insight into the nature of storm water from these industrial sites and storm water from potential Phase II facilities which may have similar characteristics.

This analysis focused on the pollutants that were required to be analyzed for in the Part II NPDES storm water permit group application plus copper, lead, and zinc. For each pollutant and each industrial sector, the mean, median, and 95th percentile were calculated for both grab and composite samples, where the pollutant was identified. Where applicants reported none detected, the result was treated as zero, an approach consistent with the analysis of data from Phase I industrial facilities as presented in Appendix F. Chapter 4 summarizes these data. Appendix F contains detailed data summaries for each of 29 industrial sectors developed for the group application process.

To facilitate characterization of the nature of discharges from potential Phase II sources, similarities between Phase I and Phase II facilities were highlighted by comparing categories with similar activities, where possible. For facilities in Group A, comparison to Phase I sectors is generally straightforward and yields valuable information about these potential Phase II facilities. For Group B facilities, the corresponding Phase I activity may not be as similar. Comparisons were made only in general terms at the industrial sector level and not at the level of specific SIC codes or facilities. The resulting information presented in Chapter 4, therefore, can only be used as a guide to the general types and levels of pollutants that may be found at facilities of a given category, rather than a definitive determination of the degree of contamination at a particular site. These results are presented in Chapter 4.

To supplement the Phase I data analysis, a literature review was conducted to locate and summarize the available information on the nature of pollutants with emphasis on the groups of categories selected by the screening procedure outlined above. The literature review focused on identifying the types of pollutants that may be associated with particular categories of facilities. General qualitative information on storm water discharges and potential pollutants is available in the literature from a number of case studies and assessments of specific locations and types of facilities. Although providing useful background information, it is usually not comprehensive for any one category and may not be comparable across categories.

2.3.2.2 Determining the Extent of Individual Phase II Sources

The extent of storm water discharges from Phase II sources was determined by identifying the locations of the facilities in those categories, rather than the pollutant loads associated with them, as in the municipal analysis. Nation-wide information on the extent of pollutants from these facilities is limited. However, detailed quantitative information on the geographic extent and distribution of these facilities can be developed by combining two data sources[14]:

- FACTS provides data, including name and address, county affiliation, primary business activity (SIC), employment, and sales, on more than 7.7 million industrial, commercial, retail, and government facilities.
- The 1990 Census of Population and Housing, discussed previously, provides detailed information on population and area for most political subdivisions in the country. County-level information on population associated with urbanized areas was used in this analysis.

An analysis was conducted to determine the distribution of individual Phase II facilities and categories in relation to population patterns. To develop information comparable to the municipal analysis, the analysis of individual sources was conducted at the county level. This analysis was conducted to examine the distribution of industrial, commercial, and retail enterprises to determine how they are distributed relative to jurisdictions of potential interest in development of potential Phase II regulatory approaches.

[14] Information on number and location of facilities was limited to the 50 States and the District of Columbia. Analysis of these statistics in relation to urbanized areas was not performed for the facilities and urbanized areas in the Commonwealth of Puerto Rico.

The geographic analysis involved developing, for each county, population, and area, data for all the same political and geographic jurisdictions studied in the municipal analysis, based on the 1990 census data base. Jurisdictions of interest included urbanized areas and Phase I cities, as discussed in Section 2.2, for municipal discharges. For each county, then, the proportion of individual facilities within urbanized areas could be calculated, and the number of facilities located in Phase I and Phase II areas could be determined.

Because the facility location data was not available at the same level of detail as census data used in the municipal analysis, the next step of the procedure made use of the approximate correlation between the location of business and economic activity and the distribution of population. Specifically, the analysis relies on the premise that industrial and commercial facilities are distributed similarly to population within county jurisdictional boundaries. For example, the percentage of facilities estimated to be in the urbanized area of a county is allocated based on the percentage of population in the urbanized area of the county. The premise may be more valid for urban retail activities, such as automobile service activities, and less valid for agricultural activities, which are generally less likely to be associated with urban areas. However, when considering all counties together, as shown in Chapter 4, this procedure produces reasonable results, even for rural businesses, because they are more often located in counties with small urban populations.

Using FACTS, individual facilities were counted for each SIC code and for each county.[15] By basing the distribution of facilities on the distribution of population within a county, it was possible to allocate a portion of the facilities in each county to urbanized areas. The national total for each jurisdictional class was obtained by summing over all counties.

[15] A few facilities had incomplete records for county name and so could not be analyzed using this procedure. Given the intensive data collection activities of Dun & Bradstreet and the focus on economic activity for marketing purposes, the largest and most economically important facilities probably have the most complete records. Thus, the types of facilities with incomplete records are probably small and economically less significant.

2.4 LITERATURE REVIEW PROCESS

The literature review for information about storm water discharges, sources, and pollutants was fundamental to the approach. The following sections describe the activities conducted during the literature search.

2.4.1 Libraries

An extensive literature search was conducted at several libraries, including the University of Maryland and George Washington University, the Library of Congress, the USGS library, and the National Agricultural Library. The On-Line Computer Library Center (OCLC), a national bibliographic data base of 27 million records representing the holdings of more than 15,000 libraries worldwide, was accessed at the University of Maryland. Libraries that use OCLC primarily include public libraries, university libraries, and governmental agency libraries, such as the Department of Interior, Department of Agriculture, and the USGS. The system enables the user to search for periodicals, books, and other publications by using author, title, or subject key words. Numerous key words and phrases were searched, including key words associated with the activities of industries selected for the Phase II analysis. General terms such as storm water, industrial pollution, and names of products or contaminants thought to be associated with particular industries were also searched using OCLC.

At the Library of Congress, a data base search was conducted for information in trade association journals and other publications, environmental engineering journals and periodicals, environmental business journals and periodicals, and other publications that potentially have information related to the industrial analysis. Many of the trade association publications are only available to association members. For those publications found in library holdings, a search was conducted for articles that did not show up during the OCLC search. The data base used at the Library of Congress comprises numerous computerized disk files, each containing information on various subjects, such as science and engineering. The science and engineering disk (the most closely related topic area) was used to search for periodicals available through local libraries. Back-issues of many of the more topical publications were scanned for information relevant to the industrial analysis. The majority of periodicals searched are included in the list given in Table 2-6. At each library, library-specific data bases were searched for documents located in the individual library but not entered into the OCLC data base.

Table 2-6. List of Periodicals and Journals Searched

Autoracing Digest	*Water/Engineering and Management*
Automotive Industries	*Waste Age*
Automotive Repair News	*Modern Casting*
Automotive Review	*Journal of Environmental Quality*
Automotive Week	*Journal of Water Pollution Control Federation*
Chemical Business	*Journal of Water Resource Planning and Management*
Chemical Industry Notes	*Journal of Transportation Engineering*
Chemical Engineering	*Journal of Irrigation and Drainage Engineering*
Chemical Marketing	*Science*
American Petroleum Institute's Annual Report	*Pipeline and Gas Journal*
Service Station Management	*American Industrial Hygiene Association Journal*
Petroleum Independent	*Pipe Line Industry*
Petroleum Marketer	*JAPCA*
Environmental Progress	*Material Handling Engineering*
Environmental Pollution	*Engineering News Record*
Environmental Research	*The Engineer*
Environmental Science and Technology	*Highway and Heavy Construction*
Water Research	*Plastics World*
Water Resources Bulletin	*ISA Transactions*
Water Resources Research	*Chemical and Engineering News*
Oil and Gas Journal	*Biocycle*
Water Science and Technology	*The Management of World Wastes*
Pollution Engineering	*Metal Finishing*
Journal of Testing and Evaluation	
Successful Farming	
Plant Engineering	

2.4.2 Additional Resources

Other resources used in the literature search included EPA documents and periodicals in the Pollution Prevention Information Clearinghouse and Toxic Release Information System, documents available through EPA, EPA's docket, topic-related development documents and effluent guidelines limitations, and publications from State offices related to potential Phase II industries. Additional organizations and individuals were contacted to obtain information on pollutant concentrations in storm water discharges from industrial facilities, especially potential Phase II sources. Only a few documents obtained contained industry-specific pollutant concentration data. The rest provided background information on potential Phase II sources. Organizations contacted specifically for information include the U.S. Department of Defense, the number and a list of military bases; the U.S. Department of Transportation, for an estimate on the acreage or miles of road disturbed per year; the Forest Service at the U.S. Department of Agriculture, for data on storm water discharges from the construction of roads for logging and related activities; and the National Estuary Program, to ascertain data on storm water impacts outlined in estuary management programs.

A list of the documents obtained from the various sources mentioned above is included in the bibliography at the end of this report. Other documents available in the EPA docket (Record For Proposed NPDES Storm Water Implementation Package) were also reviewed.

2.4.3 Potential for Obtaining Additional Information

Based on research efforts for the Report to Congress, quantitative information on pollutant concentrations (and loadings) from industrial activities, especially potential Phase II (unregulated) categories, is limited. EPA's literature search for information on industrial sources identified many major categories of information. Pursuing additional sources of information and extending the literature review effort would probably yield more qualitative information to enhance the existing information on industrial sources. In particular, information on the processes and activities associated with the facilities and a better idea of the types of pollutants involved could potentially be documented. By focusing on particular industry sectors, it may be possible to get more information on the number and size of facilities, as well as information on quantities of products mined, distributed, etc.

CHAPTER 3. MUNICIPAL SEPARATE STORM SEWER SYSTEMS

Section 402(p)(2) of the Clean Water Act (CWA) requires the control of discharges from municipal separate storm sewer systems serving a population of 100,000 or more under Phase I of the NPDES storm water program. This chapter identifies municipal separate storm sewer systems not identified in Phase I that potentially may be subject to requirements under Phase II of the NPDES storm water program. In addition, this chapter describes the nature and extent of pollutants associated with municipal separate storm sewer systems, with an emphasis on potential Phase II sources. To provide an appropriate context for the discussion of potential Phase II sources, this chapter also discusses Phase I municipal systems.

Municipal separate storm sewer systems are comprised of conveyances designed to collect and convey storm water (but not sanitary sewage[1]) that are owned or operated by a municipality. Section 402(p)(3) of the CWA authorizes EPA and NPDES States to issue system-wide or jurisdiction-wide permits for discharges from municipal separate storm sewer systems. NPDES permits for discharges from municipal separate storm sewer systems are to contain requirements to reduce the discharge of pollutants to the maximum extent practicable (MEP) and to effectively prohibit non-storm water discharges to the municipal system in order to meet water quality standards. These requirements can be implemented through municipal storm water management programs to control pollutants from targeted commercial, residential, industrial, and other sources that discharge storm water (or other non-storm water discharges) through the municipal system.

3.1 IDENTIFICATION OF MUNICIPAL SEPARATE STORM SEWER SYSTEMS

The Bureau of the Census estimates that the population of the United States and associated territories was more than 252.2 million in 1990.[2] There are 19,289 incorporated

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[1] Combined sewers are conveyances designed to collect and convey both storm water and sanitary sewage. This report generally does not address combined sewers.

[2] Population estimates based on the 50 states, the District of Columbia, Guam, the Commonwealth of Puerto Rico, the Virgin Islands, American Samoa, and the Commonwealth of the Northern Mariana Islands.

places and 17,796 minor civil divisions in the continental United States, Alaska, and Hawaii. These incorporated places and minor civil divisions are located in 3,141 counties or county equivalents. As discussed in Chapter 2, Table 2-2 provides the Bureau of the Census definitions for the major forms of municipal government.

3.1.1 Population Distributions

The Bureau of the Census defines two classes of population: urban and rural. The majority of the population in the United States is classified as urban (188 million or 75 percent of the total U.S. population), with only 25 percent of the population classified as rural.

3.1.1.1 Urbanized Areas

To provide a better separation of urban and rural population and housing in the vicinity of large cities, the Bureau of the Census defines an urbanized area as a central city (or cities) with a surrounding area that is densely settled (i.e., urban fringe). The population of the entire urbanized area must be greater than 50,000 persons, and the urban fringe must have a population density generally greater than 1,000 persons per square mile (just over 1.5 persons per acre). As discussed in Chapter 2, Table 2-2 provides the definitions of urban populations, rural populations, and urbanized areas used in the 1990 census.

The Bureau of the Census identified 405 urbanized areas of 50,000 or more people based on the 1990 census. The combined population of these areas was more than 160 million people (63 percent of the total U.S. population and 85 percent of the urban population). However, these areas occupy less than 2 percent of the Nation's total land area. Figure 3-1 shows the location of the 405 urbanized areas.

Table 3-1 gives the number of urbanized areas in different size classes. Table 3-2 provides the distribution of urbanized populations and municipalities by State.

Table 3-1. Size Distribution of Urbanized Areas in 1990

Urbanized Area Population Range	Number of Urbanized Areas	Total Population	Total Area (sq.mi.)	Average Area (sq.mi.)	Average Population Density (pop./sq.mi.)
Over 1,000,000	34	95,237,380	27,749	816	3,432
500,000 - 999,999	26	17,955,916	8,122	312	2,211
250,000 - 499,999	44	15,470,005	7,732	176	2,001
150,000 - 249,999	62	11,945,413	5,877	95	2,033
100,000 - 149,999	63	7,538,363	4,366	69	1,727
75,000 - 99,999	58	5,045,917	3,058	53	1,650
60,000 - 74,999	55	3,705,855	2,375	43	1,560
50,000 - 59,999	63	3,485,284	2,241	36	1,555
TOTALS	405	160,384,133	61,520		

Source: *1990 Census of Population and Housing*, Bureau of the Census, U.S. Dept. of Commerce

3.1.1.2 Metropolitan Areas

The Office of Management and Budget (OMB) identifies metropolitan areas based on economic and social trends, as well as population densities. The general concept of a metropolitan area is one of a large population nucleus, together with adjacent communities which have a high degree of economic and social integration. Metropolitan areas have a total population of 100,000 or more (75,000 in New England) and contain either a place with a population of 50,000 or more or an urbanized area of 50,000 or more. A metropolitan area is comprised of one or more central counties and outlying counties that have close economic and social relationships with the central county. Unlike a Census-designated urbanized area with boundaries that follow population patterns, the boundaries of a metropolitan area follow county boundaries[3] and can contain significant tracts of rural land.

[3] In New England, metropolitan areas follow town boundaries.

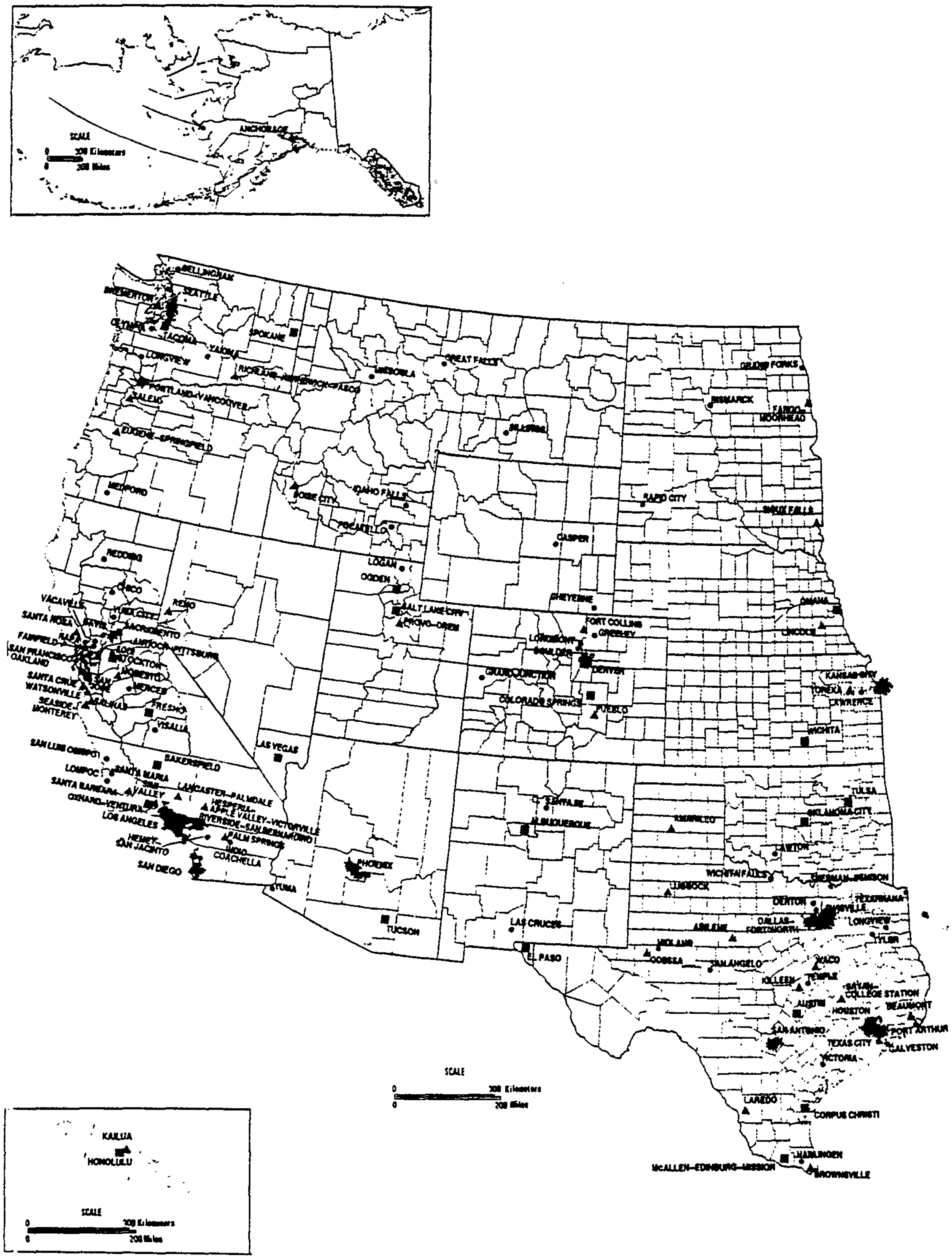

Figure 3-1. Urbanized Areas of the United States

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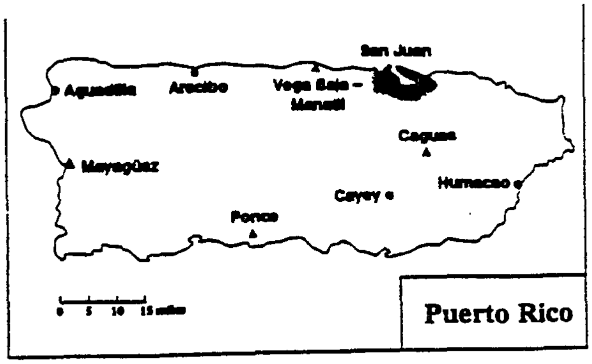

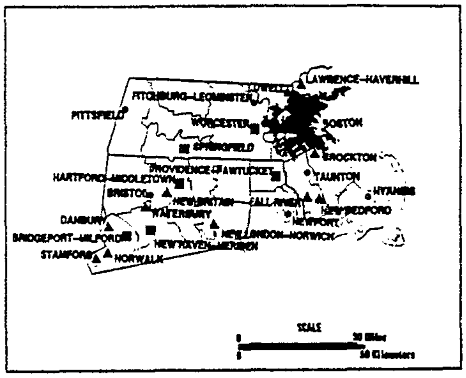

Figure 3-1. Urbanized Areas of the United States (continued)

Table 3-2. Populations in Urbanized Areas

State	Urbanized Area Population	Number of Urbanized Areas
Alaska	221,883	1
Alabama	1,839,966	12
Arkansas	591,420	6
Arizona	2,655,997	3
California	25,466,131	38
Colorado	2,377,820	8
Connecticut	2,455,697	12
District of Columbia	606,900	1
Delaware	458,749	2
Florida	10,177,624	27
Georgia	3,260,674	11
Hawaii	747,109	2
Iowa	942,653	8
Idaho	278,200	3
Illinois	8,478,687	18
Indiana	2,692,676	13
Kansas	1,018,604	5
Kentucky	1,276,855	7
Louisiana	2,228,018	9
Massachusetts	4,730,382	13
Maryland	3,581,461	7
Maine	266,732	4
Michigan	5,812,473	16
Minnesota	2,370,935	7
Missouri	2,782,738	6
Mississippi	617,412	5
Montana	208,883	3
North Carolina	2,512,866	17
North Dakota	202,334	3
Nebraska	687,875	3
New Hampshire	339,454	5
New Jersey	6,629,540	7
New Mexico	649,793	4
Nevada	911,095	2
New York	14,116,042	14
Ohio	6,656,974	20
Oklahoma	1,354,343	4
Oregon	1,420,059	5
Pennsylvania	7,207,497	20
Puerto Rico	2,125,255	9
Rhode Island	824,534	3
South Carolina	1,426,739	10
South Dakota	163,986	3
Tennessee	2,218,007	9
Texas	11,372,246	32
Utah	1,319,551	4
Virginia	3,829,739	11
Vermont	87,088	1
Washington	3,214,738	10
Wisconsin	2,464,721	15
West Virginia	388,840	7
Wyoming	114,138	2
TOTAL	160,384,133	467*

*Urbanized areas which crossed state boundaries were counted more than once. There are 405 distinct urbanized areas nationwide.

Source: 1990 Census of Population and Housing, Bureau of the Census, U.S. Dept. of Commerce

OMB has defined 284 metropolitan areas based on the 1990 census. Figure 3-2 shows the location of the 284 metropolitan areas. These areas have a combined population of 192.7 million or 77 percent of the total U.S. population. This total includes rural populations of 26.5 million (14 percent of the metropolitan area population). Metropolitan areas occupy about 16.6 percent of the land area of the United States (about 88 percent of which is rural). There are 6,998 incorporated places (2,732 of which are rural) and 823 counties located in metropolitan areas. Table 3-3 provides a distribution of population inside and outside of metropolitan areas.

Table 3-3. Populations Inside and Outside of Metropolitan Areas in 1990

	Population	Area (sq.mi.)
Inside Metropolitan Area		
Urban in Urbanized Area	159,624,517	66,311
Urban Not in Urbanized Area	8,854,157	9,507
Rural	27,032,065	551,310
Outside Metropolitan Area		
Urban in Urbanized Area	1,537,739	1,394
Urban Not in Urbanized Area	19,583,295	18,023
Rural	35,701,936	3,136,894

Source: Bureau of the Census

3.1.2 Identification of Phase I Municipal Systems

Section 402(p) of the CWA identifies discharges from municipal separate storm sewer systems serving a population of 100,000 or more as Phase I sources under the NPDES storm water program. Municipal separate storm sewer systems serving a population of 100,000 or more are defined in the NPDES regulations at 40 *CFR* 122.26(b)(4) and (7) to include:

- Incorporated cities with a population of 100,000 or more
- Counties with populations of 100,000 or more in unincorporated, urbanized areas (excluding the population of towns and townships)
- Municipalities designated by EPA or an authorized NPDES State as having Phase I municipal separate storm sewer systems.

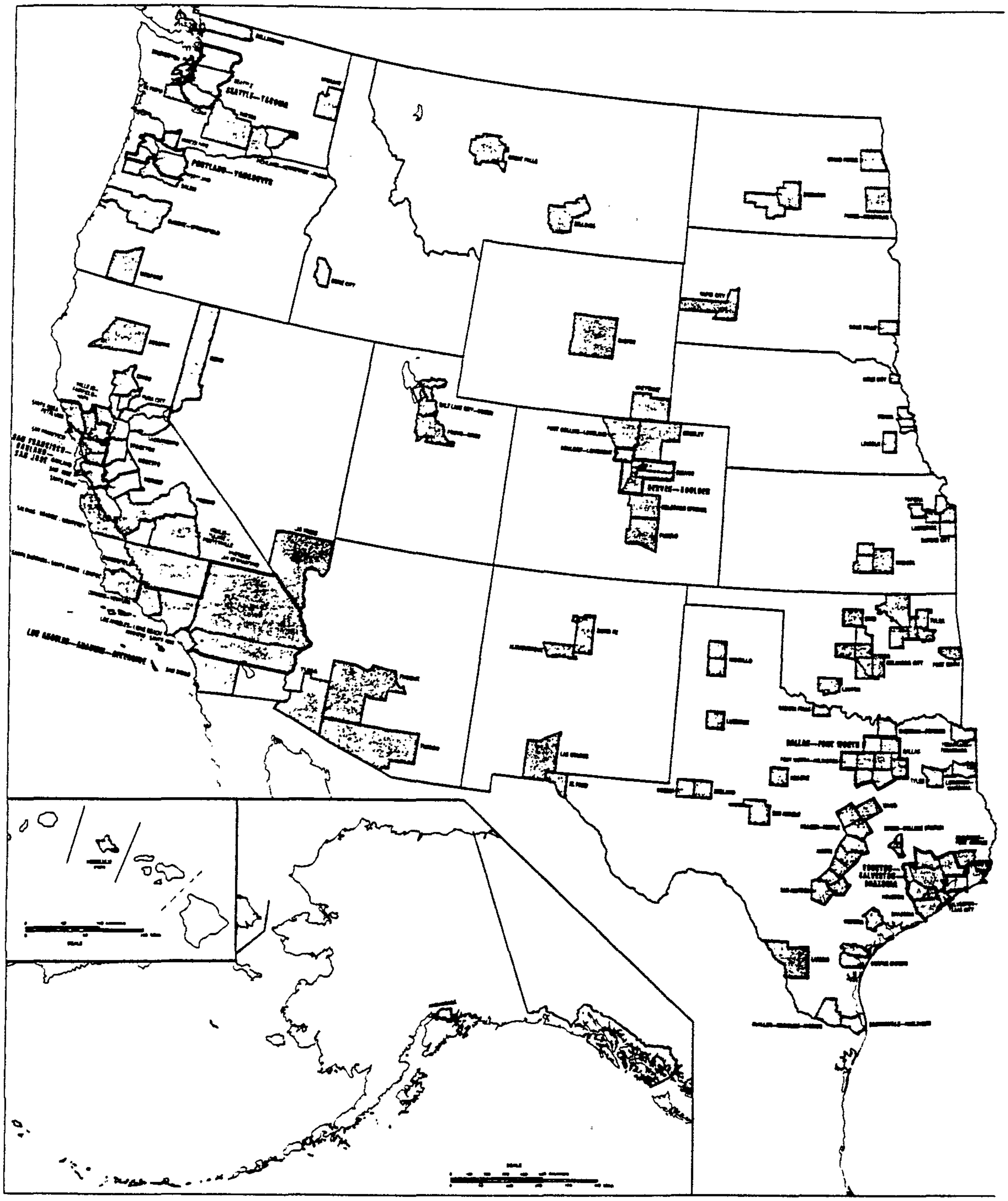

Figure 3-2. Metropolitan Areas of the United States

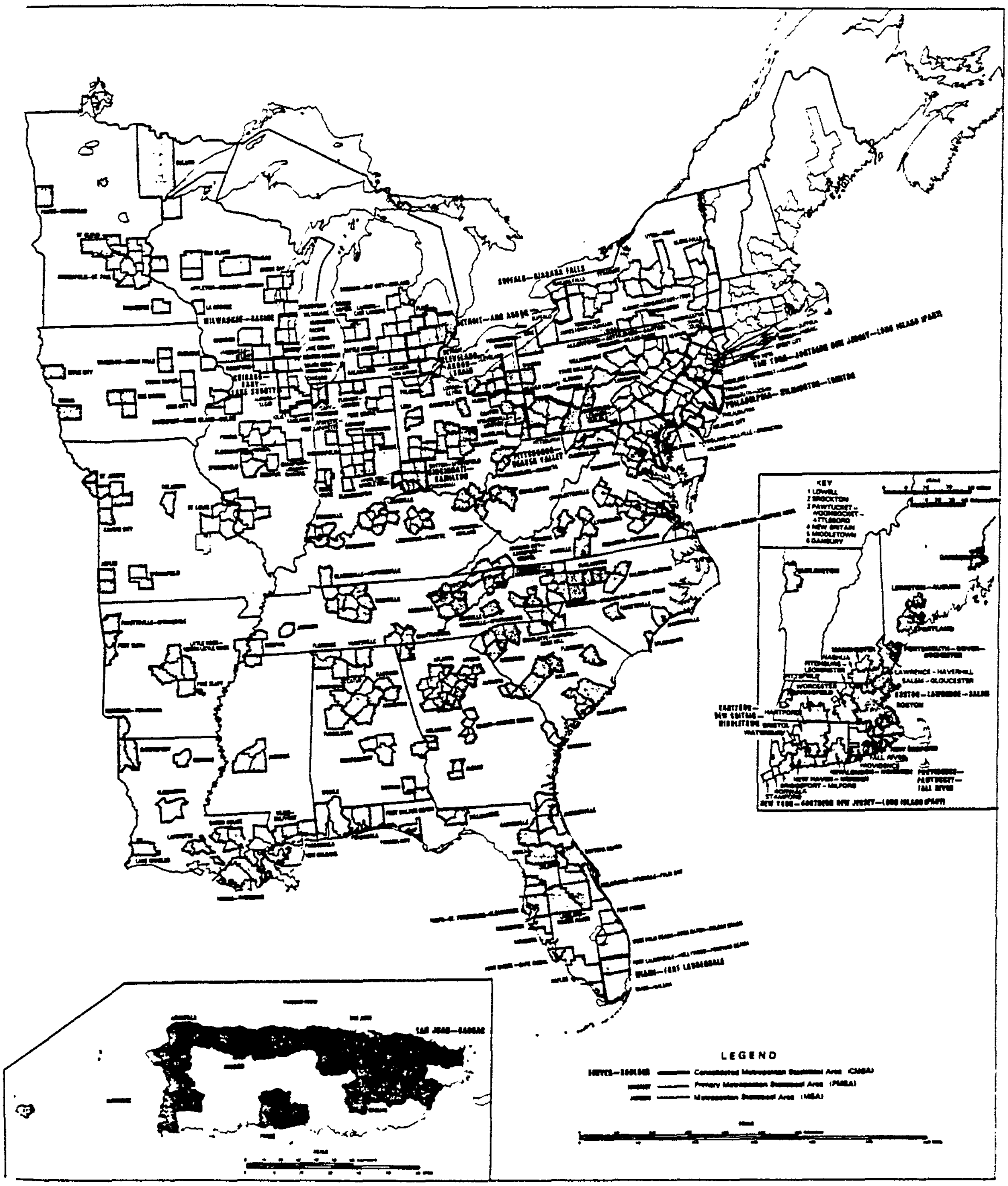

Figure 3-2. Metropolitan Areas of the United States (continued)

In addition, discharges from municipal separate storm sewer systems can be addressed under Phase I of the NPDES program if they are designated under Section 402(p)(2)(E) of the CWA as significant contributors of pollutants to waters of the United States or if they have contributed to a violation of a water quality standard.

Table 3-4 summarizes population and area estimates for municipalities with separate storm sewer systems subject to Phase I of the NPDES program. Appendix A lists Phase I municipal separate storm sewer systems. All but eight States (i.e., Maine, Montana, North Dakota, New Hampshire, New Jersey, Rhode Island, Vermont, and Wyoming) have one or more Phase I municipal separate storm sewer system. Table 3-5 summarizes Phase I municipal separate storm sewer systems by State.

Table 3-4. Municipalities Addressed by Phase I of the NPDES Storm Water Program

Phase I Municipalities		Number	Population (millions)	Area (sq.mi.)
Identified by Regulation*	Cities	140	50.9	17,634
	Counties	45	17.1 **	83,254 **
Designated by EPA/States	Cities	481	14.5	5,017
	Counties	32	3.5 **	27,862 **
	Other ***	60	NA	NA

* These counts exclude cities with a population of 100,000 or more that are exempted from Phase I of the water program due to populations served by combined sewers.

** Includes all of regulated counties. Of the 17.1 million people in counties identified by regulation, 14.6 are in urbanized unincorporated areas. Of the 3.5 million people in designated counties, 2.1 million are in urbanized unincorporated areas.

*** "Other" pertains to a municipality that is not defined by U.S. census political boundaries (i.e., State DOTs, drainage districts, universities, etc.).

Table 3-5. Summary of Phase I Municipalities (by State)

State / Territory	Identified by Regulation		Designated		Phase I Population
	Incorporated Places	Counties	Incorporated Places	Counties	
Alaska	1	0	0	0	226,338
Alabama	4	0	35	5	1,233,803
American Samoa	0	0	0	0	0
Arkansas	1	0	0	0	175,795
Arizona	4	1	0	0	2,066,289
California	25	9	217	6	23,496,438
Colorado	4	0	1	1	1,330,143
Connecticut	1	0	0	0	108,056
District of Columbia	1	0	0	0	606,900
Delaware	0	1	13	0	441,946
Florida	8	9	126	4	8,824,892
Georgia	4	4	35	5	2,870,325
Guam	0	0	0	0	0
Hawaii	0	1	0	0	847,952
Iowa	2	0	1	0	397,271
Idaho	1	0	1	0	132,107
Illinois	1	0	0	0	139,426
Indiana	2	0	0	0	904,399
Kansas	3	0	0	0	573,661
Kentucky	2	1	0	0	753,618
Louisiana	3	1	4	1	1,498,681
Massachusetts	2	0	1	0	847,481
Maryland	1	4	6	6	3,809,266
Maine	0	0	0	0	0
Michigan	5	0	0	0	702,153
Minnesota	2	0	0	0	640,618
Missouri	3	0	0	0	687,941
Mississippi	1	0	0	0	196,637
Montana	0	0	0	0	0

Table 3-5. Summary of Phase I Municipalities (by State) (continued)

State / Territory	Identified by Regulation		Designated		Phase I Population
	Incorporated Places	Counties	Incorporated Places	Counties	
North Carolina	5	1	1	0	1,325,072
North Dakota	0	0	0	0	0
Nebraska	2	0	0	0	527,767
Nevada	2	1	3	1	981,688
New Hampshire	0	0	0	0	0
New Jersey	0	0	0	0	0
New Mexico	1	0	0	0	384,736
New York	5	0	0	0	7,322,564
Northern Mariana Islands	0	0	0	0	0
Ohio	6	0	0	0	2,240,572
Oklahoma	2	0	0	0	812,021
Oregon	3	1	23	2	1,349,799
Palau	0	0	0	0	0
Pennsylvania	2	0	0	0	1,690,667
Puerto Rico	0	0	0	0	0
Rhode Island	0	0	0	0	0
South Carolina	0	2	0	0	397,573
South Dakota	1	0	0	0	100,814
Tennessee	4	0	9	0	1,484,247
Texas	15	1	4	0	7,843,991
Utah	1	1	0	0	434,446
Virgin Islands	0	0	0	0	0
Virginia	6	4	1	1	2,909,207
Vermont	0	0	0	0	0
Washington	2	3	0	0	1,895,943
Wisconsin	2	0	0	0	819,350
West Virginia	0	0	0	0	0
Wyoming	0	0	0	0	0
TOTAL	140	45	481	32	86,032,593

3.1.2.1 Incorporated Cities With a Population of 100,000 or More

The Phase I NPDES storm water regulations initially specifically identified 173 incorporated places with a population of more than 100,000.[4] However, 30 of the 173 cities with a population of 100,000 or more have been excluded from Phase I of the NPDES storm water program because, after the population served by combined sewers is subtracted from the total city population, the population served by separate storm sewers is less than 100,000.[5] Table 3-6 lists the cities excluded from Phase I because of populations served by combined sewers.

The description of Phase I sources presented in this report includes available information on cities given exemptions from Phase I because of populations served by combined sewers.

3.1.2.2 Counties With Urbanized, Unincorporated Populations of 100,000 or More

Phase I of the NPDES storm water regulations specifically identify municipal separate storm sewer systems in unincorporated portions of 45 counties as needing an NPDES permit.[6] Counties specifically identified in the Phase I regulations were described as having 100,000 or more people (based on the 1980 census) who live in unincorporated areas and are part of an urbanized area designated by the Bureau of the Census. EPA identified counties with large unincorporated, urbanized populations for regulation under Phase I of the NPDES

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[4] The specific cities listed in the current NPDES storm water regulations were based on 1980 census data. Thirty-five cities had populations of less than 100,000 under the 1980 census but have populations of 100,000 or more based on the 1990 census. Five cities had populations of more than 100,000 under the 1980 census but have populations of less than 100,000 based on the 1990 census. For the purposes of this Report, these 40 cities are not addressed as Phase I municipalities, unless they have been designated by EPA or an authorized NPDES State as needing a permit as of January 1994.

[5] To account for populations served by combined sewers, 40 *CFR* 122.26(f)(3) allows municipalities to petition EPA or an authorized NPDES State to reduce their population for the purpose of Phase I population determinations.

[6] The specific counties listed in the current NPDES storm water regulations were based on 1980 census data. Thirteen counties had unincorporated, urbanized populations of less than 100,000 under the 1980 census but have unincorporated, urbanized populations of 100,000 or more based on the 1990 census. Two counties had unincorporated, urbanized populations of more than 100,000 under the 1980 census but have unincorporated, urbanized populations of less than 100,000 based on the 1990 census. For the purposes of this Report, these 15 counties are not addressed as Phase I municipalities, unless they have been designated by EPA or an authorized NPDES State as needing a permit.

Table 3-6. Cities With Populations of 100,000 or More Given Exemption Under Phase I of the NPDES Storm Water Regulations Due to Combined Sewers

State	City	City Population	CSO Service Population
California	San Francisco	723,959	723,959
Connecticut	Bridgeport	141,686	50,000
	Hartford	139,739	110,000
	New Haven	130,474	84,300
	Waterbury	108,961	99,947
Illinois	Chicago	2,783,726	2,783,726
	Peoria	113,504	77,000
Indiana	Evansville	126,272	50,425
	Gary	116,646	116,646
	South Bend	105,511	100,000
Massachusetts	Springfield	156,983	156,983
Michigan	Detroit	1,027,974	1,017,880
	Livonia	100,850	100,850
	Lansing	127,321	50,000
Missouri	St. Louis	396,685	396,685
New Jersey	Elizabeth	110,002	107,000
	Jersey City	228,537	223,532
	Newark	275,221	275,221
	Paterson	140,891	140,891
New York	Buffalo	328,123	328,123
	Albany	101,082	96,500
	Rochester	231,636	231,636
	Syracuse	163,860	140,800
	Yonkers	188,082	184,812
Pennsylvania	Pittsburgh	369,879	369,879
	Erie	108,718	108,719
Rhode Island	Providence	160,728	160,728
Virginia	Alexandria	111,183	66,000
	Richmond	203,056	352,775
Washington	Spokane	177,196	135,600
TOTAL		9,198,485	8,840,617

storm water program because they were the primary municipal entity governing unincorporated areas. Because they are the primary municipal entity, these counties are the functional equivalent to an incorporated city for the purposes of a storm water program (i.e., the county generally performs many of the same functions and has the same legal and land use authority as incorporated cities). The 45 counties identified in this manner are located in 17 States, with the majority of the counties (33) being located in 6 States—Florida (9 counties), California (9 counties), Georgia (4 counties), Maryland (4 counties), Virginia (4 counties), and Washington (3 counties).

In 20 States, unincorporated portions of counties or county equivalents are divided into minor civil divisions. The criteria used to define Phase I municipal separate storm sewer systems did not address systems in counties with a population of 100,000 or more in these States, even where the unincorporated portions of the county were heavily urbanized. The Agency did not address such areas under Phase I of the program because of the complexities of the intergovernmental relationship between the county and incorporated places and minor civil divisions.

3.1.2.3 Designated Municipalities

The NPDES regulations authorize EPA or NPDES States to designate additional municipal systems as needing a permit under Phase I of the storm water program.[7] To date, 481 incorporated places and 32 counties have been designated by EPA and authorized NPDES States. These designated municipalities have a combined population of more than 18

[7] Designations can occur under two authorities. 40 *CFR* 122.26(b)(4) and (7) provide that additional municipal separate storm sewers may be designated as part of a system serving a population of 100,000 or more because of the interrelationship between the discharges of the designated storm sewers and the discharges from municipal separate storm sewers located in an incorporated place with a population of 100,000 or more or a county with an urbanized, unincorporated population of 100,000 or more. Additional municipal separate storm sewers within a region defined by a storm water management regional authority can be designated based on a jurisdictional, watershed, or other appropriate basis that includes an incorporated place with a population of 100,000 or more or a county with an urbanized, unincorporated population of 100,000 or more. Section 402(p)(2)(E) of the CWA provides that storm water discharges, including discharges from municipal separate storm sewer systems, that are a significant contributor of pollutants to waters of the United States or that have contributed to a violation of a water quality standard can be designated as needing a permit.

million. The majority of the designations (464 incorporated places and 28 counties) are in eight States (Alabama, California, Delaware, Florida, Georgia, Maryland, Oregon, and Tennessee). Municipalities have been designated as part of the Phase I NPDES storm water program in seven other States.

3.1.3 Identification of Potential Phase II Municipal Systems

Municipal separate storm sewer systems that are potentially subject to requirements under Phase II of the NPDES storm water program will be identified in terms of the following classes:

- Municipalities not addressed by Phase I, but located in an urbanized area with one or more Phase I municipalities
- Municipalities associated with an urbanized area without a Phase I municipality
- Urban populations outside of urbanized areas
- Rural populations
- Populations not addressed in the census.

3.1.3.1 Potential Phase II Municipalities Associated With Urbanized Areas With One or More Phase I Municipalities

Of the 405 urbanized areas designated by the Bureau of the Census, 136 have one or more municipalities with a separate storm sewer system addressed by Phase I of the NPDES storm water program. In most of these 136 urbanized areas, municipalities not addressed under Phase I are also found in the urbanized area. Table 3-7 lists the 136 urbanized areas with one or more Phase I municipalities. Table 3-8 summarizes the number of municipalities associated with different sizes of urbanized areas with a municipality with separate storm sewers subject to Phase I of the storm water program. Note that some urbanized areas cross state lines and are listed in the table in multiple states. In those cases, the portion of the urbanized area in each state is listed, rather than the total population within the urbanized area.

Table 3-7. Urbanized Areas With One or More Municipality in Phase I of the NPDES Storm Water Program

State	Urbanized Area	Total Population	Phase I Population	No. of Incorporated Places	No. of Minor Civil Divisions	No. of Counties
AK	Anchorage, AK	221,883	221,883	1	0	1
AL	Birmingham, AL	622,774	577,979	25	0	2
	Columbus, GA—AL	32,288	0	1	0	2
	Huntsville, AL	180,315	173,623	2	0	1
	Mobile, AL	300,912	255,494	6	0	1
	Montgomery, AL	210,007	187,106	2	0	3
AR	Little Rock—North Little Rock, AR	305,353	175,795	7	0	2
	Memphis, TN—AR—MS	34,600	0	3	0	1
AZ	Phoenix, AZ	2,006,239	1,410,951	15	0	2
	Tucson, AZ	579,235	567,493	3	0	1
CA	Antioch—Pittsburg, CA	153,768	146,205	3	0	1
	Bakersfield, CA	302,605	302,605	1	0	1
	Fairfield, CA	99,964	99,897	2	0	1
	Fresno, CA	453,388	403,065	2	0	1
	Hemet—San Jacinto, CA	90,929	90,929	2	0	1
	Hesperia—Apple Valley—Victorville, CA	153,176	66,646	3	0	1
	Indio—Coachella, CA	56,038	2,624	2	0	1
	Lancaster—Palmdale, CA	187,190	21,990	2	0	1
	Los Angeles, CA	11,402,946	11,402,946	115	0	4
	Modesto, CA	230,609	164,730	2	0	1
	Oxnard—Ventura, CA	480,482	387,907	7	0	2
	Palm Springs, CA	129,025	13,200	6	0	1
	Riverside—San Bernardino, CA	1,170,196	1,170,196	13	0	2
	Sacramento, CA	1,097,005	100,4620	5	0	3
	Salinas, CA	122,225	108,777	1	0	1
	San Diego, CA	2,348,417	2,348,417	18	0	1
	San Francisco—Oakland, CA	3,629,516	2,644,467	63	0	7
	San Jose, CA	1,435,019	1,411,091	14	0	1
	Simi Valley, CA	128,043	128,043	2	0	1
	Stockton, CA	262,046	210,943	1	0	1
CO	Colorado Springs, CO	352,989	280,995	3	0	1
	Denver, CO	1,517,977	918,955	23	0	7
	Pueblo, CO	106,155	98,640	1	0	1
CT	Stamford, CT—NY	187,180	108,056	1	4	1
	Worcester, MA—CT	555	0	0	1	1
DC	Washington, DC—MD—VA	606,900	606,900	1	0	1
DE	Wilmington, DE—NJ—MD—PA	407,962	407,962	9	0	1
FL	Fort Lauderdale—Hollywood—Pompano Beach, FL	1,238,134	1,183,036	27	0	1
	Fort Myers—Cape Coral, FL	220,552	102,337	2	0	1
	Jacksonville, FL	738,413	627,128	6	0	3
	Lakeland, FL	147,628	147,628	2	0	1
	Miami—Hialeah, FL	1,914,660	1,902,397	25	0	1
	Orlando, FL	887,126	746,006	17	0	2
	Pensacola, FL	253,558	225,628	2	0	2
	Sarasota—Bradenton, FL	444,385	375,194	8	0	3
	Spring Hill, FL	52,056	3,463	1	0	2
	Tallahassee, FL	155,884	124,773	1	0	1

Table 3-7. Urbanized Areas With One or More Municipality in Phase I of the NPDES Storm Water Program (continued)

State	Urbanized Area	Total Population	Phase I Population	No. of Incorporated Places	No. of Minor Civil Divisions	No. of Counties
FL	Tampa—St.Petersburg—Clearwater, FL	1,708,710	1,680,343	28	0	3
	West Palm Beach—Boca Raton—Delray Beach, FL	794,848	791,286	34	0	2
	Winter Haven, FL	86,427	86,427	4	0	1
GA	Atlanta, GA	2,157,806	2,031,973	38	0	11
	Augusta, GA—SC	217,002	151,214	2	0	2
	Chattanooga, TN—GA	46,194	0	4	0	3
	Columbus, GA—AL	188,410	173,196	2	0	2
	Macon, GA	129,496	125,952	2	0	2
	Savannah, GA	198,630	194,888	7	0	1
HI	Honolulu, HI	632,603	632,603	0	0	1
	Kailua, HI	114,506	114,506	0	0	1
IA	Cedar Rapids, IA	136,190	108,751	4	0	1
	Davenport—Rock Island—Moline, IA—IL	128,950	94,942	6	0	1
	Des Moines, IA	293,666	193,187	9	0	3
	Omaha, NE—IA	59,890	0	2	0	1
ID	Boise City, ID	167,941	132,107	2	0	1
IL	Davenport—Rock Island—Moline, IA—IL	135,068	0	11	10	2
	Rockford, IL	207,826	139,426	5	5	1
IN	Fort Wayne, IN	248,424	173,072	2	9	1
	Indianapolis, IN	914,761	731,327	24	20	6
	Louisville, KY—IN	100,159	0	4	5	2
KS	Kansas City, MO—KS	480,249	149,767	17	3	2
	Topeka, KS	132,711	119,883	1	5	1
	Wichita, KS	338,789	304,011	6	10	1
KY	Cincinnati, OH—KY	236,349	0	33	0	3
	Lexington-Fayette, KY	220,701	218,925	1	0	2
	Louisville, KY—IN	654,797	508,493	97	0	2
LA	Baton Rouge, LA	365,943	322,070	5	0	3
	New Orleans, LA	1,040,226	938,384	5	0	5
	Shreveport, LA	256,489	198,525	2	0	2
MA	Boston, MA	2,775,370	574,283	19	76	7
	Lowell, MA-NH	180,716	103,439	1	8	1
	Worcester, MA—CT	315,111	169,759	1	18	1
MD	Annapolis, MD	78,590	78,488	2	0	1
	Baltimore, MD	1,889,873	1,889,873	2	0	5
	Frederick, MD	58,393	14,100	2	0	1
	Hagerstown, MD—PA—WV	68,226	28,321	4	0	1
	Washington, DC—MD—VA	1,420,999	1,169,907	39	0	4
	Wilmington, DE—NJ—MD—PA	13,732	0	1	0	1
MI	Ann Arbor, MI	222,061	109,592	3	7	2
	Detroit, MI	3,697,529	262,674	76	33	5
	Flint, MI	326,023	140,761	8	12	1
	Grand Rapids, MI	436,336	189,126	7	8	2
	Toledo, OH—MI	18,817	0	0	3	1
MN	Minneapolis—St.Paul, MN	2,079,676	640,618	92	3	8

Table 3-7. Urbanized Areas With One or More Municipality in Phase I of the NPDES Storm Water Program (continued)

State	Urbanized Area	Total Population	Phase I Population	No. of Incorporated Places	No. of Minor Civil Divisions	No. of Counties
MO	Kansas City, MO—KS	795,068	545,197	31	20	4
	Springfield, MO	159,086	140,494	2	9	2
MS	Jackson, MS	289,285	196,637	8	0	3
	Memphis, TN—AR—MS	29,341	0	2	0	1
NC	Charlotte, NC	455,597	395,934	6	0	2
	Durham, NC	205,355	136,611	3	0	2
	Fayetteville, NC	241,763	222,522	3	0	2
	Greensboro, NC	194,508	183,521	1	0	1
	Raleigh, NC	305,925	207,951	4	0	1
	Winston-Salem, NC	185,184	143,485	4	0	2
NE	Lincoln, NE	192,558	191,972	1	0	1
	Omaha, NE—IA	484,402	335,795	6	0	2
NH	Lowell, MA-NH	935	0	0	1	1
NJ	Allentown—Bethlehem—Easton, PA—NJ	24,817	0	2	2	1
	New York, NY—Northeastern New Jersey	5,113,880	0	192	96	12
	Philadelphia, PA—NJ	944,875	0	43	37	3
	Wilmington, DE—NJ—MD—PA	26,043	0	1	2	1
NM	Albuquerque, NM	497,120	384,736	4	0	2
	El Paso, TX—NM	8,179	0	1	0	1
NV	Las Vegas, NV	697,348	697,348	3	0	1
	Reno, NV	213,747	213,747	2	0	1
NY	New York, NY—Northeastern New Jersey	10,930,132	7,322,564	125	36	10
	Stamford, CT—NY	20	0	0	1	1
OH	Akron, OH	527,863	223,019	20	14	5
	Cincinnati, OH—KY	976,326	364,040	40	20	4
	Cleveland, OH	1,677,492	505,616	76	16	7
	Columbus, OH	945,237	632,910	24	24	5
	Dayton, OH	613,467	182,044	17	16	4
	Toledo, OH—MI	470,338	332,943	12	7	3
OK	Oklahoma City, OK	784,425	438,922	23	0	5
	Tulsa, OK	474,668	367,302	6	0	5
OR	Eugene—Springfield, OR	189,192	112,669	2	0	1
	Portland—Vancouver, OR—WA	1,004,676	978,531	22	0	3
	Salem, OR	157,079	94,983	2	0	2
PA	Allentown—Bethlehem—Easton, PA—NJ	385,619	105,090	18	18	2
	Hagerstown, MD—PA—WV	1,212	0	0	1	1
	Philadelphia, PA—NJ	3,277,336	1,585,577	67	84	5
	Wilmington, DE—NJ—MD—PA	1,879	0	0	4	2
SC	Augusta, GA—SC	69,536	0	3	0	2
	Columbia, SC	328,349	130,589	9	0	2
	Greenville, SC	248,173	147,464	6	0	3
SD	Sioux Falls, SD	100,843	100,814	1	3	2
TN	Chattanooga, TN—GA	250,761	152,466	9	0	1
	Knoxville, TN	304,466	165,121	5	0	4
	Memphis, TN—AR—MS	761,252	637,326	3	0	1
	Nashville, TN	573,294	508,828	10	0	4

Table 3-7. Urbanized Areas With One or More Municipality in Phase I of the NPDES Storm Water Program (continued)

State	Urbanized Area	Total Population	Phase I Population	No. of Incorporated Places	No. of Minor Civil Divisions	No. of Counties
TX	Abilene, TX	107,836	106,654	3	0	2
	Amarillo, TX	157,934	157,615	1	0	2
	Austin, TX	562,008	465,622	7	0	2
	Beaumont, TX	122,841	114,323	3	0	2
	Corpus Christi, TX	270,006	257,453	2	0	3
	Dallas—Fort Worth, TX	3,198,259	2,493,364	56	0	9
	El Paso, TX—NM	562,838	515,187	3	0	1
	Houston, TX	2,901,851	2,468,419	34	0	7
	Laredo, TX	123,651	122,899	1	0	1
	Lubbock, TX	187,906	186,206	1	0	1
	San Antonio, TX	1,129,154	935,933	18	0	3
	Waco, TX	144,372	103,590	8	0	1
UT	Salt Lake City, UT	789,447	430,716	16	0	2
VA	Norfolk—Virginia Beach—Newport News, VA	1,323,098	1,204,925	10	0	12
	Petersburg, VA	103,526	12,115	3	0	6
	Richmond, VA	589,980	363,740	1	0	4
	Roanoke, VA	178,277	96,397	3	0	5
	Washington, DC—MD—VA	1,335,132	1,088,797	8	0	9
WA	Portland—Vancouver, OR—WA	167,482	0	1	0	1
	Seattle, WA	1,744,086	1,193,945	30	0	3
	Tacoma, WA	497,210	435,194	11	0	2
WI	Madison, WI	244,336	191,262	7	6	1
	Milwaukee, WI	1,226,293	628,088	35	11	5
WV	Hagerstown, MD—PA—WV	768	0	0	0	1

Table 3-8. Municipalities in Urbanized Areas With One or More Phase I Municipalities

Urbanized Area Population	Number of Urbanized Areas	Phase I Municipalities			Portions of Urbanized Areas Not in Phase I				
		Incorp. Places	Counties	Phase I Population	Incorp. Places	Minor Civil Divisions	Counties	Phase II Population	Total Population
50,000 - 74,999	4	0	4	48,508	9	1	3	188,185	236,693
75,000 - 99,999	4	9	2	355,741	1	0	1	169	355,910
100,000 - 124,999	8	6	2	778,728	7	3	14	122,855	901,583
125,000 - 149,999	7	8	2	747,047	17	5	4	200,418	947,465
150,000 - 249,999	32	37	9	4,780,942	45	50	44	1,542,672	6,323,614
Over 250,000	81	504	53	75,004,440	1,508	575	239	33,650,057	108,654,497
TOTALS	136	564	72	81,715,406	1,587	634	305	35,704,356	117,419,762

The 136 urbanized areas with one or more municipality with a separate storm sewer system addressed by Phase I have a total population of 117.5 million (47 percent of the total U.S. population). The portions of these urbanized areas currently not addressed by Phase I of the NPDES storm water program have a combined population of 35.7 million people. Of the 35.7 million people, 32.9 million people live in 1,587 incorporated places and 634 minor civil divisions. The remaining 2.9 million people live in unincorporated areas. EPA estimates that 305 counties currently not addressed by Phase I of the NPDES storm water program are part of an urbanized area in which one or more municipalities are in Phase I.

Two general patterns of municipal governments can be used to describe the 136 urbanized areas that have one or more Phase I municipalities. Most of the 136 urbanized areas can be described as having a large core city with a population of 100,000 that is addressed by Phase I of the program, with a large number of smaller potential Phase II incorporated places and minor civil divisions surrounding the core city. Figure 3-3 provides an example of this pattern, which illustrates the Milwaukee, Wisconsin, urbanized area.

The second pattern of municipal government for the 136 urbanized areas consists of counties that do not have minor civil divisions. Urbanized areas that follow this pattern are comprised of a core city (which is usually addressed by Phase I) surrounded by a combination of unincorporated portions of counties and incorporated places. In urbanized areas that follow this pattern, unincorporated portions of one or more of the counties surrounding the core city may be in Phase I, while the smaller incorporated places surrounding the core city are generally not addressed by Phase I. Figure 3-4 gives an example of this pattern, which illustrates the Washington, D.C., urbanized area. Figure 3-4 also shows that Phase I jurisdiction for this urbanized area generally extends beyond the 1990 boundaries of the urbanized area. In this manner, Phase I addresses much of the new development associated with the expanding urbanized population, even though it occurs outside of the 1990 urbanized area boundary.

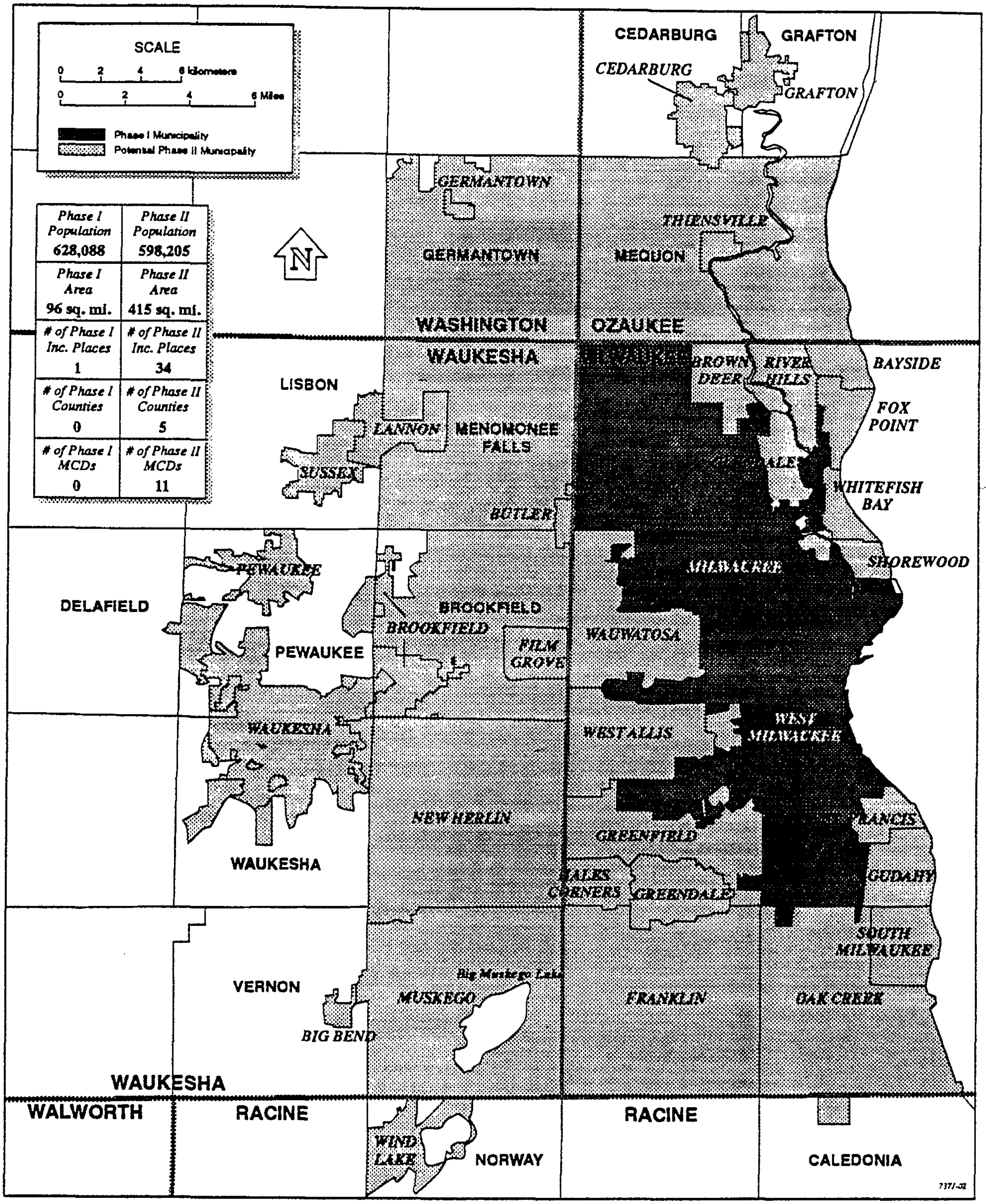
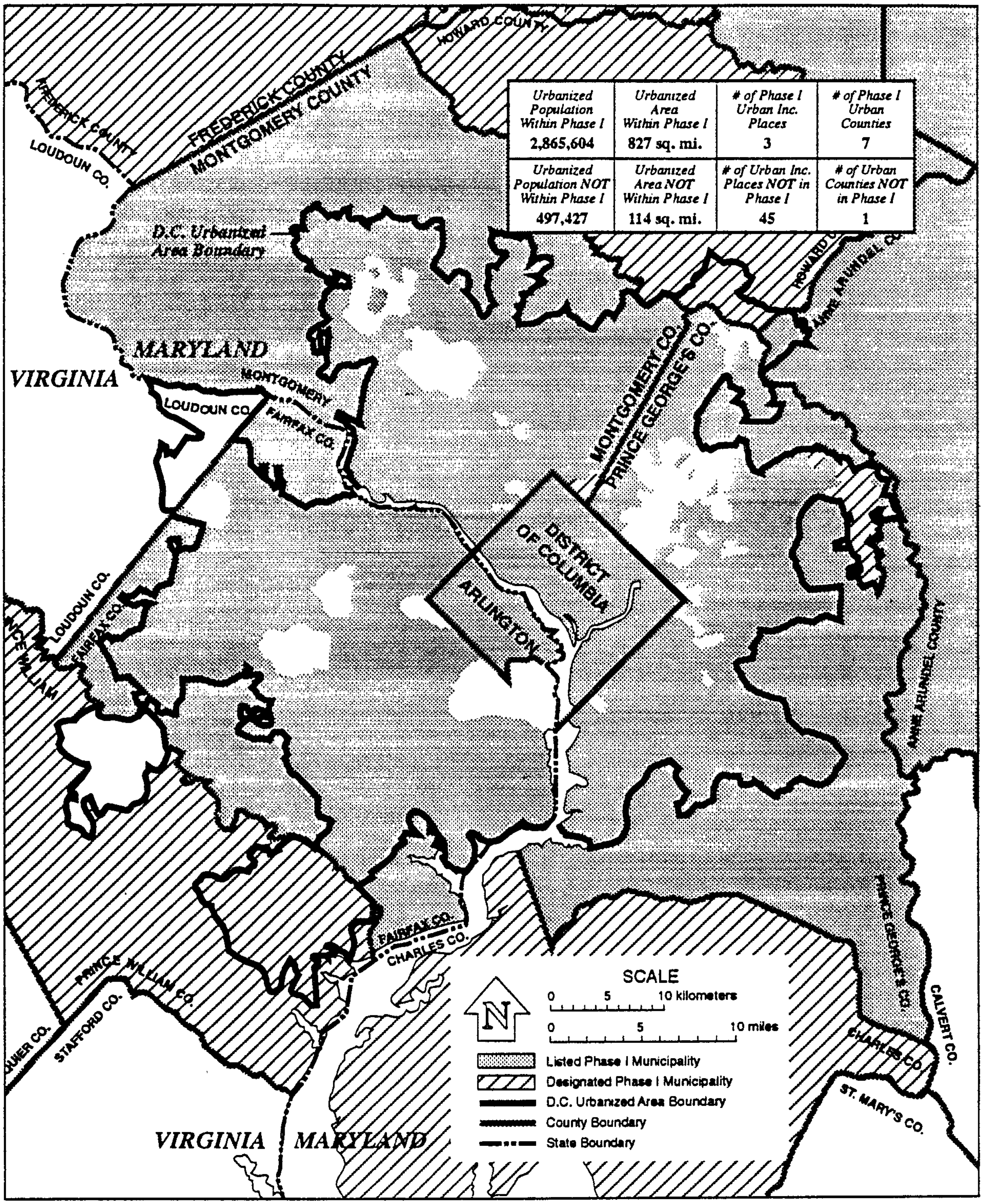


Figure 3-3. Phase I and Phase II Portions of Milwaukee, Wisconsin, Urbanized Area



Urbanized Population Within Phase I	Urbanized Area Within Phase I	# of Phase I Urban Inc. Places	# of Phase I Urban Counties
2,865,604	827 sq. mi.	3	7
Urbanized Population NOT Within Phase I	*Urbanized Area NOT Within Phase I*	*# of Urban Inc. Places NOT in Phase I*	*# of Urban Counties NOT in Phase I*
497,427	114 sq. mi.	45	1

Figure 3-4. Phase I and Phase II Portions of Washington, DC, Urbanized Area

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3.1.3.2 Potential Phase II Municipalities Associated With Urbanized Areas Without a Phase I Municipality

A total of 269 of the Census-designated urbanized areas currently do not have any municipalities with separate storm sewers subject to Phase I of the storm water program. Table 3-9 lists these urbanized areas. As in Table 3-7, note that some urbanized areas cross state lines and are listed in the table in multiple states along with the portion of the population in that state. Table 3-10 summarizes the population and number of municipalities associated with different classes of urbanized areas without a municipality with separate storm sewers subject to Phase I of the storm water program. Of the 269 urbanized areas, 101 (more than a third) have a population of more than 100,000 and 23 have a population of more than 250,000. These 269 urbanized areas without a Phase I municipal separate storm sewer system have a combined population of 42.9 million people (16 percent of the total U.S. population). Of the 42.9 million people, 37.1 million people live in 1,470 incorporated places and 966 minor civil divisions. The remaining 5.8 million people live in unincorporated areas. EPA estimates that 380 counties that are part of an urbanized area do not have a municipality addressed by Phase I of the NPDES storm water program.

Twenty-one urbanized areas have an incorporated city with a population of 100,000 or more that are not subject to Phase I of the NPDES storm water program because of populations served by combined sewers. Table 3-11 lists these urbanized areas. The 21 urbanized areas have a combined population of 17.5 million people, of which an estimated 11.7 million people are served by separate storm sewers. Three of these urbanized areas (i.e., Chicago, St. Louis, and Pittsburgh) have populations of more than a million people that are served by separate storm sewers. Of the remaining urbanized areas, 10 have a population of more than 250,000 and 7 have a population of more than 175,000, but less than 250,000. Of the 17.5 million people that live in the 21 urbanized areas, 6.0 million people live in cities with a population of 100,000 or more.

Table 3-9. List of Urbanized Areas Not Associated With a Phase I Municipality

State	Urbanized Area	Total Population	No. of Incorporated Places	No. of Minor Civil Divisions	No. of Counties
AL	Anniston, AL	68,150	5	0	2
	Auburn—Opelika, AL	56,510	2	0	1
	Decatur, AL	63,541	4	0	2
	Dothan, AL	58,925	5	0	2
	Florence, AL	69,186	4	0	2
	Gadsden, AL	71,630	6	0	2
	Tuscaloosa, AL	106,428	2	0	1
AR	Fayetteville—Springdale, AR	74,880	5	0	2
	Fort Smith, AR—OK	91,870	3	0	2
	Pine Bluff, AR	61,941	2	0	1
	Texarkana, TX—Texarkana, AR	22,776	1	0	1
AZ	Yuma, AZ-CA	70,523	1	0	1
CA	Chico, CA	71,831	1	0	1
	Davis, CA	52,711	1	0	1
	Lodi, CA	55,590	1	0	1
	Lompoc, CA	56,591	1	0	1
	Merced, CA	64,742	1	0	1
	Napa, CA	68,049	1	0	1
	Redding, CA	78,364	1	0	1
	San Luis Obispo, CA	50,305	1	0	1
	Santa Barbara, CA	182,163	2	0	1
	Santa Cruz, CA	152,355	3	0	1
	Santa Maria, CA	88,989	1	0	1
	Santa Rosa, CA	194,560	3	0	1
	Seaside—Monterey, CA	133,188	7	0	1
	Vacaville, CA	71,535	1	0	1
	Visalia, CA	83,594	1	0	1
	Watsonville, CA	51,378	1	0	2
	Yuba City, CA	77,167	2	0	2
	Yuma, AZ—CA	432	0	0	1
CO	Boulder, CO	98,910	1	0	1
	Fort Collins, CO	105,809	1	0	1
	Grand Junction, CO	71,938	1	0	1
	Greeley, CO	71,578	4	0	1
	Longmont, CO	52,464	1	0	1
CT	Bridgeport—Milford, CT	413,863	6	14	2
	Bristol, CT	92,418	1	7	3
	Danbury, CT—NY	112,647	1	7	2
	Hartford—Middletown, CT	546,198	2	19	3
	New Britain, CT	143,064	1	5	1
	New Haven—Meriden, CT	451,486	3	16	3
	New London—Norwich, CT	156,286	3	13	1
	Norwalk, CT	108,888	1	5	1
	Springfield, MA—CT	68,045	0	6	2
	Waterbury, CT	175,067	2	8	2
DE	Dover, DE	50,787	3	0	1
FL	Daytona Beach, FL	221,341	9	0	1
	Deltona, FL	58,053	0	0	1
	Fort Pierce, FL	126,342	3	0	1
	Fort Walton Beach, FL	112,522	7	0	3

Table 3-9. List of Urbanized Areas Not Associated With a Phase I Municipality (continued)

State	Urbanized Area	Total Population	No. of Incorporated Places	No. of Minor Civil Divisions	No. of Counties
FL	Gainesville, FL	126,215	1	0	1
	Kissimmee, FL	55,419	1	0	1
	Melbourne—Palm Bay, FL	305,978	13	0	1
	Naples, FL	94,344	1	0	1
	Ocala, FL	68,004	1	0	1
	Panama City, FL	103,667	6	0	1
	Punta Gorda, FL	67,033	1	0	1
	Stuart, FL	80,069	3	0	2
	Titusville, FL	51,549	1	0	1
	Vero Beach, FL	64,707	2	0	1
GA	Albany, GA	87,223	1	0	2
	Athens, GA	73,282	2	0	2
	Brunswick, GA	50,066	1	0	1
	Rome, GA	51,589	1	0	1
	Warner Robins, GA	60,976	2	0	1
IA	Dubuque, IA—IL	61,048	2	0	1
	Iowa City, IA	71,372	3	0	1
	Sioux City, IA—NE—SD	83,277	2	0	1
	Waterloo—Cedar Falls, IA	108,260	5	0	1
ID	Idaho Falls, ID	56,356	3	0	1
	Pocatello, ID	53,903	2	0	2
IL	Alton, IL	86,236	7	8	1
	Aurora, IL	192,043	7	10	3
	Beloit, WI—IL	13,371	3	3	1
	Bloomington—Normal, IL	94,186	2	4	1
	Champaign—Urbana, IL	115,524	3	7	1
	Chicago, IL—Northwestern Indiana	6,301,112	179	61	5
	Crystal Lake, IL	72,498	7	6	3
	Decatur, IL	96,039	4	8	1
	Dubuque, IA—IL	2,657	1	1	1
	Elgin, IL	123,899	7	6	2
	Joliet, IL	170,717	8	9	1
	Kankakee, IL	59,695	4	5	1
	Peoria, IL	242,353	12	16	3
	Round Lake Beach—McHenry, IL—WI	112,640	14	10	2
	Saint Louis, MO-IL	328,299	26	19	3
	Springfield, IL	124,524	5	7	1
IN	Anderson, IN	74,037	7	7	2
	Bloomington, IN	71,440	1	4	1
	Chicago, IL—Northwestern Indiana	490,975	19	12	2
	Elkhart—Goshen, IN	98,787	2	6	1
	Evansville, IN—KY	156,570	2	7	2
	Kokomo, IN	57,146	1	5	1
	Lafayette—West Lafayette, IN	100,103	2	6	1
	Muncie, IN	88,073	3	5	1
	South Bend—Mishawaka, IN—MI	215,182	5	9	2
	Terre Haute, IN	77,019	3	6	1

Table 3-9. List of Urbanized Areas Not Associated With a Phase I Municipality (continued)

State	Urbanized Area	Total Population	No. of Incorporated Places	No. of Minor Civil Divisions	No. of Counties
KS	Lawrence, KS	65,755	1	1	1
	St. Joseph, MO—KS	1,100	1	1	1
KY	Clarksville, TN—KY	21,724	1	0	1
	Evansville, IN—KY	26,517	1	0	1
	Huntington—Ashland, WV—KY—OH	56,122	8	0	2
	Owensboro, KY	60,645	1	0	1
LA	Alexandria, LA	86,001	3	0	1
	Houma, LA	65,879	1	0	2
	Lafayette, LA	129,592	4	0	1
	Lake Charles, LA	119,067	3	0	1
	Monroe, LA	110,737	3	0	1
	Slidell, LA	54,084	1	0	1
MA	Brockton, MA	160,910	1	9	3
	Fall River, MA—RI	126,508	1	4	1
	Fitchburg—Leominster, MA	82,249	2	2	1
	Hyannis, MA	66,713	0	5	1
	Lawrence—Haverhill, MA—NH	212,000	2	7	1
	New Bedford, MA	139,082	1	3	1
	Pittsfield, MA	55,047	1	3	1
	Providence—Pawtucket, RI—MA	93,090	1	10	3
	Springfield, MA—CT	464,702	5	14	2
	Taunton, MA	58,884	1	3	1
MD	Cumberland, MD—WV	51,648	2	0	1
ME	Bangor, ME	61,402	3	2	1
	Lewiston—Auburn, ME	71,598	2	2	1
	Portland, ME	120,220	3	4	1
	Portsmouth—Dover—Rochester, NH—ME	13,512	0	5	1
MI	Battle Creek, MI	77,921	2	4	2
	Bay City, MI	74,118	2	5	1
	Benton Harbor, MI	57,744	4	4	1
	Holland, MI	62,418	2	4	2
	Jackson, MI	78,126	1	4	1
	Kalamazoo, MI	164,430	3	7	1
	Lansing—East Lansing, MI	265,095	2	7	3
	Muskegon, MI	106,252	5	5	1
	Port Huron, MI	62,774	3	7	1
	Saginaw, MI	140,079	2	8	1
	South Bend—Mishawaka, IN—MI	22,750	1	3	2
MN	Duluth, MN—WI	95,356	3	1	1
	Fargo—Moorhead, ND—MN	34,923	2	2	1
	Grand Forks, ND—MN	8,658	1	0	1
	LaCrosse, WI—MN	4,725	1	1	1
	Rochester, MN	73,560	1	3	1
	St. Cloud, MN	74,037	4	5	3
MO	Columbia, MO	75,854	1	4	1
	Joplin, MO	60,208	15	5	2
	St. Joseph, MO—KS	74,295	2	4	2
	St. Louis, MO—IL	1,618,227	95	39	4

Table 3-9. List of Urbanized Areas Not Associated With a Phase I Municipality (continued)

State	Urbanized Area	Total Population	No. of Incorporated Places	No. of Minor Civil Divisions	No. of Counties
MS	Biloxi—Gulfport, MS	179,643	8	0	3
	Hattiesburg, MS	59,757	2	0	2
	Pascagoula, MS	59,386	3	0	1
MT	Billings, MT	88,181	1	0	1
	Great Falls, MT	63,506	1	0	1
	Missoula, MT	57,196	1	0	1
NC	Asheville, NC	110,429	7	0	2
	Burlington, NC	74,053	6	0	3
	Gastonia, NC	113,637	9	0	1
	Goldsboro, NC	60,230	1	0	1
	Greenville,NC	55,884	2	0	1
	Hickory, NC	69,914	6	0	2
	High Point, NC	108,686	4	0	4
	Jacksonville, NC	101,297	1	0	1
	Kannapolis, NC	78,177	4	0	2
	Rocky Mount, NC	50,870	1	0	2
	Wilmington, NC	101,357	4	0	2
ND	Bismarck, ND	66,476	3	2	2
	Fargo—Moorhead, ND—MN	86,413	2	2	1
	Grand Forks, ND—MN	49,445	1	1	1
NE	Sioux City, IA—NE—SD	10,915	1	0	1
NH	Lawrence—Haverhill, MA—NH	25,362	0	3	1
	Lowell, MA—NH	935	0	1	1
	Manchester, NH	114,918	1	6	3
	Nashua, NH	96,791	1	5	1
	Portsmouth—Dover—Rochester, NH—ME	101,448	4	6	2
NJ	Atlantic City, NJ	169,993	11	3	2
	Trenton, NJ—PA	255,696	4	7	2
	Vineland—Millville, NJ	94,236	4	5	4
NM	Las Cruces, NM	81,471	2	0	1
	Santa Fe, NM	63,023	1	0	1
NY	Albany—Schenectady—Troy, NY	509,106	11	19	4
	Binghamton, NY	158,405	4	10	2
	Buffalo—Niagara Falls, NY	954,332	14	16	2
	Danbury, CT—NY	3,593	0	1	1
	Elmira, NY	66,612	3	6	1
	Glens Falls, NY	56,475	4	4	3
	Ithaca, NY	50,132	3	3	1
	Newburgh, NY	71,584	2	4	1
	Poughkeepsie, NY	148,527	4	8	2
	Rochester, NY	619,653	6	12	1
	Syracuse, NY	388,918	11	12	2
	Utica—Rome, NY	158,553	9	11	2
OH	Canton, OH	244,576	6	8	1
	Hamilton, OH	118,315	4	7	2
	Huntington—Ashland, WV—KY—OH	33,791	6	6	1
	Lima, OH	68,621	3	5	2
	Lorain—Elyria, OH	224,087	10	8	2

Table 3-9. List of Urbanized Areas Not Associated With a Phase I Municipality (continued)

State	Urbanized Area	Total Population	No. of Incorporated Places	No. of Minor Civil Divisions	No. of Counties
OH	Mansfield, OH	76,521	3	5	1
	Middletown, OH	98,822	6	8	3
	Newark, OH	54,063	2	5	1
	Parkersburg, WV—OH	6,840	1	1	1
	Sharon, PA—OH	6,229	0	2	1
	Springfield, OH	88,649	1	3	1
	Steubenville—Weirton, OH—WV—PA	38,855	4	4	1
	Wheeling, WV—OH	25,255	5	4	1
	Youngstown—Warren, OH	361,627	12	13	2
OK	Fort Smith, AR—OK	2,616	2	0	2
	Lawton, OK	92,634	1	0	1
OR	Longview, WA—OR	2,138	1	0	1
	Medford, OR	66,974	3	0	1
PA	Altoona, PA	76,551	3	6	1
	Erie, PA	177,668	2	6	1
	Harrisburg, PA	292,904	17	16	5
	Johnstown, PA	77,841	14	10	2
	Lancaster, PA	193,583	7	13	2
	Monessen, PA	65,072	20	6	3
	Pittsburgh, PA	1,678,745	136	73	5
	Pottstown, PA	53,371	2	8	3
	Reading, PA	186,267	16	12	1
	Scranton—Wilkes-Barre, PA	388,225	44	19	2
	Sharon, PA—OH	46,587	6	2	1
	State College, PA	61,239	1	4	1
	Steubenville—Weirton, OH—WV—PA	392	0	1	1
	Trenton, NJ—PA	42,906	2	3	1
	Williamsport, PA	57,425	4	5	1
	York, PA	142,675	11	10	1
PR[1]	Aquadilla, PR	99,936			
	Arecibo, PR	88,967			
	Caguas, PR	190,922			
	Cayey, PR	53,945			
	Humacao, PR	57,144			
	Mayaguez, PR	110,904			
	Ponce, PR	190,079			
	San Juan, PR	1,221,086			
	Vega Baja-Manatil, PR	112,272			
RI	Fall River, MA—RI	17,850	0	2	1
	Newport, RI	53,481	1	3	1
	Providence—Pawtucket, RI—MA	753,203	7	17	4
SC	Anderson, SC	52,492	1	0	1
	Charleston, SC	393,956	10	0	3
	Florence, SC	54,659	2	0	2
	Myrtle Beach, SC	58,384	2	0	2
	Rock Hill, SC	58,757	2	0	1
	Spartanburg, SC	104,801	2	0	1
	Sumter, SC	57,632	1	0	1

Table 3-9. List of Urbanized Areas Not Associated With a Phase I Municipality (continued)

State	Urbanized Area	Total Population	No. of Incorporated Places	No. of Minor Civil Divisions	No. of Counties
SD	Rapid City, SD	61,124	1	0	1
	Sioux City, IA—NE—SD	2,019	1	1	1
TN	Bristol, TN—Bristol, VA	33,790	1	0	1
	Clarksville, TN—KY	75,857	1	0	1
	Jackson, TN	53,031	1	0	1
	Johnson City, TN	82,382	3	0	3
	Kingsport, TN—VA	83,174	3	0	3
TX	Brownsville, TX	117,676	1	0	1
	Bryan—College Station, TX	107,599	2	0	1
	Denton, TX	66,445	1	0	1
	Galveston, TX	58,263	1	0	1
	Harlingen, TX	79,309	5	0	1
	Killeen, TX	137,876	4	0	3
	Lewisville, TX	79,433	7	0	3
	Longview, TX	76,429	2	0	2
	McAllen—Edinburg—Mission, TX	263,192	9	0	1
	Midland, TX	91,999	1	0	2
	Odessa, TX	113,672	1	0	2
	Port Arthur, TX	109,560	4	0	1
	San Angelo, TX	85,408	1	0	1
	Sherman—Denison, TX	55,522	3	0	1
	Temple, TX	58,710	2	0	1
	Texarkana, TX—Texarkana, AR	42,310	3	0	1
	Texas City, TX	128,211	9	0	2
	Tyler, TX	79,703	1	0	1
	Victoria, TX	55,122	1	0	1
	Wichita Falls, TX	97,151	2	0	2
UT	Logan, UT	50,401	7	0	1
	Ogden, UT	259,147	20	0	2
	Provo—Orem, UT	220,556	10	0	1
VA	Bristol, TN—Bristol, VA	18,773	1	0	2
	Charlottesville, VA	67,553	1	0	2
	Danville, VA	54,315	1	0	2
	Fredericksburg, VA	56,718	1	0	3
	Kingsport, TN—VA	4,229	2	0	1
	Lynchburg, VA	98,138	1	0	4
VT	Burlington, VT	87,088	4	4	1
WA	Bellingham, WA	59,317	1	0	1
	Bremerton, WA	112,977	2	0	1
	Longview, WA—OR	54,985	2	0	1
	Olympia, WA	95,471	3	0	1
	Richland—Kennewick—Pasco, WA	116,118	4	0	2
	Spokane, WA	279,038	2	0	1
	Yakima, WA	88,054	3	0	1
WI	Appleton—Neenah, WI	160,918	7	8	3
	Beloit, WI—IL	42,705	1	3	1
	Duluth, MN—WI	27,615	2	0	1
	Eau Claire, WI	80,293	3	7	2

Table 3-9. List of Urbanized Areas Not Associated With a Phase I Municipality (continued)

State	Urbanized Area	Total Population	No. of Incorporated Places	No. of Minor Civil Divisions	No. of Counties
WI	Green Bay, WI	161,931	5	4	1
	Janesville, WI	52,995	1	3	1
	Kenosha, WI	94,292	2	2	1
	LaCrosse, WI—MN	74,203	3	4	1
	Oshkosh, WI	58,935	1	4	1
	Racine, WI	121,788	5	2	1
	Round Lake Beach—McHenry, IL—WI	53	0	1	1
	Sheboygan, WI	61,012	3	4	1
	Wausau, WI	57,352	3	3	1
WV	Charleston, WV	164,418	14	0	3
	Cumberland, MD—WV	3,007	1	0	1
	Huntington—Ashland, WV—KY—OH	79,681	4	0	2
	Parkersburg, WV—OH	51,843	3	0	1
	Steubenville—Weirton, OH—WV—PA	29,871	2	0	2
	Wheeling, WV—OH	59,252	8	0	2
WY	Casper, WY	52,248	3	0	1
	Cheyenne, WY	61,890	1	0	1

[1] Puerto Rico does not use the designations of "incorporated place," "minor civil division," or "county" for any of its municipalities; therefore the table has been left intentionally blank under these headings.

Table 3-10. Urbanized Areas Without a Municipality in Phase I of the NPDES Storm Water Program

Urbanized Area Population	Number of Urbanized Areas	Incorp. Places	Minor Civil Divisions	Counties	Total Population
50,000 - 74,999	114	287	162	159	6,954,446
75,000 - 99,999	54	156	122	83	4,690,007
100,000 - 124,999	36	132	82	43	4,050,106
125,000 - 149,999	12	48	38	9	1,639,209
150,000 - 249,999	30	191	177	39	5,621,799
Over 250,000	23	656	385	47	20,008,804
TOTALS	269	1,470	966	380	42,964,371

Table 3-11. Urbanized Areas With a City With a Population of 100,000 or More but Without a Phase I Municipality

Urbanized Area	Urbanized Area Population	Core City	Core City Population	Population Served by Combined Sewer *
Albany—Schenectady—Troy, NY	509,106	Albany	101,082	96,500
Bridgeport—Milford, CT	413,863	Bridgeport	141,686	50,000
Buffalo—Niagara Falls, NY	954,332	Buffalo	328,123	328,123
Chicago, IL—Northwestern Indiana	6,792,087	Chicago	2,783,726	2,783,726
Erie, PA	177,668	Erie	108,718	108,719
Evansville, IN—KY	183,087	Evansville	126,272	50,425
Hartford-Middletown, CT	546,198	Hartford	139,739	110,000
Lansing—East Lansing, MI	265,095	Lansing	127,321	50,000
New Haven—Meriden, CT	451,486	New Haven	130,474	84,300
Peoria, IL	242,353	Peoria	113,504	77,000
Pittsburgh, PA	1,678,745	Pittsburgh	369,879	369,879
Ponce, PR	190,079	Ponce	159,151	NA **
Providence—Pawtucket, RI—MA	846,293	Providence	160,728	160,728
Rochester, NY	619,653	Rochester	231,636	231,636
San Juan, PR	1,221,086	San Juan	426,832	NA **
Santa Rosa, CA	194,560	Santa Rosa	113,313	0
South Bend—Mishawaka, IN—MI	237,932	South Bend	105,511	100,000
Spokane, WA	279,038	Spokane	177,196	135,600
Springfield, IL	124,524	Springfield	105,227	75,000
Springfield, MA—CT	532,747	Springfield	156,983	156,983
St. Louis, MO-IL	1,946,526	St. Louis	396,685	396,685
Syracuse, NY	388,918	Syracuse	163,860	140,800
Waterbury, CT	175,067	Waterbury	108,961	99,947

* Population served by combined sewers within the core city of the urbanized area.

** Information on combined sewers in Puerto Rico not available.

3.1.3.3 Urban Populations Outside of Urbanized Areas

The Bureau of the Census defines urban populations to consist of persons living in any densely settled place of 2,500 or more inhabitants. Urban populations outside of urbanized areas are comprised of distinct population centers of more than 2,500 but less than 50,000 people. The total urban population outside of urbanized areas is 29.0 million people. Of this total, 25.1 million people live in 3,689 incorporated places. The remaining 3.9 million people live in either minor civil divisions or unincorporated portions of counties. The urban population outside of urbanized areas but inside a metropolitan areas as defined by OMB is 10.8 million.

3.1.3.4 Rural Populations

The census population data base classifies any population other than urban populations as rural populations. In 1990, the rural population totalled 61.5 million people. Of this total, 8.8 million live in 13,044 incorporated places; the remaining 52.7 million people live in either minor civil divisions or unincorporated portions of counties.

3.1.3.5 Populations Not Addressed in Census

The census data does not address certain classes of development, including resort towns and second home development. The census population data base generally does not reflect seasonal populations, such as people that only live in a resort town during peak seasons, second home development, people staying in rental units, or tourists. For example, on some peak weekends, more than 250,000 people may visit Ocean City, Maryland. According to the census, however, the permanent population of Ocean City, Maryland, is only 5,146. It has been estimated that more than two-thirds of recreational subdivisions are situated near water, often on artificially constructed lakes (Reilly, *The Use of Land*, 1973).

3.1.4 Development Trends

New development is widely recognized as providing some of the best opportunities for implementing cost-effective storm water management controls. This section identifies major trends of new development.

During the twentieth century, the U.S. population has become increasingly urbanized. The rate of growth occurring over the last four decades is exemplified by Bureau of the Census data on urbanized areas with a population of 50,000 or more. Table 3-12 shows two important trends that have occurred since 1950:

- The total populations in urbanized areas have been rapidly increasing.
- Most of this growth has been occurring outside larger central cities in urban fringe areas.

Table 3-12. Growth of Urbanized Areas in the United States Between 1950 and 1990

Year	Number of Urbanized Areas	Population in Urbanized Areas (millions)			Land Area (sq.mi.)
		Total	Central Cities	Urban Fringe	
1950	157	69.2	48.4	20.9	19,728
1960	213	95.8	57.9	37.8	25,544
1970	273	120.7	65.1	55.6	35,081
1980	366	139.2	67.0	72.1	52,017
1990	405	160.4	79.7	80.7	61,520

Source: Bureau of the Census, U.S. Dept. of Commerce

Between 1980 and 1990, the population of Census-designated urbanized areas increased by 21.2 million[8] and the cumulative size increased by 9,000 square miles. During the same period, the rural population of the United States increased by 2.2 million, and the urban population that lived outside of urbanized areas increased by 0.9 million.

[8] About 7 percent of this increase (1.5 million people) is associated with the net addition of 30 new urbanized areas between 1980 and 1990. Another part of this increase which has not been estimated here is associated with the increase in land area of pre-existing urbanized areas.

Cities with a population of 100,000 or more with municipal systems already addressed by Phase I of the NPDES storm water program increased in population by about 4.9 million people (or an increase of 9 percent) between 1980 and 1990.[9] Between 1980 and 1990, the population of urbanized areas with one or more municipal systems addressed by Phase I of the NPDES storm water program increased by 16.4 million (or 67 percent of the total national growth). This represented a 25 percent increase in the population of these areas. The population of urbanized areas without a Phase I municipal system increased by 4.8 million. This represents 20 percent of the total national growth and an 11 percent increase in the population of these areas.

Population increase is only one indicator of new development. Significant development can occur, particular in some of the larger urbanized areas experiencing migration from core cities to suburban areas. For example, between 1970 and 1990, the total population of the Chicago urbanized area was relatively stable, increasing by only 77,509 people. However, during this time significant migration was occurring from the core city to surrounding suburban areas. The population of the city of Chicago decreased by 583,257 while the population of suburban areas increased by 660,766. The Chicago urbanized area increased in land area by 307 square miles, or by 25 percent of its 1970 size.

The migration away from central business districts to the suburbs has been occurring at high rates since the late 1970s. By the mid-1980s, approximately 57 percent of the office space in the country was located in the suburbs; before that time, central business districts within the urban core contained the majority of office space (Cooper, 1986).

Growth is concentrated in certain geographic regions of the country. For example, the most growth in urbanized areas is occurring mainly in the south and west. High rates of growth are occurring in coastal and estuarine areas. Population in these areas has increased

[9] The 4.9-million increase does not include increases associated with unincorporated, urbanized portions of Phase I counties and designated municipalities.

by about 30 million people during the last 3 decades (almost half the total U.S. population increase) and is expected to increase, although at reduced levels (Culliton et al., 1990). The Bureau of the Census projects that most growth by 2010 will occur on the Pacific, Atlantic, and Gulf Coasts (Figure 3-5). High growth areas include California and Washington State in the West, all of the coastal States south of New Jersey in the East, and Florida and Texas in the Gulf Coast region.

A comparison of 1990 census data to 1980 data supports these projections (Table 3-13). Twenty-five of 30 coastal States have seen dramatic population increases since 1980 (Bureau of the Census, 1991). The largest increases occurred in California (6.1 million people), Florida (3.2 million people), and Texas (2.7 million people). While the major population corridors extend from New York to Washington, DC, Los Angeles to San Diego, and within the San Francisco Bay metropolitan area, estuaries in the Middle Atlantic contain the greatest percentage of urban land and is the most densely populated among regions (NOAA, 1990).

3.2 NATURE OF DISCHARGES FROM MUNICIPAL SYSTEMS

A number of features of the urban environment affect the manner in which discharges from municipal separate storm sewers may affect surface water resources, including:

- Urban activities and sources that generate or contribute to pollutants
- Increased levels of imperviousness
- Modifications and destruction of natural drainage features, including removal of riparian vegetation
- Design objectives of drainage system.

The degree of impact on a receiving water can also depend on other factors, including the frequency and duration of the storm water discharges, the quality and quantity of storm water discharges, the occurrence of other wet weather discharges (e.g., combined sewer

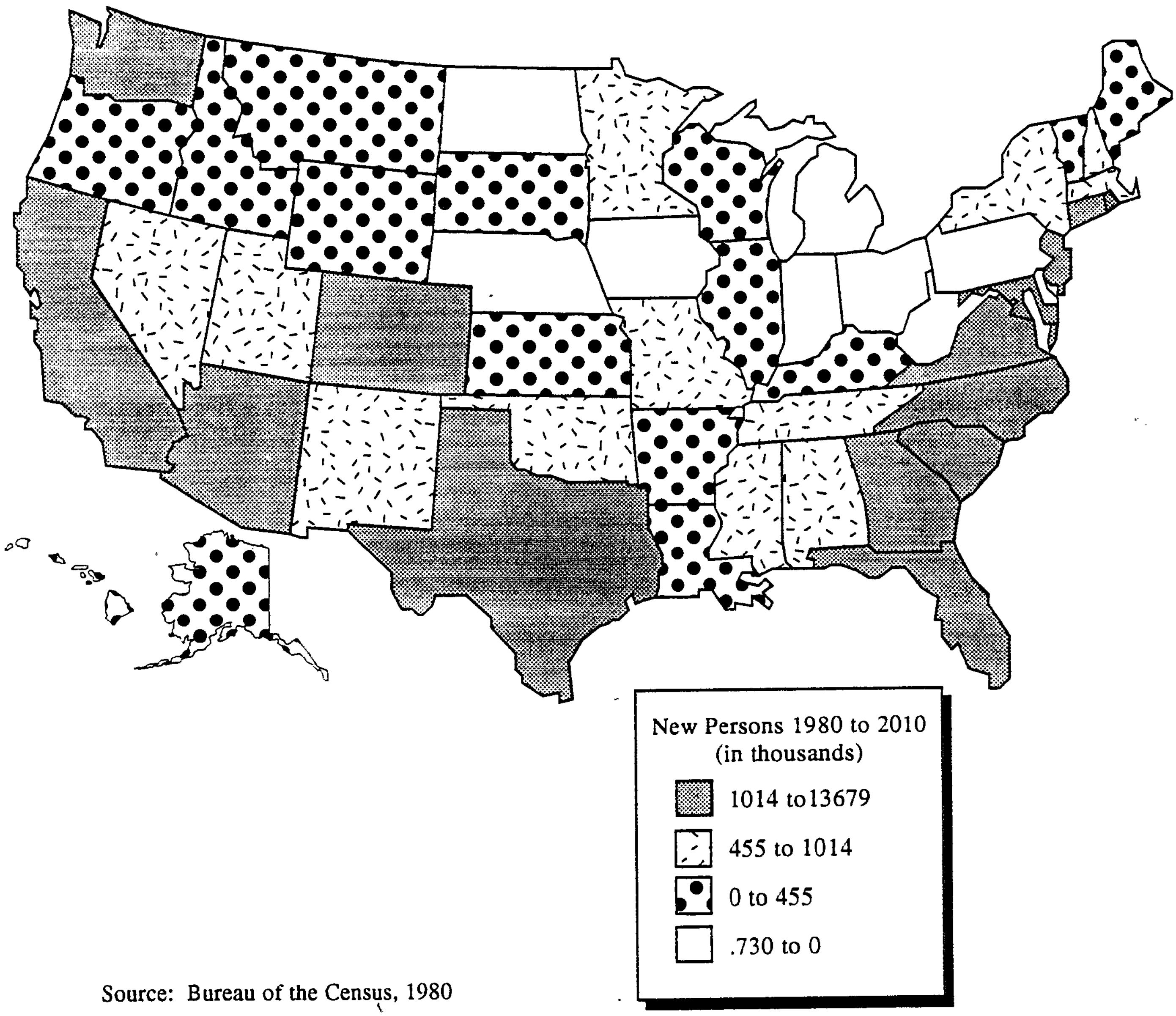

Figure 3-5. Population Growth Forecast Between 1980 and 2010

Table 3-13. Total Resident Population by State: 1990 and 1980

1990 Total Population Rank	State	1990 Total Population	1980 Total Population	Number Change 1980 to 1990	Percent Change 1980 to 1990
1	California	29,760,021	23,667,902	6,092,119	25.7
2	New York	17,990,455	17,558,072	432,383	2.5
3	Texas	16,986,510	14,229,191	2,757,319	19.4
4	Florida	12,937,926	9,746,324	3,191,602	32.7
5	Pennsylvania	11,881,643	11,863,895	17,748	0.1
6	Illinois	11,430,602	11,426,518	4,084	0.0
7	Ohio	10,847,115	10,797,630	49,485	0.5
8	Michigan	9,295,297	9,262,078	33,219	0.4
9	New Jersey	7,730,188	7,364,823	365,365	5.0
10	North Carolina	6,628,637	5,881,766	746,871	12.7
11	Georgia	6,478,216	5,463,105	1,015,111	18.6
12	Virginia	6,187,358	5,346,818	840,540	15.7
13	Massachusetts	6,016,425	5,737,037	279,388	4.9
14	Indiana	5,544,159	5,490,224	53,935	1.0
15	Missouri	5,117,073	4,916,686	200,387	4.1
16	Wisconsin	4,891,769	4,705,767	186,002	4.0
17	Tennessee	4,877,185	4,591,120	286,065	6.2
18	Washington	4,866,692	4,132,156	734,536	17.8
19	Maryland	4,781,468	4,216,975	564,493	13.4
20	Minnesota	4,375,099	4,075,970	299,129	7.3
21	Louisiana	4,219,973	4,205,900	14,073	0.3
22	Alabama	4,040,587	3,893,888	146,699	3.8
23	Kentucky	3,685,296	3,660,777	24,519	0.7
24	Arizona	3,665,228	2,718,215	947,013	34.8
25	Puerto Rico	3,522,037	3,196,520	325,517	10.2
26	South Carolina	3,486,703	3,121,820	364,883	11.7
27	Colorado	3,294,394	2,889,964	404,430	14.0
28	Connecticut	3,287,116	3,107,576	179,540	5.8
29	Oklahoma	3,145,585	3,025,290	120,295	4.0
30	Oregon	2,842,321	2,633,105	209,216	7.9
31	Iowa	2,776,755	2,913,808	-137,053	-4.7
32	Mississippi	2,573,216	2,520,638	52,578	2.1
33	Kansas	2,477,574	2,363,679	113,895	4.8
34	Arkansas	2,350,725	2,286,435	64,290	2.8
35	West Virginia	1,793,477	1,949,644	-156,167	-8.0
36	Utah	1,722,850	1,461,037	261,813	17.9
37	Nebraska	1,578,385	1,569,825	8,560	0.5
38	New Mexico	1,515,069	1,302,894	212,175	16.3
39	Maine	1,227,928	1,124,660	103,268	9.2
40	Nevada	1,201,833	800,493	401,340	50.1
41	New Hampshire	1,109,252	920,610	188,642	20.5
42	Hawaii	1,108,229	964,691	143,538	14.9
43	Idaho	1,006,749	943,935	62,814	6.7
44	Rhode Island	1,003,464	947,154	56,310	5.9
45	Montana	799,065	786,690	12,375	1.6
46	South Dakota	696,004	690,768	5,236	0.8
47	Delaware	666,168	594,338	71,830	12.1
48	North Dakota	638,800	652,717	-13,917	-2.1
49	District of Columbia	606,900	638,333	-31,433	-4.9
50	Vermont	562,758	511,456	51,302	10.0
51	Alaska	550,043	401,851	148,192	36.9
52	Wyoming	453,588	469,557	-15,969	-3.4
53	Guam	133,152	* 107,000	* 26,000	* 24.2
54	Virgin Islands	101,809	* 98,000	* 4,000	* 4.1
55	American Samoa	46,773	* 32,000	* 15,000	* 47.9
56	North. Mariana Islands	43,345	* 17,000	* 26,000	* 152.9

* Estimated 1980 census populations

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overflow discharges), and the quantity and quality of the base flow (dry weather flow) of the stream. Appendix B further discusses the potential impacts from storm water discharges to different classes of receiving waters.

3.2.1 Major Pollutant Sources

Pollutants in discharges from municipal separate storm sewer systems originate from a variety of diffuse sources. This subsection discusses both runoff-related and non-storm water sources of pollutants.

3.2.1.1 Runoff-Related Pollutant Sources

The urban environment has many sources that can contribute pollutants to storm water. Table 3-14 provides selected examples of the major common sources of pollutants in the urban environment. Many of these sources, such as those related to vehicles, building materials, and road maintenance, are ubiquitous in the urban environment. The complex interactions of the various pollutant sources in the urban environment have limited efforts to quantify the contribution of pollutants from specific sources. Rather, most studies of the quality of urban runoff have characterized pollutant concentrations in runoff from general land use categories (e.g., residential, commercial, open land). However, several recent studies have begun to look at smaller segments of the urban environment that may generate runoff with elevated levels of pollutants.[10] At least one recent study has attempted to evaluate the contribution of pollutants from different formulations of a commercial product (brake pads) to urban runoff.[11] Another recent study addressing deposition of air pollutants to waters identified fossil fuel combustion in industrial, commercial, and residential units;

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[10] For example, see Bannerman, R., et al., 1993 *Sources of Pollutants in Wisconsin Stormwater*, Water Science & Technology (28): 3-5, pp. 241, which indicates that streets and roads may be the most significant source of pollutants associated with residential, commercial and industrial land use. Pitt, R., et al. *The Treatability of Urban Stormwater Toxicants*, International Congress on Integrated Stormwater Management, 1991, which reported that runoff from vehicle service areas and parking lots generally had higher concentrations of polynuclear aromatic hydrocarbons and metal than runoff from street surfaces. In addition, a higher frequency of runoff from vehicle service areas and parking lots exhibited toxicity.

[11] See Public Review Draft of *Contribution of Heavy Metals to Storm Water from Automotive Disc Brake Pad Wear*, Santa Clara Valley Nonpoint Source Pollution Control Program, 1994.

Table 3-14. Common Pollutants and Non-Industrial Pollutant Sources Associated With Urban Runoff

Pollutant	Source (Category: Components)
Lead	Vehicles: exhaust, tire wear (filler material), lubricating oil and grease Structures and roads: paint
Zinc	Vehicles: tire wear (filler material), oil and grease (stabilizing additive), brake pads, metal corrosion Paved surfaces: deicing salts Structures: paint, metal corrosion, wood preservatives
Copper	Vehicles: parts wear (brakes, metal plating, bearings and bushings), diesel fuel Structures: paint, metal corrosion, wood preservative Other: pesticides
Cadmium	Vehicles: tire wear (filler material) Other: pesticides
Chromium	Vehicles: parts wear (brakes, metal plating, engine parts)
Nickel	Vehicles: diesel fuel, lubricating oil, parts wear (brakes, metal plating, and bushings) Paved surfaces: asphalt
Manganese	Vehicles: parts wear (engine parts)
Bromide	Vehicles: exhaust
Mercury	Other: coal combustion Vehicles: fuel combustion Structures: paint
Iron	Vehicles: body rust, engine wear Structures: rust
Cyanide	Paved surfaces: deicing salts Structures: wood preservatives
PAHs	Vehicles: exhaust Other: incomplete combustion
Chloride	Paved surfaces: deicing salts
Sulphates	Other: combustion product Vehicles: exhaust Paved surfaces: road beds, deicing salts
Nitrogen, Phosphorus	Vehicles: exhaust Other: combustion product Landscape maintenance: fertilizers Soil erosion: land disturbance, exposed soils Sewage: leaking sanitary systems, septic systems

Sources: EPA, 1992, 1990, 1983; Kobriger et al., 1984.

Table 3-14. Common Pollutants and Non-Industrial Pollutant Sources Associated With Urban Runoff (continued)

Pollutant	Source (Category: Components)
Sediments, Particulates	Soil erosion: land disturbance, exposed soils Streambank erosion: high flows Vehicles: body rust, tire wear, other wear
Pesticides	General outdoor application Structures: wood preservatives, paint
Floatables	Litter: residential, commercial, industrial, recreation Waste disposal: residential, commercial, industrial recreation Vegetation: leaves, branches, trunks
Bacteria	Sewage: leaking sanitary systems, septic systems Other: animal droppings Soil erosion: exposed soils
Oil and grease	Vehicles: drippings, leaks Paved surfaces: asphalt Equipment maintenance: exposed surfaces Other: wood preservatives, wood/coal combustion
PCBs	Vehicles: catalyst in synthetic tires Other: electrical, insulation
Benzene	Vehicles: fuel Other: solvent use
Toluene	Vehicles: fuel and asphalt Other: solvent use
Chloroform	Vehicles: form by mixing salt, gasoline and asphalt
Oxygen Demand	Vegetation: leaves Litter: various sources Soil erosion: land disturbance, exposed soils
Phthalate, bis(2-eth.)	Structures: plasticizer Other: plasticizer

Sources: EPA, 1992, 1990, 1983; Kobriger et al., 1984.

municipal waste combustion and hazardous waste and sewage sludge incineration; and various manufacturing processes, such as cement production as major local sources of metals. The report also identified fossil fuel and biomass combustion in petroleum refineries, motor vehicles, and industrial commercial and residential units as major local sources of polycyclic organic matter.

A number of the sources provided in Table 3-14 are related to materials exposed to precipitation. Examples of these sources include zinc from galvanized gutters and roofs and lead from certain exterior paints. Other sources are generally released to the environment, such as metals and polynuclear aromatic hydrocarbons (PAHs) in automobile emissions, zinc in tire wear, and emissions from industrial sites. Pollutants from these sources can be carried away from their original point of generation and accumulate on other impervious surfaces where they are eventually washed off. In addition, erosion of land and streambanks can contribute sediments and other pollutants.

Pollutant concentrations in runoff from different land uses are discussed below.

3.2.1.2 Non-Storm Water Sources

Although separate storm sewers are primarily designed to remove runoff from storm events, materials other than storm water end up in and are ultimately discharged from separate storm sewers. For example, in Sacramento, California, it is estimated that less than half of the water discharged from the storm water drainage system is directly attributed to precipitation.[12] Non-storm water discharges to storm sewers come from a variety of sources,[13] including:

- Illicit connections and cross connections from industrial, commercial, and sanitary sewage sources
- Leaking sanitary sewage systems
- Malfunctioning onsite disposal systems (septic systems)
- Improper disposal of wastes such as used oil, wastewaters, and litter

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[12] *Urban Runoff Discharge from Sacramento, CA*, Montoya, B., CA Regional Water Control Board, Central Valley Region, 1987, Report Number 87-1SPSS.

[13] A more complete description of non-storm water discharges to storm sewers is given in *Investigation of Inappropriate Pollutant Entries into Storm Drainage Systems: A User's Guide*, EPA, January 1993, EPA/600/R-92/238.

- Spills
- Infiltration of ground water contaminated by a variety of sources, including leaking underground storage tanks
- Wash waters, lawn irrigation, and other drainage sources.

Appendix C provides a more complete description of these sources of non-storm water. Table 3-15 summarizes numerous studies involving problems with non-storm water discharges. These case studies illustrate the wide range of pollutants (e.g., pathogens, metals, nutrients, oil and grease, phenols, and solvents) that can be contributed to storm sewers from non-storm water discharges. Removal of these non-storm water sources of pollutants often provides opportunities for dramatically improving the quality of discharges from separate storm sewers and is required by Section 402(p)(3)(B)(ii).

Table 3-15. Summary of Non-Storm Water Discharge Problems

Study Site	Comments
Jones Falls Watershed Baltimore City and County, MD	During the NURP study of the Jones Falls Watershed, 15 illicit connections were discovered in portions of the watershed. The illicit connections were grouped into four types: direct discharges from residences, leakage from cracked or broken sewer lines, decades-old overflows from the sanitary sewer, and sanitary sewage pumping station malfunctions. Elevated levels of pathogens, TSS, ammonia, TKN, total nitrogen, COD, and TOC were identified.
Tulsa, Oklahoma	A physical inspection was conducted on 120,000 feet of storm sewer 48 inches and larger serving a drainage area of approximately 12 square miles. 35 potential non-storm water discharges were observed. 23 of these were observed and/or suspected sanitary sewer connections, 4 were potable water discharges, and 8 were of an unknown source. In addition, 12,900 feet of sanitary sewer were laid within the storm sewer where the storm sewer served as a conduit. Most illicit connections were associated with development that occurred before 1970. Other documented observations were structural defects (900 feet of pipe showed signs of structural defects), pipe cross through (176 total), and debris buildup.

Table 3-15. Summary of Non-Storm Water Discharge Problems (continued)

Study Site	Comments
Washtenaw County, MI	Of the 1,067 businesses, homes, and other buildings inspected, 154 of the buildings inspected (14%) had illicit connections, including connections in restaurants, dormitories, car washes, and auto repair facilities. About 60% of the automobile-related businesses inspected had illicit discharges. A majority of the illicit connections discovered had been approved connections when installed. Pollutants that were detected include heavy metals, nutrients, TSS, oil and grease, radiator fluids, and solvents.
Fort Worth, TX	24 outfalls in a 10-mile radius were targeted for end-of-pipe observations. The success of the program was judged by a decline in the number of undesirable features at the target outfalls, from an average of 44 undesirable observations per month in 1986 (522 total) to an average of 21 undesirable observations per month in 1988. The Fort Worth investigation indicated problems associated with allowing septic systems, self-management of liquid waste by industry, and construction of municipal overflow bypasses from the sanitary sewer to the storm drains. These problems were attributed to the inability of the POTW to expand as rapidly as urban growth occurred. During a 30-month period, problems detected include 133 hazardous spills, 125 incidents related to industrial activity, 265 sanitary sewer line breaks, and 21 bypass connections of the sanitary sewer to the storm sewer. Highlighted cases include a 20 gallon-per-minute flow from a cracked sanitary sewer from a bean processing plant to a storm drain and an illicit connection of a sanitary sewer line from a 12-story office building to a storm sewer. Most industrial pollution enters the storm sewer system from illegal dumping, storm runoff, accidental spills, and direct discharges. Metals were not detected in dry-weather discharges but were found in significant levels in receiving water sediment. City officials state that the high metal concentrations in sediment are consistent with otherwise unexplained serious reported fish kills.
Seattle, WA	The city of Seattle has detected improper disposal and illicit connections from industrial sites by investigating sediment in storm sewers. One storm drain outfall that represented a major source of lead to the Duwamish River was traced back to a former smelter that crushed batteries to recover lead. Lead concentrations in the sediment were high enough to allow the city to send it to an operating smelter to be refined. Another storm drain contained high levels of creosote, pentachlorophenol, copper, arsenic, and PCBs, which (except for the PCBs) were traced back to a wood treatment facility. Thirty cubic yards of contaminated sediments removed from the storm drain contained 145 pounds of contaminants. Sediments removed from storm drains in another industrial area contained very high levels of PCBs (about 1 pound of PCBs in 70 cubic yards of sediment).
Upper Mystic Lake, NY	The NURP study for the Upper Mystic Lake Watershed project identified contamination of storm water runoff and, subsequently, surface water contamination of surface waters by sanitary discharges as a major problem in the watershed that contributed large quantities of phosphorus, certain metals, and bacteria. Interactions at 19 manholes serving both sanitary and storm sewer lines were identified as the major contributor of pollutants.

Table 3-15. Summary of Non-Storm Water Discharge Problems (continued)

Study Site	Comments
Bellevue, WA	The NURP report for Bellevue, WA, recorded 50 voluntary citizen reports of illegal dumping and other non-storm water discharges during a 27-month period. The incidents reported were varied and resulted in at least two significant fish kills. 25 percent of the citizen reports involved improper disposal of used oil to the storm sewer. Other reports involved spills, illicit connections of floor drains, septic system pipes, and a car wash, as well as chemical dumping and concrete trucks rinsing out into catchbasins or streams.
Ann Arbor, MI	Studies in 1963, 1978, and 1979 found that discharges from the Allen Creek storm drain contained significant quantities of fecal coliform, fecal streptococci, solids, nitrates, and metals. Of the 160 businesses dye-tested, 61 (38%) were found to have improper storm drain connections. Chemical pollutants, including detergents, oil, grease, radiator wastes, and solvents, were causing water quality problems. Monitoring of the storm drainage system during storm events indicated a decrease in the concentration of 32 of 37 chemicals monitored after the improper connections were removed.
Medford, OR	Fecal coliform tests at storm drain outfalls in city parks were used to detect 4 leaking sanitary sewer lines that were either located above the storm lines or saturated the ground with effluent, which entered the nearby storm drains; an agricultural equipment wash rack; and a house with sanitary lines plumbed to the storm drain. In addition, in one of the oldest sections of town, a large storm drain bored in the early 1900s also contained the sanitary sewer line. Under manholes, the sanitary line was only a trough. Even minor clogs or breaks resulted in a spillover of effluent into the storm drain below.
Toronto, Ontario*	Dry weather samples of discharges were taken from 625 storm drains in the Humber River watershed. About 10 percent of the outfalls were considered significant sources of nutrients, phenols, and/or metals, while 30 of the outfalls had fecal coliform levels of greater than 10,000 per 100 ml. Investigations identified 93 industrial and sanitary sewage illicit connections. Problems included residential connections of sanitary sewage to the storm sewers and yard runoff from a meat packing plant to a storm drain.
Grays Harbor, WA	Dry weather sampling of 29 outfalls of separate storm drains indicated that discharges from 6 of the outfalls had abnormally high pollutant levels with suspected illicit connections. The area under consideration had originally been served by combined sewers. Earlier efforts to separate the system had been incomplete, with some residences discharging sanitary sewage to the storm drain.
Seward, NY	Sewage from septic systems with clogged drainfields in clay soils flowed into open storm sewers. The open storm sewers posed health risks to neighborhood children and lowered property values.

Table 3-15. Summary of Non-Storm Water Discharge Problems (continued)

Study Site	Comments
Norfolk Naval Station, VA	The Norfolk Naval Shipyard was originally built in 1767 and has had numerous additions since. It has an extensive network of underground pipes, including both separate storm sewers and sanitary/industrial sewers. In response to a lawsuit, officials at the Shipyard conducted dye-testing of sanitary facilities throughout the shipyard, which led to the identification and elimination of 25 cross-connections of sanitary and industrial waste to the separate storm sewer system.
Sacramento, CA	The city of Sacramento is currently undertaking a project to identify pollutant discharges and illegal connections to the storm water drainage systems. Recent studies identified acute toxicity in storm water and determined that less than half of the water discharged from the drainage system was not directly attributable to precipitation. Mass loading estimates of copper, lead, and zinc discharged by the drainage system were several times higher than the estimated pollutant loads of these metals from the Sacramento Regional Treatment Plant secondary effluent.
Hazardous Waste Case Studies	These case studies determined that onsite waste disposal where pollutants were added to runoff, eventually ending up in drainage systems, and other situations where a generator dumped wastes directly down a drain were common. Of the 36 cases of illegal dumping investigated in a GAO report, 14 cases investigated involved disposal of hazardous wastes directly to, or with drainage to, a storm sewer, flood control structure, or the side of a road. An additional 10 sites involved disposal to the ground, to landfills (other than those receiving hazardous wastes), or to trash bins, which can ultimately result in additional pollutants to subsequent storm water discharges.

* Information from cities outside of the United States included for informational purposes only.

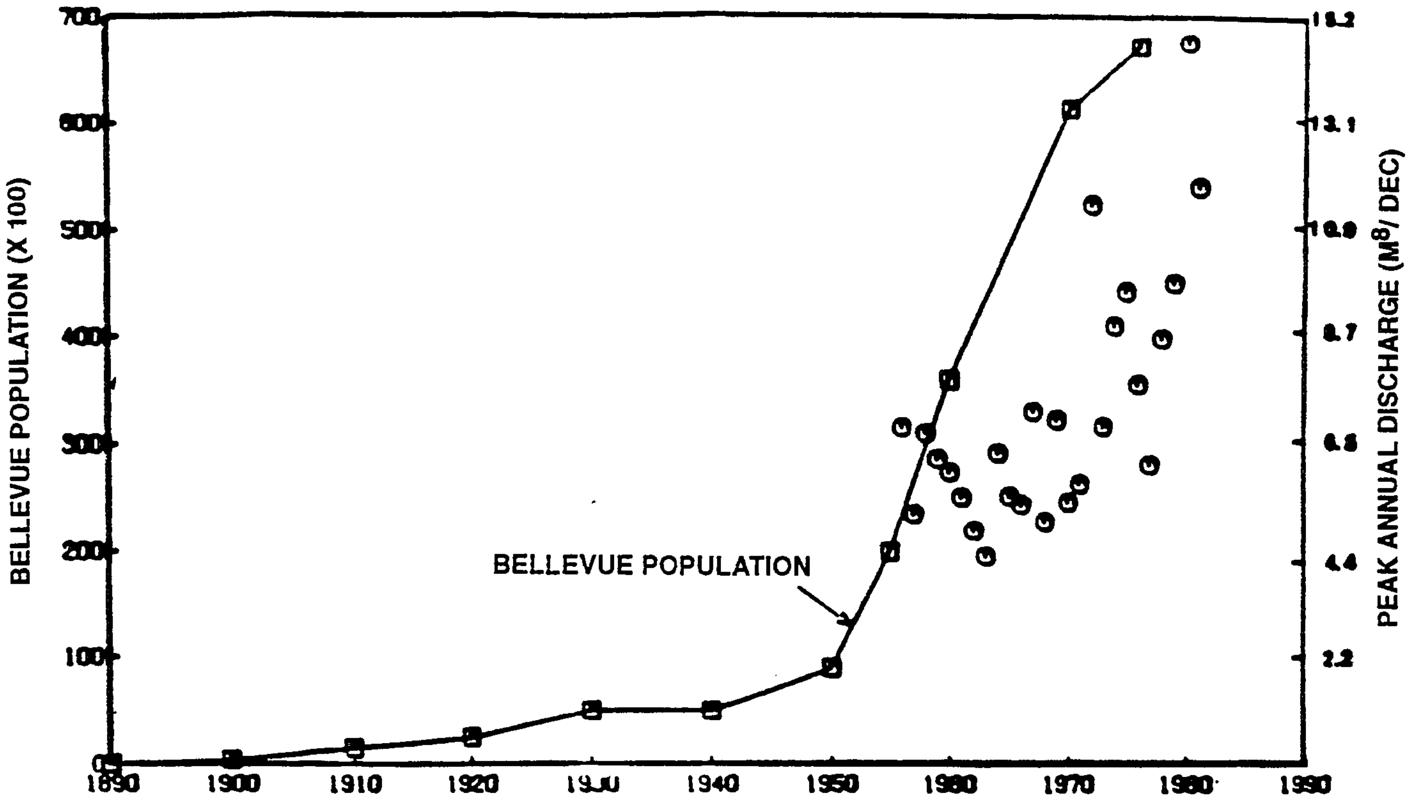
3.2.2 Imperviousness

The level of watershed imperviousness can be linked to impacts to streams and other surface water resources (Schueler et al.). Urbanization and development increase the imperviousness of land, which alters the natural vegetation and infiltration characteristics of watersheds. These increases in imperviousness can dramatically alter natural flow patterns of streams, wetlands, and other surface water resources. Increased levels of imperviousness replace natural vegetation and decrease the natural infiltration characteristics of a watershed, increasing the amount of runoff during wet weather events. Schueler estimates that in undeveloped watersheds, 5 to 15 percent of the annual stream flow is delivered during storm events. As a general rule, the amount of runoff occurring during storm events is directly proportional to the amount of watershed imperviousness. For example, runoff from storm events will typically comprise half the annual stream flow in a watershed that is 50 percent impervious (Schueler, 1987). Figure 3-6 illustrates how storm water peak flows increase as population (and, consequently, imperviousness) increases based on data from the United States Geological Survey (USGS) and the Bellevue Planning Department (1977). In addition to causing increased flooding, changes in the hydrology of a stream can result in accelerated stream bank or stream bed erosion. Such erosion can cause or contribute to a number of generally detrimental effects on stream hydrology and morphology. For example, erosion can widen or deepen the stream channel, eliminate pools and other structures in the stream, and shift gravel or sand bars (Schueler, 1992).

Increased levels of imperviousness also cause less infiltration of rainfall to recharge ground water supplies, thereby lowering the water table. One result of lowered water tables is that baseline stream flows can be significantly decreased during dry weather. Reduced flows between storms may significantly affect the aquatic habitat and the ability of a stream to dilute toxic spills or other dry weather pollutants within the stream system (Bellevue NURP project). In some cases, the installation of storm sewers in a watershed results in previously perennial streams running dry several times a year (Long Island NURP project).

The level of watershed imperviousness is probably the most significant factor affecting pollutant loadings in runoff from many land uses, including residential and commercial areas (NURP, EPA 1984). Increasing imperviousness increases runoff volumes, which, in turn, increase pollutant loads. Increased imperviousness can also increase stream temperatures, resulting in adverse effects on cold water habitats. Moreover, increased imperviousness can result in decreases in fish diversity (Schueler and Galli, 1992).[14]

[14] For more information on the relationship of watershed imperviousness and biological quality see Jones and Clark, 1987; Klein, 1979; Limburg and Schmidt, 1990; Pedersen and Perkins, 1986; and Booth and Jackson, 1994.



Source: Scott, Steward, and Stober

Figure 3-6. Population of Bellevue and Peak Annual Discharge in Kelsey Creek. Data From USGS and Bellevue Planning Dept., 1977

3.2.3 Modification of Natural Stream Channels and Riparian Vegetation

During the process of development, the natural drainage system (e.g., streams, wetlands, and other receiving waters) and surrounding vegetation is often modified. Streams can be diverted through underground culverts or channelized. Wetlands can be drained or filled, reducing the natural capacity of the drainage systems to dampen peak flows associated with storm events. After development has occurred, the natural drainage system is often unable to handle the higher volume of flows. The higher volume of flows can result in high stream bank and stream bed erosion rates or flooding. Drainage systems that have undergone these changes often need additional engineered modifications downstream, such as channelization or lining projects or direction of streams through underground culverts.

Removal of riparian vegetation, coupled with increased watershed imperviousness, can result in significant increases in water temperatures. Such changes can reduce or eliminate sensitive stream insects and fish species. Modification of riparian vegetation can also have significant impacts on stream habitat value.[15]

3.2.4 Design Objectives of Drainage System

The manner in which a storm sewer system is installed, and its design objectives, affect the quality and quantity of the storm water discharge, as well as the potential presence of non-storm water discharges. The historical development of storm sewers can be characterized in terms of four overlapping time periods. A description of storm water management during these periods shows how some of the water quality problems associated with storm sewer discharges have come about.[16]

1800-1850 — The first storm sewers were installed primarily to reduce flooding and ponding. Sanitary sewage connections resulted when adequate sanitary sewers were not provided.

1850-1950 — In some municipalities, combined sewers designed to carry both storm water and sanitary sewage were installed.

1900-Present — In other municipalities, separate systems were installed for sanitary and storm sewers. Storm sewers were designed to provide for the rapid removal of storm water runoff from a site.

1970-Present — Some communities begin to address storm water as a resource to be used to recharge ground water and to supply fresh water to surface waters. In addition, properly managed storm water avoids problems with erosion, flooding and adversely impacting natural drainage features such as streams, wetlands and lakes. The multiple goals of water quality and water quantity are addressed when managing storm water.

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[15] For a more detailed discussion of the relationship between streams and the hyporheic zone, the area that is biologically and hydrologically connected to the surface water of a system, see *Entering the Watershed, A New Approach to Save America's River Ecosystem*, Doppet, B. et al., 1993.

[16] NURP - Ann Arbor, MI Report, 1984, and *Water and the City: The Next Century*, Rosen and Keating, American Public Works Association, 1991.

3.2.4.1 Early Sewers (1800-1850)

The oldest urban storm sewers in the United States date back to the early 1800s. Ponding of surface waters, coupled with poor sanitary conditions in urban areas, led to the installation of these early storm sewers to provide drainage. Little is known of the early storm sewers, as they were constructed by individuals or small districts at their own expense with little or no engineering or public supervision. Early storm sewers preceded the development of sanitary sewers. Once these early storm sewers were in place, they received wastes from other sources, some from direct connections of ditches and pipes to the storm sewers and others from materials dumped into the streets or storm sewers. Wastes which ended up in storm sewers included house wastes (most buildings lacked indoor plumbing), cesspool overflows, garbage, and excrement from horses and livestock. These practices created health and aesthetic problems, as storm sewers were often oversized on a flat grade, resulting in accumulation of sewage in storm sewers during dry weather. Wastes which accumulated during dry weather were then discharged into receiving streams during rain events. Many cities prohibited the discharge of domestic sewage to storm sewers but failed to provide public sanitary sewers, resulting in secret connections built without public supervision. Other illegal connections to the storm sewer were often overlooked by municipal officials because of the lack of proper sanitary sewers (NURP, 1984) (APWA, 1991).

3.2.4.2 Combined Sewers (1850-1950)

By the second half of the 19th century, combined sewer systems, designed to carry both sanitary sewage and storm runoff, were being installed to limit the costs associated with separate systems. At the time, these systems were chosen over separate systems because of their lower costs, even though it was known that separate systems were preferred on the basis of sanitary conditions. By 1875, although 67 cities in the United States with populations of greater than 100,000 had combined sewer systems, none treated waste before discharging it to the nearest receiving water body. In many cities, streams were covered to minimize the resulting nuisance. Pollution and health problems forced the expensive installation of interceptors to collect dry weather flows from hundreds of combined sewer outlets for conveyance or pumping to treatment plants prior to discharge.

As cities expanded, storm runoff and sewage flows increased. Combined interceptors which had been installed prior to expansion could not handle increases in flow to the point that even modest rain events could cause flooding of streets and basements. Combined sewer overflows (CSOs) that discharged storm water and sewage directly to surface waters were installed to minimize flooding problems, including sewage backing up into the basements of commercial and residential buildings. These systems bypassed treatment and the general sanitary quality of receiving waters again deteriorated (NURP, 1984) (APWA, 1991).

3.2.4.3 Separate Sewers for Water Removal (1900-Present)

The first large scale sewer system to provide separate collection of storm runoff and sanitary sewage was built in 1880 in Memphis, TN, although the construction of combined systems was continued and extended in most major cities. As early as 1900, many State regulatory agencies would not permit further construction of combined sewers. Where water quality impacts from CSOs were extreme, some cities implemented programs to separate portions of the older combined system.

Problems arose with separate storm water and sewage systems. As city populations increased, the demand for sewer service increased. However, sewer mains, interceptors, pumping stations and treatment plants were slow to grow. The post-World War II boom for sewer service into fast growing suburban areas was often associated with high infiltration rates and many illegal rain water connections which overloaded the system during rain events. To limit raw sewage backups in basements, hundreds of connections were made to bleed sewage from the sanitary sewers to the storm drains to limit flows in the sanitary sewers. Improper connections of grey waters such as automobile repair shop floor drains were either encouraged or implicitly allowed to discharge to storm drains.

Other problems arise with separate storm sewers, as storm water management often focuses on the rapid removal of storm water runoff from a site. The assumption is that problems will disappear after storm water leaves the site. Under this approach, which usually involves concrete channels and underground piping networks, storm drains are constructed without regard for the control and slow release of storm water or for possible downstream effects. This approach to storm water management has been characterized by simplistic goals, rigid design standards (such as requiring piping for drainage instead of relying on natural drainage features), low engineering review costs, and high construction and maintenance costs. In some cases, flood problems are only shifted to downstream sites (NURP, 1984) (APWA, 1991).

3.2.4.4 Storm Water Management for Water Quantity and Water Quality Purposes (1970-Present)

A few communities have developed programs where storm water is managed for multiple purposes including controlling water quantity (to avoid flooding and stream scour and to maintain stream flows during dry weather by recharging ground water during storms) and improving water quality. A range of alternative storm water control measures and facilities can be implemented to serve multiple purposes effectively. The natural cycles and processes which occur prior to the development of the land are used as a guide for managing storm water after development has occurred. Natural flow patterns and rates of discharge are retained through special storm water control facilities and measures. Natural processes are incorporated into the design of many "soft" engineered systems, including vegetated buffers, greenways, revegetation of storm water systems, wetland creation or retention for storm water management, and onsite retention, detention or infiltration systems. Policies emerging from these programs include:

- Reducing peak flows and improving storm water quality by onsite retention
- Reducing the volume of storm water leaving the site by natural infiltration

- Releasing storm water from onsite facilities at a rate similar to the pre-development runoff rate
- Managing for smaller storm events as well as those larger storm events that can cause major floods
- Protecting wetlands and floodplains as natural storm water storage areas
- Making storm water facilities amenities of the development (such as retaining natural drainage channels or providing attractive landscaping for storm water management ponds) and encouraging open space and recreational uses
- Developing programs that relate erosion and sediment controls during construction with storm water management after construction is completed.

The implementation of this approach typically involves somewhat higher costs for development plan review by local governments, but lower costs for storm water facility construction, and results in reduced social costs (NURP, 1984) (APWA, 1991).

3.3 THE EXTENT OF DISCHARGES FROM MUNICIPAL SYSTEMS

3.3.1 Pollutant Concentrations of Runoff From Residential and Commercial Areas

Many studies have examined the nature of pollutants in municipal storm water discharges on a local level, but few have attempted to do so on a national level. The two most extensive assessments of pollutants in urban runoff are the Nationwide Urban Runoff Program (NURP) and information compiled in the USGS data base. These two data bases primarily reflect pollutant concentrations associated with runoff from residential and commercial areas.

From 1978 to 1983, EPA provided funding and guidance to NURP to provide a better understanding of the nature of urban runoff from residential and commercial areas. NURP included 28 projects that were conducted separately at the local level but were centrally reviewed, coordinated, and guided by EPA. Project locations across the country were selected by EPA to provide a range of types of receiving waters and beneficial uses, hydrologic characteristics, and urban characteristics.

The major focus of NURP was to characterize the water quality of runoff from residential, commercial, and industrial park sites. The NURP program evaluated data from 81 sites in 22 cities covering more than 2,300 separate storm events. Of the 81 sites selected, 39 were completely or primarily residential, 10 were commercial, 20 were mixed commercial and residential, 4 were industrial parks, and 8 were open spaces in urban areas. Because the industrial park category did not represent heavy industrial activity, the data from industrial parks were merged with commercial land use data. Each project was separate and distinct but shared common field monitoring protocols.

The NURP study provides insight on what can be considered background levels of pollutants for runoff from residential and commercial land uses. Sites evaluated in NURP were carefully selected so that they were not influenced by pollutant contributions from construction sites, industrial activities, or illicit connections. Several sites were eliminated from the study because of elevated pollutant loads associated with these or other sources.

NURP showed that the concentrations of pollutants in runoff from residential and commercial areas vary considerably from site to site. NURP postulated that the best general characterization of runoff from commercial and residential areas for planning purposes, where local information is lacking, can be obtained by pooling data from many sites.

The majority of samples collected under NURP were analyzed for seven conventional pollutants (biochemical oxygen demand, chemical oxygen demand, total suspended solids, total Kjeldahl nitrogen, nitrate plus nitrite, total phosphorus, and soluble phosphorus) and three metals (total lead, total copper, total zinc). Table 3-16 presents average discharge concentrations for these pollutants in runoff from the residential and commercial sites studied in NURP.[17]

[17] Recently, concerns have been raised regarding the validity and use of historical data for metals. As discussed in Chapter 2, EPA believes that historical data on storm water runoff from NURP and USGS are suitable for the purposes of this report.

Table 3-16. Summary of Event Mean Concentrations From NURP for Selected Pollutants

Constituent	Mean	Median Site	90th Percentile Site	Coefficient of Variability for Events
TSS (mg/l)	239	100	300	1-2
BOD (mg/l)	12	9	15	0.5-1
COD (mg/l)	94	65	140	0.5-1
Total P (mg/l)	0.50	0.33	0.70	0.5-1
soluble P (mg/l)	0.15	0.12	0.21	0.5-1
TKN (mg/l)	2.3	1.5	3.3	0.5-1
Nitrate plus nitrite (mg/l)	0.86	0.68	1.75	0.5-1
Total Cu (mg/l)	0.05	0.03	0.09	0.5-1
Total Pb (mg/l)	0.24	0.14	0.04	0.5-1
Total Zinc (mg/l)	0.35	0.16	0.50	0.5-1

In addition, the Section 307(a) priority pollutants were measured at 20 of the sites. Of the 119 pollutants analyzed, 77 were detected. All 13 metals on the priority pollutant list were detected, and all but 3 of the metals were detected at frequencies greater than 10 percent of the samples. Copper, lead, and zinc, found in at least 91 percent of the samples, were the most frequently detected metals. Of the 106 organic pollutants measured, 63 were detected. A plasticizer (bis (2-ethylhexyl) phthalate) and a pesticide (alpha-hexachlorocyclohexane (alpha-BHC)) were found in at least 20 percent of the samples analyzed. An additional 11 organic pollutants were reported at frequencies between 10 and 20 percent, including 4 pesticides, 3 phenols, 4 polycyclic aromatics, and a single halogenated aliphatic compound. NURP data also showed that during warm weather conditions, fecal coliform counts in urban runoff are typically in the tens to hundreds of thousands per 100 milliliters of runoff. Table 3-17 lists pollutants that were detected in 10 percent or more of the NURP samples.

Table 3-17. Priority Pollutants Detected in at Least 10 Percent of the NURP Samples

Pollutant	Detection Frequency (%)
Metals and inorganics	
Antimony	13
Arsenic	52
Beryllium	12
Cadmium	48
Chromium	58
Copper	91
Cyanides	23
Lead	94
Nickel	43
Selenium	11
Zinc	94
Pesticides	
Alpha-hexachlorocyclohexane	20
Alpha-endosulfan	19
Chlordane	17
Lindane	15
Halogenated aliphatics	
Methane, dichloro-	11
Phenols and cresols	
Phenol	14
Phenol, pentacholoro-	19
Phenol, 4-nitro	10
Phthalate esters	
Phthalate, bis(2-ethylhexyl)	22
Polycyclic aromatic hydrocarbons	
Chrysene	10
Fluoranthene	16
Phenanthrene	12
Pyrene	15

Source: EPA, 1983

The USGS has also collected urban rainfall, runoff, and water quality data nationally for several decades. In the mid-1980s, a data base containing information on 717 storms at 99 stations in 22 metropolitan areas throughout the United States (Driver et al., 1985) was compiled. The USGS examined a set of constituents similar to those compiled for NURP; the USGS also reported its data in terms of flow-weighted samples so that concentrations and loading values could be compared directly to NURP results. As described in Section 2.1.2.1 of this report, EPA compared information from the USGS data base to the findings from NURP.

In general, the findings between the two studies were very similar. Both data bases identified sediments and metals as the most significant pollutants measured. This determination is consistent with the findings of Driver and Lystrom (1986), who also compared the two data sets.

Two major trends related to automobiles that have occurred since the bulk of NURP data were collected are expected to affect urban runoff quality. The first trend involves the dramatic reductions in the levels of lead in gasoline. NURP data were generally collected during the time period when leaded gasoline was being phased out, and current concentrations of lead in runoff are expected to be generally lower than indicated by the NURP data.[18] Storm water monitoring data collected since that time tend to show a significant decrease in lead, but much less of a reduction then the percentage reductions of

[18] Tetraethyl lead has been extensively used as an inexpensive anti-knock, octane boosting gasoline additive since 1923. Aside from the Surgeon General temporarily suspending the production and sale of lead in gasoline in 1925, the use of lead in gasoline was largely unregulated until 1978. Decreases since that time are the result of two regulatory programs under the Clean Air Act (CAA): regulation of the amount of lead in leaded gasoline; and automobile emission standards resulting in new technology, catalytic converters, requiring the use of unleaded gasoline. Beginning in 1975, many automobile manufacturers began installing catalytic converters, which were poisoned by lead in gasoline, to meet emission standards. In 1978, EPA began to lower the level of lead in leaded gasoline under sections 211(c)(1) and (2) of the CAA to protect the public health and welfare and to safeguard the performance of emission control devices in general use. Most recently, EPA lowered the low-lead standard to 0.10 gplg, effective January 1, 1986, (March 7, 1985 (50 *FR* 9386)).

lead in gasoline. Other remaining sources of lead include industrial sources, paint, background levels in soil, and soil contaminated after 65 years of using lead in gasoline.[19]

The second trend pertains to the prohibition of the use of asbestos in brake pads and clutch linings. This is expected to result in a decrease in asbestos in runoff, which was not monitored in NURP, and an increase in copper and zinc, which are a substitute for asbestos in some brake pads.

3.3.1.1 Comparison of Pollutant Concentrations in Runoff from Residential/Commercial Areas to Discharges From Publicly Owned Treatment Works

The concentration of pollutants in runoff from residential and commercial areas (based on NURP and USGS data bases) can be compared to the typical concentration of pollutants found in the discharges from publicly owned treatment works (POTWs) that provide secondary treatment[20] (see Table 3-18). The concentration of total suspended solids (TSS) in runoff from residential and commercial areas is about an order of magnitude greater than the concentrations from POTWs receiving secondary treatment. The concentrations of COD, total lead, and total copper were somewhat higher in runoff from residential and commercial areas. The concentration of phosphorus and nitrogen were about an order of magnitude greater in discharges from POTWs.

[19] This is consistent with the finding of *Deposition of Air Pollutants to the Great Waters, 1994 Report to Congress*, EPA, 1994, which indicates that the environment may act as an important reservoir or source of persistent contaminants that have been released previously.

[20] EPA estimates that 76 million people, or 42 percent of the population served by sanitary sewage treatment works, are served by systems that either provide greater than secondary treatment or have no discharge. *1992 Needs Survey Report to Congress*, EPA, 1993.

Table 3-18. Comparison of Mean Pollutant Concentrations in Runoff From Residential and Commercial Areas to Sewage Treatment Plant Receiving Secondary Treatment

Constituent	Runoff from Residential and Commercial Sites (NURP)	Sewage Plant With Secondary Treatment
TSS (mg/l)	239	20
BOD (mg/l)	12	20
COD (mg/l)	94	33
Total P (mg/l)	0.5	6
Soluble P (mg/l)	0.15	5
TKN (mg/l)	2.3	20
Nitrate plus nitrite (mg/l)	0.86	NA
Total Cu (mg/l)	0.05	0.05
Total Pb (mg/l)	0.24	0.03
Total Zn (mg/l)	0.35	0.14

Source: POTW discharge concentrations for lead, zinc, copper, BOD, COD, TSS, and oil and grease were based on data reported in *Fate of Priority Pollutants in Publicly Owned Treatment Works* (EPA, 1981). This report summarizes monitoring data from POTWs receiving secondary treatment in 50 cities. Pollutant concentrations for total phosphorus, soluble phosphorus, and total Kjeldahl nitrogen were based on personal communication with Dolloff Bishop or the EPA Wastewater Engineering Laboratory in Cincinnati, Ohio. Recently, concerns have been raised regarding the validity and use of historical data for metals. As discussed in Chapter 2, EPA believes that historical data on storm water runoff from NURP and USGS are suitable for the purposes of this report.

3.3.1.2 Comparison of Pollutant Concentrations in Runoff from Residential/Commercial Areas to Water Quality Criteria

NURP determined that toxic metals were the most prevalent priority pollutants in runoff from commercial and residential areas. All 14 inorganic priority pollutants (13 metals, plus cyanides, excluding asbestos) were detected in urban storm water. As shown in Table 3-19, a number of these constituents were detected at levels exceeding EPA water quality criteria. The table also identifies organic pollutants found that exceeded certain EPA water quality criteria. These exceedances were observed less frequently than exceedances for the inorganic constituents. Levels of coliform bacteria were also found to exceed EPA water quality criteria during and immediately after storm events in many surface waters (EPA, 1983).

Table 3-19. Summary of Water Quality Criteria Exceedances for Pollutants Detected in at Least 10 Percent of NURP Samples—Percentage of Samples in Which Pollutant Concentrations Exceed Criteria[1]

Pollutant	Frequency of Detection(*)	Detection Samples[2]	Criteria Exceedances						
			None	FA	FC	OL	HH	HC[4]	DW
I. Pesticides									
α-Hexachlorocyclohexane	20	21/106						8,18,20	
γ-Hexachlorocyclohexane (Lindane)	15	15/100			8			0,10,15	
Chlordane	17	7/42		2	17			17,17,17	
α-Endosulfan	19	9/49			10				
II. Metals and Inorganics[5]									
Antimony	13	14/106	X					52,52,52	1
Arsenic	52	45/87						12,12,12	
Beryllium	12	11/94			6*				1
Cadmium[6]	48	44/91		8	48		1		1
Chromium[6,7]	58	47/81			1*				
Copper[6]	91	79/87		47	82				
Cyanides	23	16/71		3	22		4		
Lead[6]	94	75/80		23	94		73		73
Nickel[6]	43	39/91			5		21		
Selenium	11	10/88			5		10		10
Zinc[6]	94	88/94		14	77				
IV. Halogenated Aliphatics									
Methane, dichloro-	11	3/28						0,0,11	
VII. Phenols and Cresols									
Phenol	14	13/91	X						
Phenol, pentachloro	19	21/111		1*	11*	1			
Phenol, 4-nitro-	10	11/107	X						
VIII. Phthalate Esters									
Phthalate, bis(2-ethylhexyl)	22	15/69			22*				
IX. Polycyclic Aromatic Hydrocarbons									
Chrysene	10	11/109						10,10,10	
Fluoranthene	16	17/109	X						
Phenanthrene	12	13/110						12,12,12	
Pyrene	15	16/110						15,15,15	

*Indicates FTA or FTC value substituted where FA or FC criterion not available (see below).

1 Based on 121 sample results received as of September 30, 1983, adjusted for quality control review. Where a value is reported for criteria exceedances, this value is a percentage of the number of samples where the pollutant was detected and blanks indicate no exceedances by any of the samples for which the pollutant was detected.

2 Number of times detected/number of acceptable samples.

3 FA = Freshwater ambient 24-hour instantaneous maximum criterion ("acute" criterion).
FC = Freshwater ambient 24-hour average criterion ("chronic" criterion).
FTA = Lowest reported freshwater acute toxic concentration. (Used only when FA is not available.)
FTC = Lowest reported freshwater chronic toxic concentration. (Used only when FC is not available.)
OL = Taste and odor (organoleptic) criterion.
HH = Non-carcinogenic human health criterion for ingestion of contaminated water and organisms.
HC = Protection of human health from carcinogenic effects for ingestion of contaminated water and organisms.
DW = Primary drinking water criterion.

4 Entries in this column indicate exceedances of the human carcinogen value at the 10^{-5}, 10^{-6}, and 10^{-7} risk level, respectively. The numbers are cumulative (i.e., all 10^{-5} exceedances are included in 10^{-6} exceedances, and all 10^{-6} exceedances are included in 10^{-7} exceedances).

5 Concerns have been raised regarding the validity and use of historical data for metals. As discussed in Chapter 2, EPA believes that historical data on storm water runoff from NURP and USGS are suitable for the purposes of this report.

6 Where hardness dependent, hardness of 100 mg/l $CaCO_3$ equivalent assumed.

7 Different criteria are written for the trivalent and hexavalent forms of chromium. For purposes of this analysis, all chromium is assumed to be in the less toxic trivalent form.

3.3.2 Pollutant Concentrations from Other Urban Land Uses

The NURP data base is limited to runoff from residential, commercial and industrial park land uses. These land uses typically comprise between 55 to 85 percent of the area of urban areas (EPA, 1990). Other major urban land uses which have the potential to contribute runoff with higher levels of pollutants include central business districts, industrial areas (typically 10 to 20 percent of the area of urban areas), and construction activities.

3.3.2.1 Central Business Districts

NURP noted that data describing runoff from central business districts are limited. However, NURP suggested that some central business districts may produce pollutant concentrations in runoff that are significantly higher than those from other sites in a given urban area. Pollutant loads from central business districts are thought to be significant because of the high pollutant concentrations coupled with the high degrees of imperviousness.

3.3.2.2 Industrial Land Uses

No truly industrial sites were included in any of the NURP projects. However, NURP suggested that runoff from industrial sites may have significantly higher contaminant levels than runoff from other urban land use sites. Several studies tend to support this suggestions, such as the Fresno, CA, NURP project which showed that industrial areas had the poorest storm water runoff quality of the four land-uses evaluated. Of the 62 non-pesticide constituents monitored, 52 were statistically highest in industrial site runoff. A study conducted in Spokane, WA, showed that industrial and commercial sites clearly contributed greater quantities of total dissolved solids, COD, total Kjeldahl nitrogen, lead and zinc (Oregon, 1986—Spokane Water Quality Management Program).

Given the range of different industrial activities in different urban areas, it would be difficult to characterize industrial runoff on a national basis. However, recent data collection efforts describing runoff from different types of industrial activities can be used to evaluate the potential for pollutants in runoff from specific industrial areas. Chapter 4 summarizes some of these efforts.

3.3.2.3 Construction Activities

The amount of sediment in storm water discharges from construction sites can vary considerably, depending on whether effective management practices are implemented at the construction site. Uncontrolled or inadequately controlled construction site sediment loads have been reported to be on the order of 35 to 45 tons/acre/year (Novotny and Chesters, 1981). Sediment runoff rates from construction sites are typically 10 to 20 times that of agricultural lands, with runoff rates as high as 100 times that of agricultural lands; the rates are typically 1,000 to 2,000 times those of forest lands. Over a short period of time, construction sites can contribute more sediment to streams than was previously deposited over several decades.[21]

3.3.3 Pollutant Loading Estimates

EPA has developed loading estimates for selected pollutants in discharges from municipal separate storm sewer systems associated with urbanized areas.[22] Chapter 2 describes the methods used for estimating pollutant loads.

Table 3-20 summarizes pollutant load estimates for different classes of municipalities currently addressed by Phase I of the NPDES storm water program and potentially addressed under Phase II. EPA estimates that in 1990, about 40 percent of the pollutant loads associated with runoff from urbanized areas came from Phase I municipalities. About one-quarter of the pollutant loads in runoff from urbanized areas came from potential Phase II

[21] Under current regulations, construction activities resulting in the disturbance of 5 or more acres are covered by the NPDES storm water program.

[22] The model used to estimate pollutant loads assumed constant concentrations for each of the seven pollutants. This assumption results in the ratio of loadings of different pollutants remaining constant for different classes of municipalities. Thus, where the percentage of pollutant loadings is presented, the percentage is the same for all seven pollutants.

Table 3-20. Estimated Pollutant Loadings in Runoff From Urbanized Areas

Classification	Population Category	Number of Urbanized Areas*	Population* (millions)	Total Area** (sq. mi.)	Number of Incorporated Places*	Number of Minor Civil Divisions*	Number of Counties*	Percentage of Urbanized Area Loading
NATIONAL		405	252.2	3,540,166	19,289	17,796	3,141	NA
ALL URBANIZED AREAS	50,000 - 99,999	176	12.2	7,674.0	457	285	251	12
	100,000 -249,999	125	19.5	10,243.0	485	350	154	16
	Over 250,000	104	128.7	43,603 0	2,649	939	296	72
	TOTAL	405	160.4	61,520.0	3,591	1,574	703	100
URBANIZED AREAS AFFILIATED WITH PHASE I MS4s								
- Phase I MS4s within Phase I affiliated Urbanized Areas	50,000 - 99,999	8	0.4	210.7	9	0	6	0
	100,000 - 249,999	47	6.3	3,066.4	51	0	13	5
	Over 250,000	81	75.0	21,741.9	504	0	53	35
	SUBTOTAL	136	81.7	25,019.0	564	0	72	40
- Phase II Portions of Phase I affiliated Urbanized Areas	50,000 - 99,999	8	0.2	102.5	10	1	4	1
	100,000 - 249,999	47	1.9	1,174.4	69	58	62	2
	Over 250,000	81	33.7	14,944.8	1,508	575	239	25
	SUBTOTAL	136	35.8	16,221.7	1,587	634	305	28
	TOTAL	136	117.5	41,240.7	2,151	634	377	68
URBANIZED AREAS NOT AFFILIATED WITH A PHASE I MS4								
- Urbanized Areas Not Affiliated with Phase I MS4s	50,000 - 99,999	168	11.6	7,232.7	443	284	242	11
	100,000 -249,999	78	11.3	5,823.0	371	297	91	9
	Over 250,000	23	20.0	6,176.7	656	385	47	12
	TOTAL	269	42.9	19,606.0	1,470	966	380	32
- Urbanized Areas Containing a City with a CSO Exemption**	50,000 - 99,999	0	0	0	0	0	0	0
	100,000 -249,999	7	1.5	661.2	40	70	17	1
	Over 250,000	14	16.0	5,242.5	524	358	43	9
	TOTAL	21	17.5	5,903.7	564	428	60	10
PHASE I MS4s OUTSIDE URBANIZED AREAS		NA	4.3	86,097	57	0	5	NA

* Totals are based upon 1990 Census, and include Puerto Rico, Guam, Virgin Islands, American Samoa, and the Commonwealth of the Northern Mariana Islands.
** Some municipalities identified in the November 1990 application regulations (55 *FR* 47990) as Phase I based on 1980 census data received combined sewer exclusions from Phase I where the total population served by separate storm sewers was less than 100,000 after subtracting the population served by combined sewers. (The 21 urbanized areas [with a population of 17.5 million] containing these municipalities are also contained in the above totals and are not in addition to those totals.)

portions of urbanized areas with a Phase I municipality. An additional one-third of the pollutant loadings associated with urbanized areas came from urbanized areas that do not have a Phase I municipality.

Table 3-21 compares annual pollutant loadings for three metals, zinc, lead, and copper, from urban runoff from the Metropolitan Washington urbanized area, with a sewage treatment plant that provides advanced treatment and that serves about 2 million people (the Blue Plains sewage treatment plant), and major industrial process wastewater discharges located in Maryland and Virginia. In general, the data in Table 3-21 indicates that the annual loadings of metals, nutrients, and oxygen demanding pollutants in urban runoff from the Washington, DC, area are higher than the loadings from the predominant sewage treatment plant for the area (the Blue Plains Sewage Treatment Plant provides advanced treatment and serves approximately two million people). The data also indicate that the annual loadings of zinc and lead in urban runoff from the Washington, DC, area are higher than the loadings from all industrial point source discharges from facilities in Maryland and Virginia that reported pollutant release information in 1987 to the Toxic Release Inventory established under the Emergency Planning and Community Right-to-Know Act.

Table 3-21. Annual Pollutant Loadings in Pounds for Selected Pollutant Sources

Pollutant	Urban Storm Water from Metropolitan Washington	Blue Plains Sewage Treatment Plant[1]	All MD and VA Direct Industrial Discharges in 1987 Toxic Release Inventory
Zinc	480,000	137,000	132,000
Lead	132,600	5,500	31,300
Copper	113,000	21,000	127,000
Nitrogen	30,000,000	12,000,000	not available
Phosphorus	1,200,000	113,000	not available
BOD5	9,500,000	1,400,000	not available

[1] Portions of collection system for Blue Plains are combined sewers carrying both runoff and sewage. The POTW loadings do not account for discharges from combined sewer overflows. The loadings estimate does account for urban storm water that is conveyed to Blue Plains, treated, and discharged. Recently, concerns have been raised regarding the validity and use of historical data for metals. As discussed in Chapter 2, EPA believes that historical data on storm water runoff are suitable for the purposes of this report.

A number of factors are expected to result in future changes to total loadings and the distribution of loadings between Phase I and Phase II municipalities. Factors that would generally increase loadings include increases in population and the area of urbanized areas. If recent development trends continue, most increases in loadings are expected to occur in urbanized areas with a Phase I municipality. The majority of the increase in loadings in these areas is expected to occur in suburban areas surrounding core cities.

The increased implementation of storm water management measures is expected to generally decrease pollutant loadings. Given the existing Federal mandate for storm water controls, such decreases are expected to occur in Phase I municipalities sooner than in potential Phase II municipalities.

Widespread product substitutions associated with activities that generate pollutants ultimately discharged in storm water may either increase or decrease pollutant loads, depending on the nature of such substitutions.

When analyzing annual loadings associated with urban runoff, it is important to recognize that discharges of urban runoff are highly intermittent and that the short-term loadings associated with individual events will be high and may have shockloading effects on receiving water.

3.3.4 Floatables/Litter/Plastics

Litter is common in urbanized areas. During storm events, litter can be washed into separate storm sewers or carried through other storm water conveyances to receiving waters. Litter is also commonly disposed of directly to storm sewer catchbasins. Discharges from separate storm sewers were identified as major sources of plastics to the surface waters in *Methods to Manage and Control Plastics Wastes—Report to Congress*, (EPA, 1989). Another study concluded that the majority of floating litter that washes up on New Jersey's beaches originates from discharges from separate storm sewers (New Jersey DEP, 1988).

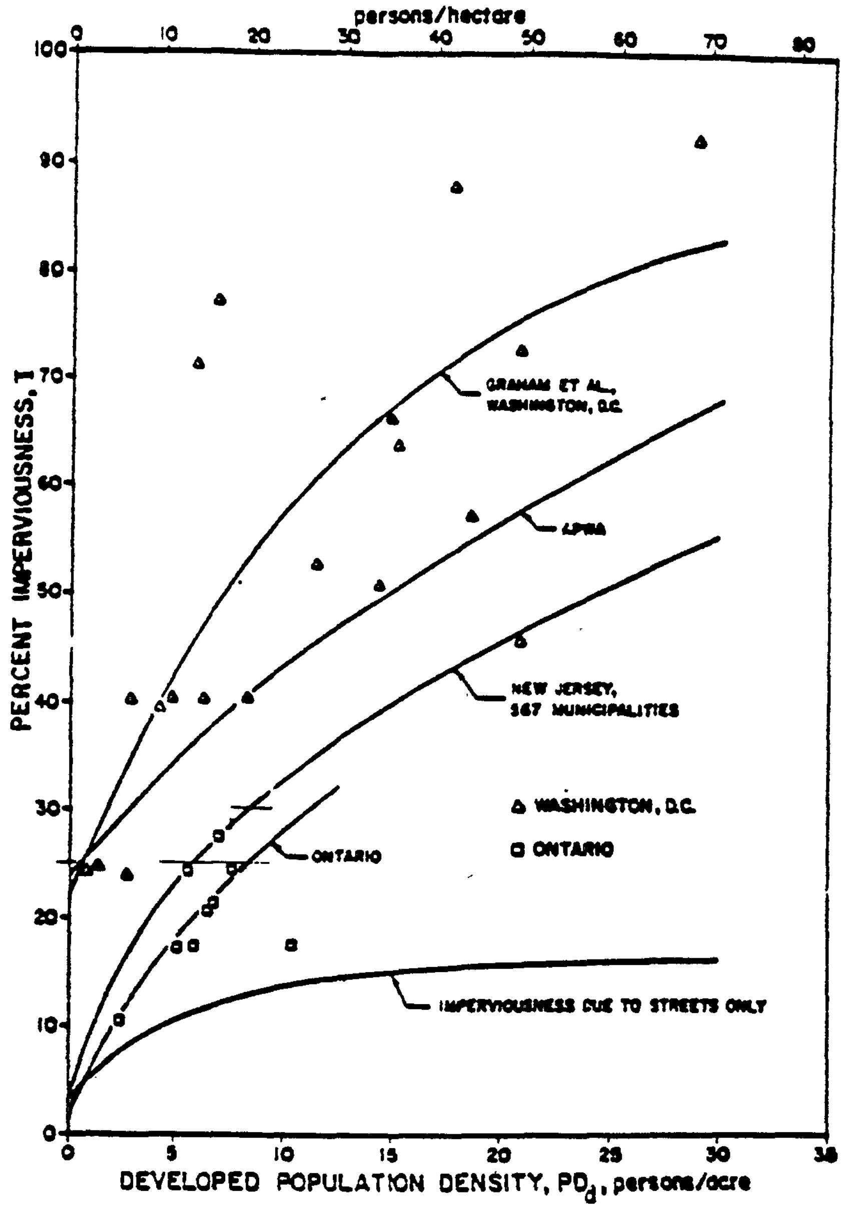
Litter can cause significant aesthetics problems and impact the operating effectiveness of drainage systems and related management practices such as detention ponds.

3.3.5 Population Densities and Imperviousness

As discussed previously, the amount of imperviousness in urban watersheds can be linked to impacts to streams and other surface water resources. The population density of a municipality can be used as an indicator of the level of imperviousness. Figure 3-7 summarizes several studies that attempted to link population densities to percent imperviousness (Kobriger, 1984). However, using population density as an indicator of imperviousness does not account for high levels of day-time use associated with many commercial or industrial areas with high levels of imperviousness.

Population density is related to the total urban population in an area. Table 3-1, presented previously, indicates that as the total population of an urbanized area increases, so does the average population density. The average population density of urbanized areas with a total population of 1,000,000 or more (3,413 persons per square mile) is more than double the average population density of urbanized areas with a population of 50,000 to 100,000 (about 1,600 persons per square mile).

The population density varies within urbanized areas. Core cities generally have a higher population density than outlying suburban areas. However, other smaller cities that are part of larger urbanized areas can have high population densities. In 1990, the Bureau of the Census reported more than 600 incorporated places with populations under 100,000 but with a population density of at least 5,000 persons per square mile. Approximately 550 of the more than 600 incorporated places meeting this criterion were in an urbanized area. Approximately 415 of these incorporated places are in an urbanized area where at least one Phase I municipality is located.



Source: Kobriger, 1984.

Figure 3-7. Relationship Between Population Density and Percent Imperviousness

3.4 SUMMARY

Bureau of the Census estimates that the population of the United States and associated territories was more than 252.2 million in 1990[23] and that there are 19,289 incorporated places and 17,796 minor civil divisions in the continental United States, Alaska and Hawaii. These incorporated places and minor civil divisions are located in 3,141 counties or county equivalents.

The concept of Bureau of the Census-designated urbanized areas served as an important tool for analyzing potential approaches to a Phase II program that addresses municipal separate storm sewer systems. More than 160 million people (63 percent of the total United States population) reside in the 405 urbanized areas with a population of 50,000 or more that have been designated by the Bureau of the Census. These areas occupy less than 2 percent of the Nation's total land area. These areas represent the largest, most widespread areas of dense urban development in the country.

The majority of new urban development also occurs in Census-designated urbanized areas. Construction activity related to new development is recognized as a significant source of pollution and impairment of waterbodies, providing some of the best opportunities for implementing storm water management controls in a highly cost-effective fashion. Between 1980 and 1990, the population of Census-designated urbanized areas increased by 21.2 million.[24] During the same time period, the rural population of the United States increased by 2.2 million, and the urban population that lived outside of urbanized areas increased by 0.9 million. Between 1980 and 1990, the population of urbanized areas with one or more municipal systems addressed by Phase I of the NPDES storm water program increased by 16.4 million (or 75 percent of the total National growth). This represents a 25 percent

[23] Population estimates based on the 50 States, the District of Columbia, Guam, the Commonwealth of Puerto Rico, the Virgin Islands, American Samoa, and the Commonwealth of the Northern Mariana Islands.

[24] About 7 percent of this increase, (1.5 million people) are associated with the net addition of 30 new urbanized areas between 1980 and 1990. Another part of this increase which has not been estimated here is associated with the increase in land area of pre-existing urbanized areas.

increase in the population of these areas. The population of urbanized areas without a Phase I municipal system increased by 2.6 million. This represents 12 percent of the total national growth and a 7 percent increase in the population of these areas.

The population and number of municipalities in urbanized areas, and estimated percentage of pollutant loads in runoff from urbanized areas are summarized in Table 3-20 and discussed below.

Phase I of the NPDES program for storm water discharges addresses 621 incorporated places (cities) and portions of 77 counties.[25] These municipalities had a combined population of 86 million people in 1990. Cities with a population of 100,000 or more whose municipal systems are already addressed by Phase I of the NPDES storm water program increased in population by about 4.9 million between 1980 and 1990.[26] The majority of the population of Phase I municipalities, 81.7 million people live in 136 of the 405 Census-designated urbanized ares. EPA estimates that about 40 percent of the pollutant loads in storm water discharged from urbanized areas come from Phase I municipalities.

The Phase II portions of the 136 urbanized areas with one or more Phase I municipal separate storm sewer system had a combined population of 35.8 million people. The population of those portions of these urbanized areas increased by 2.6 million between 1980 and 1990. EPA estimates that 1,587 incorporated places, 634 minor civil divisions, and parts of 305 counties are located in the Phase II portions of these urbanized areas. EPA estimates that 28 percent of the pollutant loads in storm water discharged from urbanized areas come from Phase II portions of the 136 urbanized areas with a Phase I municipality.

[25] Of these municipalities, 140 cities and 45 counties are specifically identified in the NPDES regulations that were published in November of 1990. EPA and authorized NPDES States have designated an additional 481 cities and 32 counties as Phase I municipalities. In addition, approximately 30 municipalities (located in 21 urbanized areas) have received combined sewer exclusions where the total population served by separate storm sewers is less than 100,000 after subtracting the population served by combined sewers. The methodology used to classify municipalities as Phase I vs. Phase II for the purposes of this report is explained in Chapter 2.

[26] The 4.9 million increase does not include increases associated with unincorporated, urbanized portions of Phase I counties and designated municipalities.

A total of 269 of the Census-designated urbanized areas do not have a municipality with separate storm sewers subject to Phase I of the storm water program. The 269 urbanized areas without a Phase I municipal separate storm system have a combined population of 42.9 million people. EPA estimates that 1,470 incorporated places, 966 minor civil divisions, and parts of 380 counties are located in these urbanized areas. EPA estimates that about one-third of the pollutant loads in storm water discharged from urbanized areas come from the 269 urbanized areas without a Phase I municipality. Of the 269 urbanized areas without a Phase I municipal system, 101, or over a third, have a population of more than 100,000, and 23 have a population of more than 250,000.

In addition to populations within urbanized areas discussed above, the Bureau of the Census has identified an additional urban population of 29 million people that live outside of urbanized areas, as well as 62.8 million people classified as rural. Of this total, 25.1 million people live in 3,689 incorporated places. The remaining 4 million people live in either minor civil divisions or unincorporated portion of counties. Although discharges from municipal separate storm sewer systems serving these populations are potential Phase II sources, they are not addressed in this report.

CHAPTER 4. INDIVIDUAL PHASE II DISCHARGES

This chapter identifies the discharges of storm water other than those from municipal separate storm sewer systems for which permits are not currently required and assesses, to the extent practicable, the nature and extent of pollutants in those discharges. To provide a context for this analysis, this chapter begins with an overview of the industrial categories that are addressed under Phase I of the storm water regulatory program. Using an approach described in Chapter 2 of this report, other categories of industrial, commercial, and retail facilities that may be sources of polluted storm water discharges are identified. For these potential Phase II sources, the type of their discharges and statistics on their geographic distribution are described. The nature of industrial storm water discharges is characterized using a summary of the sampling data reported by Phase I group permit applicants and comparing groups of Phase II sources to these Phase I industries. In an analysis patterned after that in Chapter 3, this chapter also explores the relationship between individual Phase II industrial, commercial, and retail facilities and urbanized areas of different configurations. The final section of this chapter summarizes the results of the analyses and offers some perspectives on individual Phase II storm water discharges. The results of these analyses are meant to be guideposts and are not intended to be an identification of specific industrial categories that must be regulated under Phase II.

4.1 OVERVIEW OF INDIVIDUAL PHASE II SOURCES

There are more than 7.7 million industrial, commercial, retail, and government facilities in the United States.[1] The Office of Management and Budget classifies businesses into categories based on similarity of economic activity. Some aspects of this discussion are

[1] This estimate is based on data from the FACTS data base, which is leased by EPA from Dun & Bradstreet Information Services, which created, maintains, and annually updates information based on a variety of sources. This estimate does not include inactive and abandoned mines which may constitute hundreds of thousands of additional sources.

based on this Standard Industrial Classification (SIC) code system.[2] Table 4-1 presents a breakdown of the major categories of industry and commerce. The current storm water regulatory program potentially applies to some types of individual facilities within the mining, construction, manufacturing, and transportation divisions. There are more than 850,000 enterprises in these divisions; however, only a portion of these are within the 11 categories of activities "associated with industrial activity" as defined by the November 1990 storm water permit application regulations.[3] As a result, from these 850,000 enterprises, EPA has estimated that approximately 150,000 facilities are currently subject to Phase I requirements.

Table 4-1. Summary of Major SIC Divisions of U.S. Commerce

Description	Total Facilities	SIC Codes Covered
Agriculture, Forestry, and Fishing	310,086	01 - 09
Mining	39,936	10 - 14
Construction	805,100	15 - 17
Manufacturing	511,831	20 - 39
Transportation and Public Utilities	306,894	40 - 49
Wholesale Trade	582,681	50 - 51
Retail Trade	1,850,121	52 - 59
Finance, Insurance, and Real Estate	672,693	60 - 67
Services	2,585,750	70 - 89
Public Administration	71,379	90 - 97
Total	7,736,471	

The remaining universe of facilities fall into two main groups, those that have a statutory or regulatory exemption, including agricultural and most silvicultural activities, and those that are considered to be potential Phase II activities. Many of these potential Phase II

[2] The Standard Industrial Classification (SIC) code system organizes industries into categories and subcategories. Major groups are designated by a two-digit code number between 01 and 99. Within major groups, facilities are further categorized at the industry group (3-digit) level and industry (4-digit) level.

[3] This figure excludes about 800,000 building, construction, and specialty contractors, which are regulated to the extent that they engage in construction activities disturbing 5 acres or more.

sources, however, are not expected to become subject to Phase II regulation. Sources that are not in Phase I and are not expected to become subject to NPDES storm water regulation in Phase II consist of sources that lack the potential to contribute significant levels of pollutants to storm water, including financial institutions, some governmental activities and many types of service organizations.

The remaining categories of light industrial, commercial, retail, governmental establishments, and residential activities represent the universe of facilities under consideration for potential inclusion in Phase II. These facilities fall into several general categories with respect to Phase II:

- Facilities with activities essentially identical or closely related to those "associated with industrial activity," that are not covered for a variety of statutory and regulatory reasons.
- Facilities with activities similar to those "associated with industrial activity," such as transportation activities, energy producers and distributors, and utilities.
- Commercial activities with industrial components, such as assembly and repair operations.
- Agriculture-related operations that include currently unregulated feedlots.[4]
- Non-agricultural operations with potential for use of pesticides and fertilizers.
- Facilities and households with failing septic systems.
- Other facilities with potential to use or produce toxic substances, including laboratories and some governmental facilities.

In general, the geographic distribution of industrial, commercial, and retail activity—in short, economic activity—tends to be closely associated with population and population

[4] To be subject to the NPDES program, sources must have point source discharges of pollutants to waters of the United States. EPA has defined concentrated animal feeding operations (CAFOs) as point sources currently subject to permitting under NPDES. This study looks at feedlots which do not meet the regulatory definition of CAFO to study their impacts on water quality and to identify them as potential sources to be covered under Phase II.

density. Through this relationship between population and economic activity, this industrial analysis can be compared with the municipal analysis undertaken in the previous chapter. The Phase I municipal approach is taken as the starting point for a locational analysis of industrial Phase I and potential Phase II sources in this chapter. The municipal component of Phase I of the storm water regulatory program focuses on the largest cities and counties, which contain about one-third of all the facilities in both regulated and nonregulated categories. There are a few notable exceptions to this relationship between economic activity and population, including agricultural and mining activity. These are discussed in more detail later in this chapter.

4.1.1 The Phase I Permitting Framework for Industrial Discharges

Section 402(p) of the CWA provides that EPA or NPDES-approved States cannot require a permit for storm water discharges from individual sources before October 1, 1994, except for discharges "associated with industrial activity" or those that had a permit prior to February 4, 1987, unless they are significant contributors of pollutants to waters of the United States or contribute to the violation of a water quality standard. The Act also clarifies that permits for discharges associated with industrial activity must meet all of the applicable provisions of CWA Sections 402 and 301, including both applicable technology-based requirements and water quality-based standards. All other storm water discharges that are potential candidates for coverage fall under Phase II of the program. The basic permitting framework for Phase I of the NPDES storm water program is established in 40 *CFR* 122, primarily Section 122.26.

The November 16, 1990, storm water regulations described 11 categories of industrial facilities that defined the term "discharges associated with industrial activity." The categories were derived from a combination of narrative descriptions and specific SIC code designations to define and identify Phase I sources (40 *CFR* 122.26(b)(14)). The types of industrial facilities covered by the definition are illustrated in Table 4-2.

Table 4-2. Industrial Facilities That Must Submit Applications for Storm Water Permits (Phase I)

40 *CFR* 122.26(b)(14) Subpart	Description
(i)	Facilities subject to storm water effluent limitations guidelines, new source performance standards, or toxic pollutants effluent standards under 40 *CFR*, Subchapter N [except facilities which are exempt under category (xi)].
(ii)	Facilities classified as: SIC 24 (except 2434) . . . . . . Lumber and Wood Products SIC 26 (except 265 and 267) . Paper and Allied Products SIC 28 (except 283 and 285) . Chemicals and Allied Products SIC 29 . . . . Petroleum and Coal Products SIC 311 . . . . Leather Tanning and Finishing SIC 32 (except 323) . . . . . . Stone, Clay and Glass Products SIC 33 . . . . Primary Metal Industries SIC 3441 . . . . Fabricated Structural Metal SIC 373 . . . . Ship and Boat Building and Repairing
(iii)	Facilities classified as SIC 10 through 14, including active or inactive mining operations and oil and gas exploration, production, processing, or treatment operations, or transmission facilities that discharge storm water contaminated by contact with, or that has come into contact with, any overburden, raw material, intermediate products, finished products, byproducts, or waste products located on the site of such operations. SIC 10 . . . . Metal Mining SIC 11 . . . . Anthracite Mining SIC 12 . . . . Coal Mining SIC 13 . . . . Oil and Gas Extraction SIC 14 . . . . Nonmetallic Minerals, except Fuels
(iv)	Hazardous waste treatment, storage, or disposal facilities, including those that are operating under interim status or a permit under Subtitle C of the Resource Conservation and Recovery Act (RCRA).
(v)	Landfills, land application sites, and open dumps that receive or have received any industrial wastes including those that are subject to regulation under subtitle D or RCRA.
(vi)	Facilities involved in the recycling of material, including metal scrapyards, battery reclaimers, salvage yards, and automobile junkyards, including but not limited to those classified as: SIC 5015 . . . . Motor Vehicle Parts, Used SIC 5093 . . . . Scrap and Waste Materials
(vii)	Steam electric power generating facilities, including coal handling sites.
(viii)	Transportation facilities which have vehicle maintenance shops, equipment cleaning operations, or airport de-icing operations. Only those portions of the facility that are either involved in vehicle maintenance (including vehicle rehabilitation, mechanical repairs, painting, fueling, and lubrication), equipment cleaning operations, or airport de-icing operations, or which are otherwise listed in another category, are included. SIC 40 . . . . Railroad Transportation SIC 41 . . . . Local and Suburban Transit SIC 42 (except 4221-25) . . . . Motor Freight and Warehousing SIC 43 . . . . U.S. Postal Service SIC 44 . . . . Water Transportation SIC 45 . . . . Transportation by Air SIC 5171 . . . . Petroleum Bulk Stations and Terminals

Table 4-2. Industrial Facilities That Must Submit Applications for Storm Water Permits (Phase I) (continued)

40 *CFR* 122.26(b)(14) Subpart	Description
(ix)	Treatment works treating domestic sewage or any other sewage sludge or wastewater treatment device or system, used in the storage, treatment, recycling, and reclamation of municipal or domestic sewage, including lands dedicated to the disposal of the sewage sludge that are located within the confines of the facility, with a design flow of 1.0 million gallons per day or more, or required to have an approved pretreatment program under 40 *CFR* Part 403. Not included are farm lands, domestic gardens, or lands used for sludge management where sludge is beneficially reused and which are not physically located in the confines of the facility, or areas that are in compliance with Section 405 of the CWA.
(x)	Construction activity including clearing, grading, and excavation activities except operations that result in the disturbance of less than 5 acres of total land area and those that are not part of a larger common plan of development or sale.
(xi)	Facilities under the following SICs [which are not otherwise included in categories (ii)-(x)], including only storm water discharges where material handling equipment or activities, raw materials, intermediate products, final products, waste materials, byproducts, or industrial machinery are exposed to storm water. SIC 20 .... Food and Kindred Products SIC 21 .... Tobacco Products SIC 22 .... Textile Mill Products SIC 23 .... Apparel and Other Textile Products SIC 2434 .... Wood Kitchen Cabinets SIC 25 .... Furniture and Fixtures SIC 265 .... Paperboard Containers and Boxes SIC 267 .... Converted Paper and Paper Board Products (except containers and boxes) SIC 27 .... Printing and Publishing SIC 283 .... Drugs SIC 285 .... Paints, Varnishes, Lacquer, Enamels SIC 30 .... Rubber and Misc. Plastics Products SIC 31 (except 311) .... Leather and Leather Products SIC 323 .... Products of Purchased Glass SIC 34 (except 3441) .... Fabricated Metal Products SIC 35 .... Industrial Machinery and Equipment, except Electrical SIC 36 .... Electronic and Other Electric Equipment SIC 37 (except 373) .... Transportation Equipment SIC 38 .... Instruments and Related Products SIC 39 .... Miscellaneous Manufacturing Industries SIC 4221 .... Farm Products Warehousing and Storage SIC 4222 .... Refrigerated Warehousing and Storage SIC 4225 .... General Warehousing and Storage

Source: *Federal Register*, Vol. 55, No. 222, p. 48065, November 16, 1990.

Note: On June 4, 1992, the U.S. Court of Appeals for the Ninth Circuit remanded the exemption for construction sites of less than five acres and for manufacturing facilities in category (xi) which do not have materials or activities exposed to storm water to the EPA for further rulemaking. *NRDC* v. *EPA*, 966 F.2d 1292 (9th Cir. 1992). In response to the remands, the Agency intends to conduct further rulemakings on both the light manufacturing and the construction activities. In the December 18, 1992, *Federal Register*, EPA stated that it is not requiring permit applications from construction activity under five acres or light industry without exposure until this further rulemaking is completed.

For a more complete discussion of the interpretation of this definition, refer to the *NPDES Storm Water Program Question and Answer Document*, Parts I and II (EPA, 1992, 1993), which appear in Appendix D.

The original permitting framework of Phase I provided operators of industrial facilities with three options for applying for NPDES permit coverage. They could (1) submit individual applications, (2) participate in a group application, or (3) submit a notice of intent to be covered by a general permit.[5] For the first phase of the storm water program, EPA issued general permits to facilitate permitting the large number of facilities covered by the program on September 9, 1992 (57 *FR* 41176), September 25, 1992 (57 *FR* 44412), and April 14, 1993 (58 *FR* 19427). This Phase I framework is the result of a lengthy rulemaking process that included opportunities for, and response to, public comment. In addition, authorized NPDES States have issued numerous other general permits for facilities within their States.

Section 402(p)(2)(E) of the CWA allows EPA or States to require permits for any other discharges determined to be a contributor to a violation of a water quality standard or a significant contributor of pollutants to waters of the United States. Thus, the Phase I approach provides the foundation for extending regulation to additional sources and classes of discharges, as appropriate.

4.1.2 Industrial, Commercial, and Retail Sources *Not* Subject to Phase I Permit Requirements

This section responds to Congress' first mandate in CWA Section 402(p)(5): to identify the sources of storm water discharges for which permits are not currently required under Phase I. This chapter addresses individual Phase II sources; municipal separate storm sewer systems were discussed in Chapter 3. Based on a review of those facilities not subject to Phase I permitting requirements and a screening procedure based on information drawn from the literature review, activities were identified that may present opportunities for pollutant releases to storm water. The purpose of the source identification is to present the

[5] The group application permitting option is no longer available to permit applicants because the application deadlines have passed. EPA proposed an industry-specific multi-sector model general permit based on the information received through the group application process on November 19, 1993. EPA will be finalizing the multi-sector general permit in the near future.

full range of potential Phase II sources and to characterize them to the extent possible to facilitate decision making on the appropriate scope and approach of Phase II. The screening process was used to narrow consideration to a subset of facilities that may be appropriate for coverage under Phase II. Both the regulatory analysis and screening procedure are described below.

4.1.2.1 Phase I Regulatory Review

In defining "storm water discharges associated with industrial activity," the Phase I regulations identify 11 categories of facilities considered to be engaging in "industrial activity" (see Table 4-2). Only those facilities described in the 11 categories of the definition that have point source discharges of storm water are required to apply for storm water permit coverage under Phase I of the program. As shown in Table 4-2, regulated activities under Phase I were identified by SIC category, narrative descriptions of activities, or, in some cases, both. For example, Category viii regulated activities are defined as "only those portions of the facility that are either involved in vehicle maintenance . . ., equipment cleaning operations, or airport de-icing operations, or which are otherwise listed in another category . . . ." Seven separate SIC codes are then listed, including six two-digit codes and one four-digit code; several four-digit codes were specifically omitted from coverage.

There are a number of sources closely related to Phase I activities that are currently unregulated. One general class includes construction activities that disturb less than 5 acres (Category x) and light industrial activities that have no exposure of materials to storm water (Category xi). On June 4, 1992, the Court of Appeals for the Ninth Circuit remanded the exemption of both of these categories from the original storm water regulations.[6] The court found that EPA had not adequately established that light industrial facilities without exposure of materials or operations to storm water and construction sites disturbing less than 5 acres were non-industrial in nature.

[6] *Natural Resources Defense Council v. EPA*, 966 F.2d 1292 (9th Cir. 1992).

In response to the Ninth Circuit Court ruling, EPA issued a *Federal Register* notice on December 18, 1992, to explain the outcome of the ruling and to request comment and specific factual information to assist in the development of a new proposal to address light industry and small construction site categories. EPA noted that it did not believe that the court's decision has the effect of automatically subjecting small construction sites and light industries to the existing application requirements and deadlines. The Agency also indicated that it believed that additional notice and comment were necessary to clarify the status of these facilities. To the extent that some or all of these facilities may not be addressed by Phase I, they would be potential Phase II sources.

Additional categories of potential Phase II facilities have been identified based on the screening procedure described below.

4.1.2.2 Screening Procedure

Potential Phase II sources, categories, and activities were identified using previous information and additional screening based on the major sectors of the economy identified by SIC codes. Identifying potential Phase II sources based on SIC codes facilitates quantitative analysis of the numbers of facilities potentially subject to Phase II and provides a basis for a geographical location analysis that parallels the municipal analysis in Chapter 3. The geographical analysis (discussed in Section 4.2.2) was developed to show the distribution and "concentration" of non-domestic enterprises across the country and their association with various sizes and types of population centers. This geographical approach could later be related to a water quality or environmental assessment at a finer level of detail at the regional, state or local level.

As discussed in Chapter 2, major sectors of the economy are defined on the basis of the two-digit SIC code. This two-digit code is a relatively general categorization of the Nation's economic activity: all industrial, commercial, and retail activities are organized into 83 two-digit SIC codes. The four-digit SIC code provides a more detailed breakdown of these enterprises and is much more specific to the activities conducted at the establishment. Although all unregulated activities are potential Phase II sources, in practical terms, only a subset of four-digit SIC industry groups has real potential to use, process, or store pollutant-bearing materials or to engage in activities that could lead to contamination of storm water.

SIC codes are assigned by economic activity, not pollution potential. However, economic activities often correspond to physical activities or use of specific materials that can be assessed relative to the potential to generate storm water pollution. Thus, SIC codes can serve as an indicator of the underlying activities or materials of concern, even if they cannot be used to directly assess environmental effects.

The screening process described below focuses on two broad classes of facilities. The first (designated Group A) consists of facilities that fall within the same general range of SIC codes as Phase I industrial activities but that are not covered under Phase I. The second major group (designated Group B) consists of a specific subset of four-digit SIC codes of concern (outside SIC codes 10-45) where discharges of pollutants are suspected based on case studies, expert opinion, literature review, other EPA programs and concerns, and experience with Phase I of the storm water program.

This screening process does not establish negative environmental effects from storm water discharges. It does serve as a tool for focusing attention on those categories potentially contributing to storm water pollution. The geographical analysis reported in Section 4.2.2 allows EPA to determine how these specific categories of potential Phase II facilities are distributed nationally in geographic areas of concern (e.g., urbanized areas).

The following criteria were used to identify four-digit SIC codes of primary environmental concern. First, facilities highly similar to Phase I facilities are identified (Group A). Next, an additional 12 categories of potential Phase II sources are identified based on their similarity to Phase I activities or based on case studies and expert opinion

(Group B). These 12 Group B categories are then related to specific SIC code groupings for subsequent analysis in Section 4.2. The categories identified through this process represent the types of establishments or activities that may warrant further investigation and control under Phase II. This preliminary identification does not establish that water quality impacts are occurring.

As noted earlier, the SIC code system is a useful framework for identifying the numbers and locations of facilities. The SIC approach allows EPA to access information from many sources with a very precise level of detail, because of the efforts of many organizations (e.g., Commerce Department) to record and track economic activity by industrial category. Still, focusing on SIC codes for the purposes of this study does not imply that a regulatory strategy must proceed on this basis. The types of activities conducted at these facilities could be regulated through narrative descriptions, as was done for some categories in Phase I. Experience with the Phase I definition of "discharges associated with industrial activity" suggests that SIC designations alone may not be completely satisfactory because activities of concern may be conducted at a wide variety of facilities that do not happen to have the same primary SIC code. In addition, other potential Phase II sources that are not reflected by the SIC code system, including parking lots, large retail complexes, and facilities or residences with septic systems for septic wastewater disposal, can similarly be studied for impacts on water quality or regulated based on narrative description. Even within an SIC-based regulatory framework, additional factors, such as size, location, pollutant usage, or activity cutoffs or restrictions, can be used to identify specific facilities for regulation based on a potential correlation between facilities and water quality impacts.

The SIC system does not capture some types of facilities or activities that generate storm water discharges. SIC codes are designated based on the primary activity in which an establishment is engaged. A business that is involved in a number of different activities will be classified according to a single industrial code, which may not reflect activities associated with storm water discharges. In addition, some facilities carry out activities off-site, such as material storage and vehicle maintenance, that will not have independent business identities and, thus, no separate SIC designations. Similarly, the SIC system may not identify all facilities that are owned or operated from a remote central business location. The SIC system also does not individually identify industrial activities associated with municipalities. Although some municipal services (e.g., public ambulance services) are identified, other types of activities (e.g., municipal power generating facilities) are not captured within the SIC system. Even with these limitations, EPA analysis of potential Phase II sources in terms of SIC code assignments provides an extremely valuable analytical tool to assess the location and concentration of these activities at the national level.

Group A Sources

Although Phase I industrial activities generally fall within SIC codes 10-45, there are many omissions and exceptions within this range. While some of these omissions were intentional, others are the result of the specificity of the 1990 application regulations. Other facilities have been excluded from Phase I based on specific legislative changes. These classes of facilities are deserving of special attention due to their extreme similarity to Phase I industrial activities. For the purposes of discussion and analysis in this report, these facilities have been classified as Group A.

To clearly identify Phase II facilities that fall within the SIC range 10-45, a list of unregulated activities related to Phase I sources in each of the 11 industrial categories was developed. This list appears in Table 4-3. The similarity of many of the facilities on this list to Phase I facilities makes them difficult to distinguish from Phase I facilities for the purposes of the analyses in this report. In order to help characterize these sources, they have been categorized below according to three main criteria. The three groups identified together make up Group A. Although these groups do not encompass every one of the possible exceptions presented in Table 4-3, they represent the majority of facilities in SIC codes 10-45 that were not addressed under Phase I.

Table 4-3. Categories of Activities *Not* Regulated Under Phase I

Category	Activities and Facilities
i	• Facilities that were not considered for inclusion in the effluent guideline formulations
ii	• Offsite warehouses (unless auxiliary to a regulated facility) • Offsite salt storage piles • Chemical distributors that conduct incidental mixing and blending of products • Distributors of farm products and equipment with mixing and blending of fertilizers (not SIC 2875)
iii	• Pipelines • Petroleum product distribution, including SIC 49
iv	• Hazardous waste generation/storage sites subject to certain RCRA Subtitle C requirements but not permitting
v	• Landfills that have not received or do not receive industrial waste (Municipal Solid Waste Landfills (MSWLFs)) • Solid waste transfer stations with no vehicle maintenance or that are owned or operated by the entity that owns the final disposal site • Land application of sewage treatment plant effluent (exempted from RCRA requirements) • Incinerators (BIFs and municipal incinerators) (hazardous waste incinerators are permitted under RCRA Subtitle C and therefore are regulated under Phase I) • Temporary offsite waste storage sites
vi	• Interim recycling facilities (collection sites, satellite storage sites)
vi	• Facilities that generate electricity, but do not use steam electric generation
viii	• General equipment and vehicle storage/maintenance yards (municipal fire trucks, police cars, park maintenance; construction equipment yards) • Vehicle maintenance of garbage collection trucks owned by landfill operator • SIC 40-45 facilities without vehicle maintenance • Material handling/storage areas at SIC 40-45 facilities • School bus maintenance facilities owned or operated by school districts • Mining related equipment maintenance • Warehouses under SIC 4226 that do not have vehicle maintenance • Petroleum product wholesalers (SIC 5172) and bulk stations (SIC 5171) without vehicle maintenance
ix	• Treatment works with design flows less that 1 MGD (Transportation Act of 1991 exempted POTWs owned or operated by municipalities with population of less than 100,000) • Off-site non-domestic sewage treatment plants and sludge drying beds • Portable sanitary and septage service facilities • Water treatment plants
x	• Construction operations that result in the disturbance of less that five acres of total land area are under review due to the court opinion in *Natural Resources Defense Council* v. *EPA*, 966 F.2d 1292 (9th Cir. 1992)
xi	• Facilities where there is no exposure of material are under review due to the court opinion on *Natural Resources Defense Council* v. *EPA*, 966 F. 2d 1292 (9th Cir. 1992)

- **Auxiliary Facilities or Secondary Activities**—SIC codes are assigned on the basis of the primary activity from a financial standpoint that is taking place at a particular facility. Facilities with industrial activities that are in support of, or auxiliary to, a non-regulated activity would not be covered under Phase I. Examples include maintenance of construction equipment and vehicles and local trucking for an unregulated facility (grocery stores etc.).

- **Facilities Intentionally Omitted from Phase I**—Another class of facilities which are not addressed under Phase I are those that are related to, but were intentionally omitted from, one of the 11 industrial categories. For example, category ix does not cover treatment works with a design flow of less than 1 MGD, and category v does not address landfills that have not received industrial waste. While these activities may be slightly different from Phase I activities in size, scope, or specific materials present, there are many similarities which may make these facilities a potential concern in Phase II.

- **Facilities Exempted by the Transportation Act**—The Intermodal Surface Transportation Efficiency Act of 1991 (Transportation Act) exempted most industrial activities owned or operated by municipalities of less than 100,000 people from permit coverage under Phase I.[7] This exemption applies to approximately 19,000 incorporated places and 17,000 minor civil divisions in over 3000 counties. It is important to note that these activities are identical to Phase I facilities and are not located in municipalities which are covered under Phase I.

The overlap in SIC code assignments between Group A facilities and Phase I regulated activities make accurate estimation of the number of facilities in Group A very difficult. The estimates used are based on a process of elimination. Beginning with the total number of facilities in SIC codes 10-45 and subtracting the number of facilities accounted for under Phase I gives approximately 100,000 to 200,000 facilities. This is roughly equivalent to the size of Phase I. The difficulty in distinguishing these facilities from their closely related Phase I analogues also makes the geographic analysis conducted in section 4.2 difficult. Although the analysis has been conducted on a general basis for the entire group, this will only yield an overall approximation. Sub-classes of facilities within this group may be

[7] The Transportation Act exempted industrial activities owned or operated by municipalities of less than 100,000 population from Phase I permitting requirements with the exception of powerplants, airports, and uncontrolled sanitary landfills.

distributed quite differently. For information on the distribution of specific two-digit SIC codes within group A, see Appendix G.

Group B Sources

Based on the regulatory review and analysis of the types of industrial sources not covered under Phase I (discussed previously), several categories of facilities that are inherently similar or related to Phase I sources, but that fall into SIC code categories outside of SIC codes 10-45, were identified. A number of criteria were used to develop a comprehensive list of facilities which should be considered for inclusion in Phase II. This list constitutes Group B.

The first criteria used to identify Group B facilities were activities with industrial components or closely related activities. The main categories identified include:

- **Transportation Activities and Services**—SIC series 478x, which are similar to those identified in Category viii of the Phase I definition (see Table 4-2)
- **Energy Producers and Distributors**—Similar to Categories iii and vii, including pipelines (SIC 461x) and petroleum producers (SIC 4925)
- **Other Utilities**—Water supply, irrigation, and sanitation services that may often be municipally operated (SICs 494x, 495x, and 497x), which are related to Category ix
- **Municipal or Governmental Activities or Services**—In the 922x series that may have industrial components (Category ii) or activities related to transportation or vehicle maintenance (Category viii) (e.g., police stations, jails, and fire stations).

The next criterion used was commercial facilities with industrial components or similar operations. Commercial facilities were specifically excluded from Phase I by congressional intent. However, officials engaged in controlling urban runoff and nonpoint source pollution at the local, State, and national level believe that many commercial sources represent an important environmental concern. These concerns are documented in State and local nonpoint source programs, urban runoff programs, and estuary programs identified through the literature review. The Rensselaerville Study (1992) reflected potential areas of concern by identifying "gas, auto, service stations, transportation related activities, highway systems, land development, agricultural sources and related activities, commercial activities with industrial components, and large retail complexes."[8] Taking a broad view of these descriptions, facilities were identified in two main categories. The first category comprises commercial or retail establishments with industrial components or activities:

- Many types of establishments that provide automotive or transportation services, including car dealers and gas/service stations (SICs in the 55xx series) and other automobile-related services and maintenance with SIC codes from 751x to 754x, such as truck and car renters, various types of repair and body shops, parking structures, and car washes

- Commercial enterprises involved in fuel wholesaling and distribution, such as gas and petroleum storage and distribution (SICs 493x and 517x) and fuel oil and coal dealers (SIC 598x)

- Commercial or wholesale enterprises with manufacturing or assembly activities, mainly in the 50xx and 52xx series

- Commercial or wholesale facilities that include food processors or wholesalers that may have organic wastes (SIC 514x), photographic studios (SIC 7221) and photo finishing labs (SIC 7384), small repair shops that may have metal wastes (SIC 769x), including repair of communications devices, refrigeration units, other electrical or electronic devices, and welding; research and testing laboratories (SIC 873x) and laundries (SIC 721x)

- National security entities (SIC 9711); although industrial activities at military facilities are regulated in Phase I, potential Phase II activities may be located on these sites as well and would not show up individually in the analysis that follows.

The second category consists of commercial or retail facilities and other sources that are similar or related to agricultural activities or sources and includes:

[8] No SIC codes specifically identify all large retail complexes. However, these are partially addressed through the loading analysis of storm water from urban/urbanized areas in the municipal section (Chapter 3). If such items were to be addressed in a regulatory framework, it would likely be on the basis of a narrative description rather than a SIC designation.

- Agriculture-related operations in the SIC groups 021x and 025x because they may represent confined animal facilities or feedlots.[9] Wholesale livestock facilities (SIC 5154) were also included under this criterion as were animal husbandry operations aside from general farms, such as zoos (SIC 8422), racetracks and stables (SIC 7948), which may have operations that are similar to feedlots.

- Because of potential for use of pesticides and fertilizers, the following were included: nurseries and lawn and garden facilities (SIC 078x) and other facilities that may store, mix, or use agricultural chemicals or other pesticides, such as farm products and raw materials sellers (SIC 5159), wholesalers of chemicals and allied products (SIC 5169), farm suppliers (SIC 5191), lawn and garden suppliers (SIC 5261), and exterminators (SIC 7342).

- Other facilities that may use pesticides or fertilizers in substantial quantities, such as golf courses and other recreational establishments with large lawns (SIC 799x) and colleges and schools (SIC 822x), which may have lawns, gardens, nurseries, or experimental agricultural areas. (These may also operate power plants or treatment works or engage in other activities similar to regulated industrial categories.)

From the 12 categories of Group B Phase II sources identified above, the universe of facilities was screened to identify a specific subset for further analysis. Through this selection process, potential Phase II facilities were identified, including those associated with products or waste materials that contain pollutants, such as metals, pesticides, and nutrients, and those associated with processes, practices, or events that can lead to the discharge of those pollutants into storm water. The SIC manual identifies 83 major groups of SIC codes in 10 major divisions (identified in Table 4-1). These major groups are divided into 1,047 four-digit categories. Of these, 604 fall into Phase I regulated activities or closely related facilities which make up Group A (SIC 10-45). Of the 443 that remain in agricultural, commercial, and retail divisions, 168 fall into the excluded service sectors. Of the remaining 275 categories, the screening process and the 12 categories identified above correspond to 90 individual categories of facilities and activities for further study as potential Phase II sources.

[9] See footnote 4 regarding feedlots currently regulated under the NPDES program.

This subset of 90 four-digit SIC codes is listed in Table 4-4. More than a million facilities were identified for these SIC categories by searching EPA's Facility and Company Tracking System (FACTS) data base.[10]

To facilitate analysis, some additional grouping is necessary. These 90 individual categories could be grouped together based on the 12 criteria used to identify them. However, some of the criteria group together dissimilar activities. For example, "commercial wholesalers" include four dissimilar categories: wood, ore, metal, and machinery wholesalers. Based on these distinctions, the 12 groups were further subdivided, forming 18 potential Phase II sectors. The 18 sectors are listed in Table 4-5. The affiliation of each specific SIC code with a sector is shown in Table 4-4, along with the numbers of facilities in that SIC code. This grouping into sectors facilitates discussion of similarities and differences among categories later in the chapter.

The data on numbers of facilities in Table 4-4 reveal some interesting facts about individual categories. Of the 18 Group B sectors, the automobile service sector (comprised of gas/service stations (SIC 5541), general automobile repair (SIC 7538), top, body repair (SIC 7532), repair shops and services (SIC 7699), car dealers, new & used (SIC 5511), car dealers, used only (SIC 5521), car washes (SIC 7542), passenger car rental (SIC 7514), truck rental (SIC 7513), parking structures (SIC 7521), and miscellaneous auto services (SIC 7549)) make up more than one-third of the total number of facilities identified in all 18 sectors.

Table 4-5 also shows facility counts for the 18 Group B sectors, illustrating even more clearly the dominant categories. Facilities engaged in automotive service and vehicle maintenance are far more numerous than other groups of potential Phase II sources. Machinery and electrical repair facilities are the second largest group, and intensive users of agricultural chemicals, including lawn and garden establishments and nurseries, are the third largest group.

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[10] As discussed in Chapter 2, the FACTS data base is leased by EPA from Dun & Bradstreet Information Services, which created, maintains, and annually updates information based on a variety of sources.

Table 4-4. SIC Codes Selected for Study Based on Screening Procedure

SIC Code	Description Selected (90) 4-Digit Code	Number of Facilities	Phase II* Sector
5541	Gas/Service Stations	91,924	Automotive Service
7538	General Auto Repair	87,994	Automotive Service
7699	Repair Shops & Related Svcs., NEC	70,095	Machinery & Electrical Repair
7532	Top, Body Repair	48,800	Automotive Service
5084	Industrial Mach. & Equipment	38,880	Wholesale, Machinery
5511	Car Dealers, New & Used	37,387	Automotive Service
0782	Lawn & Garden Services	36,369	Intensive Ag. Chemical Use
5211	Lumber & Bldg. Materials	34,757	Wholesale, Wood Products
5521	Car Dealers, Used Only	32,145	Automotive Service
7539	Specialized Repair	26,381	Automotive Service
7216	Dry Cleaning	22,042	Laundries
7622	Radio and Television Repair	20,527	Machinery & Electrical Repair
5191	Farm Supplies	20,189	Intensive Ag. Chemical Use
7221	Photographic Studios	20,010	Photographic Activities
9629	Electrical Repair Shops, NEC	19,448	Machinery & Electrical Repair
5261	Lawn & Garden Supply	19,443	Intensive Ag. Chemical Use
5085	Industrial Supplies	17,869	Wholesale, Machinery
0212	Beef Cattle, not Feedlots	14,684	Livestock, Feedlots
7692	Welding Repair	14,305	Machinery & Electrical Repair
5031	Lumber, Millwork	13,836	Wholesale, Wood Products
5083	Farm Mach. & Equip.	13,670	Wholesale, Machinery
7217	Carpet Cleaners	13,636	Laundries
7549	Misc. Automotive Services	13,571	Automotive Service
7542	Car Washes	12,842	Automotive Service
7342	Disinfect/Exterminating	12,359	Intensive Ag. Chemical Use
4731	Arrangement Freight Trans.	12,303	Transport, Rail and Other
0241	Dairy Farms	12,298	Livestock, Feedlots
5172	Petroleum Products/Dist.	11,128	Petrol. Pipelines & Distributors
0181	Ornamental Nurseries	11,019	Intensive Ag. Chemical Use
4953	Refuse Systems	10,797	Various Utilities
7384	Photo Finishing Labs	10,674	Photographic Activities
5169	Chem & Allied Prod, NEC	10,355	Intensive Ag. Chemical Use
5051	Metal Service Centers	10,267	Wholesale, Metal Products
7623	Refrig. & Air Condition. Repair	8,504	Machinery & Electrical Repair
5171	Petroleum, Bulk	8,086	Petrol. Pipelines & Distributors
7514	Passenger Car Rental	7,939	Automotive Service
7513	Truck Rental	7,799	Automotive Service
7212	Garment Cleaners	7,280	Laundries
0783	Shrub & Tree Services	7,260	Intensive Ag. Chemical Use
5983	Fuel Oil Dealers	7,233	Petrol. Pipelines & Distributors
5082	Constr. & Min. Mach.	7,143	Wholesale, Machinery
8221	Colleges and Universities	6,829	Extensive Ag. Chemical Use
8731	Comm. Research Labs	6,382	Laboratories
5984	Fuel and Coal Dealers	6,226	Petrol. Pipelines & Distributors
5147	Meat & Products	5,298	Wholesale, Food
4941	Water Supply	4,904	Various Utilities

Table 4-4. SIC Codes Selected for Study Based on Screening Procedure (continued)

SIC Code	Description Selected (90) 4-Digit Code	Number of Facilities	Phase II* Sector
8249	Vocational Schools	4,647	Extensive Ag. Chemical Use
5146	Fish & Seafoods	4,579	Wholesale, Food
7219	Laundry Services	4,575	Laundries
5154	Livestock	4,351	Livestock, Feedlots
0213	Hogs	4,328	Livestock, Feedlots
8734	Testing Laboratories	4,301	Laboratories
7992	Golf Courses, Public	4,295	Extensive Ag. Chemical Use
5039	Construct Materials	4,036	Wholesale, Metal Products
9511	Air, H_2O & Solid Waste Mgmt.	3,688	Various Utilities
7521	Parking Structures	3,088	Automotive Service
0211	Beef Cattle Feedlots	2,972	Intensive Ag. Chemical Use
7211	Laundries	2,940	Laundries
7694	Armature Rewinding Shops	2,865	Machinery & Electrical Repair
9221	Police Protection	2,508	Munic. Services, Vehicle Maint.
9711	National Security	2,414	National Security
7948	Race Tracks/Stables	2,271	Livestock, Feedlots
5159	Farm Prods. Raw Mats	1,895	Intensive Ag. Chemical Use
4959	Sanitary Svcs., NEC	1,894	Various Utilities
8222	Junior Colleges	1,850	Extensive Ag. Chemical Use
9223	Jails	1,714	Munic. Services, Vehicle Maint.
5144	Poultry & Products	1,495	Wholesale, Food
5052	Coal/Minerals & Ores Wholesale	1,384	Wholesale, Coal & Ores
7996	Amusement Parks	1,371	Extensive Ag. Chemical Use
0252	Chicken Eggs	1,171	Livestock, Feedlots
0219	General Livestock, not Dairy	1,160	Livestock, Feedlots
4783	Packing and Crating	1,099	Transport, Rail and Other
5989	Fuel Oil Dealers, NEC	1,075	Petrol. Pipelines & Distributors
0251	Broiler, Fryer, Roaster Chicken	941	Livestock, Feedlots
7218	Ind. Launderers	903	Laundries
4789	Transport Services, NEC	899	Transport, Rail and Other
0254	Poultry Hatcheries	719	Livestock, Feedlots
4971	Irrigation System	662	Various Utilities
0214	Sheep and Goats	618	Livestock, Feedlots
4925	Gas Producers, Distributors	604	Petrol. Pipelines & Distributors
0273	Animal Aquaculture	595	Livestock, Feedlots
4612	Crude Petroleum Pipelines	390	Petrol. Pipelines & Distributors
9229	Fire Protection	389	Munic. Services, Vehicle Maint.
4613	Refined Petroleum Pipelines	347	Petrol. Pipelines & Distributors
4785	Weighing: Vehicle Trans.	332	Transport, Rail and Other
4939	Utilities, NEC	297	Various Utilities
8422	Botanical Gardens & Zoos	285	Livestock, Feedlots
4932	Gas & Service	212	Petrol. Pipelines & Distributors
4741	Rental of Railroad Cars	175	Transport, Rail & Other
4619	Pipelines, NEC	18	Petrol. Pipelines & Distributors
	TOTAL	1,015,239	

*Phase II sector is a grouping devised to facilitate discussion of similar facilities. The sectors are further described in the text and summarized in Table 4-5.

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Table 4-5. Summary of Group B Phase II Sectors

Description of Phase II Sectors	No. of Facilities
Automotive Service	369,870
Machinery & Electrical Repair	135,744
Intensive Ag. Chemical Use (a)	121,861
Wholesale, Machinery	77,562
Laundries	51,376
Wholesale, Wood Products	48,593
Livestock, Feedlots	43,421
Petroleum Pipelines & Distributors	35,319
Photographic Activities	30,684
Various Utilities	22,242
Extensive Ag. Chemical Use (b)	18,992
Transport, Rail and other	14,808
Wholesale, Metal Products	14,303
Wholesale, Food	11,372
Laboratories	10,683
National Security	4,611
Municipal Services, Vehicle Maint.	2,414
Wholesale, Coal & Ores	1,384
Total	1,015,239

(a) e.g., nurseries, farm chemical suppliers & distributors
(b) e.g., large lawns, golf courses

Remaining Phase II Activities

The identification of all Phase I facilities together with facilities in Groups A and B only account for approximately 1.5 million of the estimated 7.7 million total facilities. This leaves over 6 million facilities "unaccounted for" in this analysis. These remaining facilities include a wide range of activities which fall into a number of general classifications.

General Sources—Widespread sources of potential storm water contamination which are not necessarily associated with any one particular activity are a large category of sources not addressed in this analysis. These include parking lots, trash dumpsters, leaking and failing septic systems, and activities related to individual residences such as fertilizer and pesticide application. The tremendous number of these sources would make individual permitting virtually impossible. Although the identification and analysis of individual Phase II sources does not focus on these sources, the municipal analysis does account for pollutant loadings from these types of sources which are related to the general process of urbanization.

Service Sectors—Major SIC groups in the service sectors, such as banking, finance, insurance firms, and all types of food services were not considered to be potential Phase II sources. The activities of these enterprises are generally conducted indoors and do not inherently use or produce contaminants that may enter storm water. However, these facilities may also have some of the general sources of storm water contamination discussed above, such as parking lots or trash dumpsters. All of the major SIC groups excluded on this basis are listed in Table 4-6. Although the analysis of this report does not focus on service sector facilities in detail at the four-digit SIC level, the geographic and distributional analysis was conducted for these facilities at the major group (two-digit SIC) level. These results are presented in Appendix G.

4.2 NATURE AND EXTENT OF POLLUTANTS ASSOCIATED WITH INDIVIDUAL PHASE II SOURCES

This section responds to the second congressional mandate in CWA Section 402(p)(5): to determine the nature and extent of pollutants in storm water discharges to the maximum extent practicable. EPA developed quantitative and qualitative information on the types of activities or materials associated with potential Phase II sources and their locations relative to various geographic jurisdictions.[11]

The nature of storm water discharges from industrial and commercial sources was addressed in two ways. First, sampling data on quality of runoff from Phase I industrial sources were analyzed and summarized to provide a basis of comparison for potential Phase II sources. The data submitted with group permit applications are among the most comprehensive sources of data on pollutant concentrations in industrial runoff. Second, descriptive information on the potential for storm water discharges from industrial and commercial activities was identified and summarized. This was based on the literature review, inference from descriptions of the activities associated with industrial and

[11] As discussed in Chapter 2, EPA was not able to identify adequate data to support the calculation of pollutant loadings on a national scale.

Table 4-6. SICs Not Considered as Potential Phase II Sectors

Transportation and Public Utilities Sector:	
SIC 48	Communication Facilities
Retail Trade Sector:	
SIC 53	General Merchandise Stores
54	Food Stores
56	Apparel and Accessory Stores
57	Home Furniture, Furnishings and Equipment Stores
58	Eating and Drinking Places
Finance, Insurance, and Real Estate Sector all facilities:	
SIC 60	Banking
61	Credit Agencies
62	Security Brokers
63	Insurance Carriers
64	Insurance agents
65	Real Estate
67	Investment Offices
Services Sector:	
SIC 70	Hotels and Lodging Places
78	Motion Pictures
Health Services Sector:	
SIC 80	Doctors' Offices and Medical Clinics
81	Legal Services
83	Social Services
86	Membership Organizations
88	Private Households with Employees
Public Administration Sector:	
SIC 91	General Government, Except Finance
93	Public Finance and Taxation
94	Administration of Human Resource Programs
96	Administration of Economic Programs

Source: OMB, 1987

commercial facilities, the documented experiences of municipalities operating storm water management programs, and EPA's experience in assisting the regulated community in meeting group application requirements under Phase I of the regulatory program.

Determining the extent of pollutants was addressed by identifying the geographic distribution of the sources that may contribute pollutants to storm water. Through a locational analysis, categories of facilities were analyzed to determine to what extent they are located in various sizes of cities, urban areas, and other political jurisdictions. This quantitative assessment of location is informative and useful for certain policy discussions but does not establish the presence of pollutants in storm water for any potential Phase II sources.

4.2.1 Nature of Pollutants Associated With Individual Phase II Sources

This section presents information on pollutants and activities associated with industrial, commercial, and retail categories that may contribute to storm water contamination.

4.2.1.1 Phase I Industrial Group Applicant (Part II) Data

Phase I Industrial Group Applicant (Part II) Data provides a basis for identifying the areas and activities that may be of concern when associated with nonregulated categories of facilities. This section presents analyses of storm water runoff quality data from Phase I (industrial) permit applicants. As part of the permitting process, 44,000 Phase I group applicants in 700 groups were organized into 29 sectors based on general similarity for purposes of writing a multisector general permit.[12] Part II of the permit application required approximately 10 percent of the members of each group to submit sampling results for pollutants in storm water discharges, including conventional, nutrients, and other toxic pollutants that might be present. Table 4-7 summarizes these results by reporting the composite sample mean concentration for each sector for nine of the basic pollutants studied in NURP plus oil and grease. Although the sources and methods of data collection differ, this industrial sector concentration data can be compared with summary data from NURP or USGS to provide some insight into storm water runoff quality. Comparisons can also be made among sectors to determine which are more likely to discharge higher concentrations of certain classes of pollutants. Appendix E provides a comprehensive summary of the industry sectors and sampling data from the group application process.

[12] The sectors were designed to group similar facilities together. Facilities were separated into 31 sectors for analysis of the Part II Group Application data for this report. Only 29 sector permits were developed in the multi-sector general permit. After some groups were combined, and others withdrew, only 700 groups representing 44,000 facilities remained from approximately 60,000 which began the group application process.

Table 4-7. Summary of Sampling Data from Phase I Group Permit Applications (with comparison to NURP and USGS studies[1])

		Pollutant Composite Mean (mg/l)									
		Conventionals				Nutrients			Metals		
Sector	Description	BOD5	COD	TSS	O&G	NO2+3	TKN	P	Copper	Lead	Zinc
NURP	Median Urban Site *	12	82	180	NR	0.86	1.90	0.42	0.04	0.18	0.20
USGS	Commercial Site *	16	NR	248	NR	0.38	NR	0.31	0.03	0.22	0.31
01	Lumber & Wood Products	45.37	242.50	575	2.54	0.75	2.32	6.29	0.05		0.36
02	Paper & Allied Prod.	24.25	133.90	44		0.76	3.17	0.36	0.03	0.03	0.78
03	Chemicals & Allied Products	11.74	77.24	94	0.19	4.29	17.75	9.51	0.12	0.02	1.74
04	Petrol Refining & Related Ind.	10.87	86.93	165	0.00	0.82	1.63	0.28			
05	Stone, Clay, Glass Products	7.32	77.53	386	1.55	1.40	2.37	0.87	0.16	0.25	0.39
06	Primary Metal Ind.	34.08	109.84	162	2.97	1.38	3.00	0.52	2.25	0.19	6.55
07	Metal Mining	10.63	195.07	623		0.90	3.39	1.06	0.59	6.07	3.87
08	Coal & Lignite Mining	6.55	26.86	690		1.00	2.65	0.12	0.00		0.06
09	Oil & Gas Extraction	10.59	115.94	413	2.14	0.60	1.69	3.41			
10	Nonmetallic Mineral Mining	6.89	66.20	1576	0.00	1.27	2.41	1.13	0.01		0.29
11	Hazardous Waste TSDFs	9.44	51.93	83		0.39	1.07	0.11			
12	Industrial Landfills & Dumps	9.04	102.02	1850		1.38	3.03	0.95		20.64	
13	Used Motor Vehicle Parts	11.77	66.23	839		1.62	2.27	2.23		0.88	
14	Scrap & Waste Materials	24.00	203.71	376	1.06	5.88	3.38	0.77	0.63	0.02	3.35
15	Steam Electric Power Plants	5.69	69.47	212	2.90	0.75	1.95	0.63	0.03		0.37
16	Railroad Transport	9.27	189.46	249		1.41	2.48	0.92		0.01	0.28
17	Transport: Trucks, Freight, etc.	11.07	85.64	454	5.28	1.99	2.04	0.73	0.02	0.05	1.34
18	Water Transport	6.00	75.79	224		0.66	9.41	0.15		0.09	0.42
19	Ship & Boat Building, Repair	6.27	69.96	45		0.82	2.20	0.86	0.08		0.33
20	Air Transport	21.34	75.63	80	6.36	1.29	16.00	0.29	0.01	0.01	0.35
22	Wastewater Treatment	46.11	187.09	114	2.96	20.50	4.74	0.68	0.05	0.01	0.12
23	Food, Tobacco Manufact.	42.54	141.65	200	5.03	0.98	4.07	1.32	0.05	0.04	0.79
24	Textile & Apparel Manufact.	9.82	48.05	80		1.14	1.92	0.31	0.07	0.01	0.30
25	Furniture & Fixtures	8.80	76.33	143		1.51	4.40	0.26	0.00		0.59
26	Printing & Publish.	6.95	42.37	31		1.35	1.57	0.35	0.02	0.01	0.47
27	Rubber & Plastic Prods.	11.21	72.08	119	1.56	1.26	1.63	0.34	0.03	0.02	0.80
28	Leather/Products	22.32	91.94	115	0.00	1.88	6.22	0.83		0.06	
29	Fabricated Metal Prod., Jewelry	10.04	86.17	125	6.83	1.27	1.78	0.84	0.46	0.22	2.17
30	Ind. & Comm & Transport Equip.	7.32	46.09	97	0.00	1.28	1.76	0.39	0.08	0.01	0.42
31	Electronic Equip & Instruments	7.48	36.32	67	3.40	0.66	1.34	1.02	0.01	0.14	0.15
33	Military Indust. Activities	16.51	54.50	126	3.68	0.88	1.28	7.12	0.17		0.68

*Recently, concerns have been raised regarding the validity and use of historical data for metals. As discussed in chapter 2, EPA believes that historical data on storm water runoff from NURP and USGS are suitable for the purposes of this report.

Although it focuses on Phase I sources rather than Phase II, this analysis is an important contribution to the literature and this report because it may be the most comprehensive data available on sector-specific industrial discharges. This information can assist EPA and States in evaluating and targeting Phase II sources, at least those that may be similar to Phase I sources. The information can also be used to compare with other sources of information and to give some perspective on which Phase II sectors are of most concern (to the extent they are similar to Phase I activities). This exercise also demonstrates the usefulness of the data collection effort involved in the group application process. These summary data can also provide a baseline from which to measure future improvements in runoff quality and a basis for developing measurable indicators for performance evaluation of State, local, or industrial programs in the future.

An understanding of the group application sampling data is necessary. EPA approved facilities chosen for sampling within a group (ranging from 50 percent of small groups to 10 percent of large groups but no more than 100 facilities per group) only if they were representative, based on industrial activity, significant materials exposed, and geographic distribution. All data received from samplers were checked and double key punched and verified during entry.[13] At the same time, it is important to understand that the facilities submitting sampling data were not randomly selected but rather were identified by the group applicants. These facilities also chose the sampling locations at their sites and conducted monitoring in accordance with EPA guidance on the selection of suitable locations, storm events, and methodology.

In addition to the Phase I permit application data, historical data from past studies can provide some perspective on the nature of storm water from regulated and unregulated sources. Historical data on storm water quality from various types of sites from NURP and USGS were presented in Chapter 2. These data were collected from general urban, commercial, or industrial areas, not from specific industrial facilities. However, these data do provide useful historical reference points. In particular, the mean and median for the NURP urban site and USGS commercial sites were chosen for comparison with the new industry-specific data from permit applications. These levels provide a reference point based on past studies of the nature of storm water discharges. The pollutant concentrations observed in the NURP study should not be considered to be "acceptable" or normal levels of storm water contamination.

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[13] Only those applications received before January 1993 are included in the data base used in this analysis.

Permit application data were analyzed for 11 pollutants, including 9 pollutants studied in NURP—biochemical oxygen demand (BOD), chemical oxygen demand (COD), total suspended solids (TSS), nitrate plus nitrite nitrogen, total Kjeldahl nitrogen (TKN), total phosphorus, copper, lead, and zinc—plus oil and grease and pH. As discussed, Table 4-7 reports summary results for the composite mean from the permit application data for 31 Phase I sectors. Appendix F gives more detailed results for each pollutant and each industrial sector, including the mean, median, and 95th percentile, as well as the number of samples taken. To provide a basis for comparing across industrial categories, the mean of the composite sample results was chosen as an indicator of average storm water quality. Composite samples are preferable to grab samples for comparing average runoff conditions because grab sample results (also reported in the tables) may represent pollutant spikes, rather than more long term average storm conditions. The following paragraphs review these results.

Conventionals

Among the conventional pollutants, total suspended solids appears to be the pollutant with highest concentration. Half of the Phase I industrial sectors had concentrations higher than NURP and average results in the hundreds of parts per million are common. Composite mean concentrations were over 1,500 mg/l for mineral mining and for landfills. These data confirm the result in NURP and other literature that sediment is an important component of storm water runoff. It should be noted that sediments can also carry additional pollutants, such as metals and organics. As reported on Table 4-7, COD results for the composite mean are higher than NURP in about half of the sectors (14 sectors out of 31). The highest reported composite mean value for COD was 242 mg/l and five sectors had concentrations greater than 150 mg/l, including lumber and wood products, scrap and waste materials, metal mining, railroad transport, and wastewater treatment. All sectors had concentrations higher than the average of commercial sites found in USGS studies. Results for BOD indicate that average runoff quality is not appreciably higher than the secondary treatment standard for POTWs of 30 mg/l. Although 10 sectors have higher levels of BOD than reported in NURP and USGS, the highest composite mean value for BOD was 46 mg/l. Most results for pH (reported in Appendix F) are in the range of 6.8 to 8.5, indicating that acidity or alkalinity is not the greatest concern associated with runoff from these industrial sites. For oil and grease, composite results are highly variable, and neither NURP nor USGS provides a baseline for comparison. The highest concentrations, over 5 mg/l, are engaged in industrial sectors associated with transportation and vehicle and machinery maintenance, as might be expected.

Nutrients

Overall, storm water discharges from industrial sites do not appear to be contributing high concentrations of nutrients. Results reported in Table 4-7 indicate that concentrations for TKN exceed NURP results in 22 cases, including wastewater treatment plants, chemical manufacturers, scrap yards, mining sectors, transportation sectors, and leather manufacturers. However, most of the results were in the range of 2 to 5 mg/l. Concentrations (for the composite mean) over 16 mg/l were reported for the chemical and allied products sector and the air transport sector. Concentrations of nitrogen in the form of nitrates and nitrites for the industrial sites represented in the permit application data are generally in the range of 0.8 to 2.0 mg/l, but there are some important exceptions. The highest concentrations for the composite mean occurred in the wastewater treatment sector (20.5 mg/l) and the scrap and waste materials sector (5.9 mg/l). Phosphorus results also do not show generally high concentrations; only nine sectors had composite mean results over 1 mg/l. The highest concentrations occurred for chemical and allied products manufacturers (9.5 mg/l), military facilities (7.1 mg/l), lumber and wood products manufacturers (6.3 mg/l), and oil extractors (3.4 mg/l). In summary, nutrient concentrations exhibit a mixed pattern across industrial groups, with some very low and very high results. Results for the two forms of nitrogen and for phosphorus indicate that storm water discharges of nutrients tend to be site- and pollutant-specific. That is, discharge of one form of nutrient does not in general indicate that other forms are present or suspect, although the chemical and allied products sector is associated with all three.

Metals

Because sampling for metals proceeded on the basis of whether individual facilities had reason to believe they were present in their discharge, not all sectors reported results for metals. Again, referring to Table 4-7, results for copper show that 13 sectors had composite mean concentrations higher than NURP. The highest of these included the primary metals sector (2.25 mg/l) and scrap and waste materials (0.63 mg/l). Eight sectors reported no sampling results for copper. For lead, the table shows that the majority of sectors (15 out of 23) had concentrations below the mean value reported in NURP (0.18 mg/l). However, two of those with higher concentrations had extremely high values: the highest concentrations of lead found in industrial runoff were associated with industrial landfills and dumps (20.6 mg/l) and metal mining (6.1 mg/l). The next highest values came from the scrap and waste materials sector (.88 mg/l) and the stone, clay, and glass products sector (.25 mg/l). Results for zinc show that most of the sectors (22 of 25) had composite mean concentrations higher than the 0.20 mg/l value reported in NURP for general urban runoff. Nineteen sectors had concentrations higher than the 0.31 mg/l value reported in USGS studies for commercial sites. The highest concentrations found were associated with the primary metals (6.6 mg/l), metal mining (3.9 mg/l), and scrap and waste materials (3.6 mg/l) sectors. Six sectors did not report results for zinc. In summary, higher concentrations of metals tended to be associated with the primary metals sector, metal mining, industrial landfills, scrapyards, and metal fabricators.

4.2.1.2 Qualitative Assessment of Potential Phase II Categories

The sampling data presented previously were used to assist in understanding the nature of storm water discharges in Phase II sectors. To facilitate comparison of potential Phase II sources with the sampling results reported above, where possible, categories of Phase II sources were compared to similar Phase I sectors. These comparisons were made qualitatively and are not meant to suggest that the sectors conduct exactly the same activities or operations. Similarities were identified for 12 of the 18 Phase II sectors, as summarized in Table 4-8. The remaining categories of potential Phase II sources were generally not classifiable based on similarities to Phase I sources. Using this correspondence to Phase I and information from the literature review, a summary table was developed showing the potential pollutants associated with each of the potential Phase II sectors. For some sectors, permit application data were used as the basis for determining which pollutants could be present. For other sectors, literature review information and other documents were used. This information is summarized in Table 4-8, which can be used as a guide to the possible presence of pollutants at Phase II facilities. This does not indicate that the pollutants will be found in substantial quantities or that water quality will be impaired. In particular, pollutants are associated with categories similar to Phase I facilities based on the fact that the Phase I sector had among the highest (top ten) concentrations of that pollutant. Thus, it is based on a relative ranking: an industrial category may be among the highest, even when overall concentrations are not very high.

Based on the literature review, assessments of SIC descriptions, the selection criteria outlined above, and the pollutant data summarized in Table 4-8, information about the 18 potential Phase II categories can be summarized into several major groups. The first major group includes facilities with activities similar to those regulated under Phase I, even though they may be small commercial or retail establishments, rather than industrial ones. This class includes about 80 percent of the potential Phase II sources. One of the chief activities of concern in this group is vehicle maintenance and related transport, storage, and machine repair activities. Other activities conducted at these facilities that are substantially similar to those already regulated include loading and unloading operations, which include pumping of gases or liquids, pneumatic transfer of dry materials, or transfer of containers to or from vehicles; outdoor storage, including storage of fuels, raw materials, byproducts, intermediates, final products, and process residuals or wastes; and other outdoor activities and land disturbing operations, such as small construction and landscape maintenance. The types of products or waste materials at facilities in this class could include a wide variety of materials that potentially contribute pollutants to storm water runoff. Although discharges could include the whole range of pollutants, these sources may be more likely to contribute

Table 4-8. Correspondence Between Potential Phase II Sectors and Phase I Sectors and Potential Pollutants of Concern

Description	Rank by # of Facilities	Corresp. to Phase I	Potential Pollutants of Concern						Pesticides & Toxics
			Conventionals			Nutrients		Metals	
Phase II "Sectors"		Sectors	B/COD	TSS	O&G	N	P		
Automotive Service	369,870	17, 13		X	X	*	*	X	S
Machinery & Electrical Repair	135,744	31			X		*		
Intensive Ag. Chemical Use	121,861	NA	S	S		S	S		S
Wholesale, Machinery	77,562	30			S			X	
Laundries	51,376	NA	S			S	S		
Wholesale, Wood Products	48,493	1	X	X			*		
Livestock, Feedlots	43,421	NA	S	S		S	S		
Petrol. Pipelines & Distributors	35,319	9, Other				*	*	X	S
Photographic Activities	30,684	NA	S					S	S
Various Utilities	22,242	11, 12, 22	X	X	X	*		X	
Extensive Ag Chem Use	18,992	NA	S	S		S	S		S
Transport, Rail and Other	14,808	16	X	S	S	*		S	S
Wholesale, Metal Products	14,303	14	X		S	*		X	
Wholesale, Food	11,372	23	X	S	X	*	*	X	
Laboratories	10,683	NA	S						S
National Security	4,611	17, 29, 33		X	X	*		X	S
Munic. Services, Vehicle Maint.	2,414	17, 29	X	S	X		*	X	S
Wholesale, Coal & Ores	1,384	8		X			*		

X - Indicates similar Phase I sector ranked in top ten of all sectors for this pollutant class
S - Indicates pollutant is suspected, based on literature review and expert opinion
NA - Not applicable: No clear correspondence with Phase I Sectors
* - Overall, nutrient levels were not high in Phase I application data. This indicates that the pollutant was found in the top ten, but actual concentration levels were not high.
Blanks indicate that such pollutants are not pollutants of concern for the Phase II sectors.

toxics, in addition to conventionals and nutrients. Pollutants of concern include organic and inorganic chemicals; fuels, such as coal and oil; paints; metals; solvents; and oil and grease. Although not specifically addressed in this analysis, off-site storage and maintenance activities, which may be owned and operated by Phase I facilities but are not currently regulated, could also fall into this class.

The second major classification of facilities includes categories of industrial, commercial, or retail activities and businesses with discharges that may be similar to those from agricultural sources (which are exempt from NPDES regulation under the CWA). For example, smaller feedlots that are not currently regulated and large users of pesticides and fertilizers may be similar to agricultural discharges but are not specifically exempted by statute. This class of facilities includes more than 180,000 facilities or about 20 percent of those selected for study. This group includes lawn and garden services (SIC 0782), farm supplies (SIC 5191), and lawn and garden supply (SIC 5283), which are among the largest SIC groups selected for study (see Table 4-4). Fertilizers and pesticides from these facilities have the potential to contaminate storm water from activities such as land application, spills and leaks, rinsing of containers and trucks, and improper disposal. Thus, the pollutants of concern include conventionals, pesticides, and nutrients that are associated with uses of open space that superficially resemble agricultural uses, such as lawn and landscape care or commercial/retail production, transport, or storage of nursery products.

The third major class of potential Phase II sources includes categories of facilities with the potential to use or produce toxic substances but about which there is little information. Research and development laboratories and some kinds of governmental activity (such as justice and public order facilities, SIC 92xx) fall into this category. Some of these facilities may be administrative centers with little potential to discharge pollutants. Others, such as police and fire protection services, however, may include vehicle maintenance activities with potential for discharges similar to those described above. This group includes about 20,000 facilities, representing only about 2 percent of those chosen for study.

This section described the categories of facilities and evaluated the nature of potential pollutant discharges qualitatively based on similarity to Phase I sources and information from storm water literature. However, from a national perspective, little quantitative information exists on discharge quality from these potential Phase II sources.

The majority of Group A facilities are so similar to Phase I activities that data collected from Phase I permit application data may be used to evaluate their pollution potential. There are also a very few classes of unregulated facilities for which some data is already available. One category of facilities for which substantial information is currently available is feedlots. Although feedlots which meet the definition of Concentrated Animal Feeding Operation (CAFO) are currently subject to NPDES permitting requirements, many smaller feedlots do not meet the current regulatory definition of CAFO and hence are not subject to current NPDES regulations.[14]

The United States Department of Agriculture (USDA) has estimated that there are approximately 6,000 animal feeding operations with 1,000 or more animal units.[15] EPA's Permit Compliance System (PCS) data base indicates that, as of October of 1994, EPA and authorized States have individual permits covering 928 CAFOs and general permits covering at least another 2,130 facilities. The total number of NPDES permits for feedlots is significantly less than the approximately 6,000 facilities that have more than 1,000 animal units. The discrepancy between the number of facilities authorized to discharge by NPDES permits and the total number of feedlots over 1,000 animal units is believed to be due to a number of factors, including: (1) due to limited State and Federal resources, some feedlots that should have a permit have not been brought into the NPDES program; (2) some regulatory authorities misinterpret the Federal regulations for CAFOs and mistakenly exempt facilities that should have permits; and (3) permits are only required for facilities that discharge at times other than the event of a 25-year/24-hour storm. USDA estimates that there are approximately 378,000 animal feeding operations with less than 1,000 animal units but more than 20 animal units.

Animal feedlots contribute to a significant degree of water quality impairment. States report the scope and sources of water quality impairments under Sections 305(b) and 319 of the CWA. Information from these sources indicates that, nationally, feedlots cause 7 percent

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[14] As discussed in Chapter 1, CAFOs are defined as animal feeding operations that discharge to waters of the United States at times other than during events greater than a 25-year, 24-hour storm and that: (1) have more than 1,000 animal units; (2) have more than 300 animal units and pollutants are discharged into navigable waters through a man-made flushing system or other man-made device, or pollutants are discharged directly into waters of the United States which originate outside of and pass over, across or through the facility or otherwise come into direct contact with the animals confined in the operation; or (3) are designated by EPA or an authorized NPDES State upon determining that it is a significant contributor of pollution to the waters of the United States.

[15] U.S. Department of Agriculture, Office of Budget and Policy Analysis, Draft Report, 1992. *Progress and Status of Livestock and Poultry Waste Management to Protect the Nation's Waters.*

of impairment in lakes and 13 percent of impairments in rivers.[16] Feedlot impact is less significant, on average, in estuaries and ocean coasts, although there are estuaries, such as the Chesapeake Bay and Puget Sound, where animal waste is a significant water quality problem. In addition, the U.S. Fish and Wildlife Service estimated in 1984 that feedlots impair fisheries in nearly 60,000 miles of streams nationally. EPA is unable to identify the relative contributions to impairment of facilities currently subject to NPDES permits and those that are not; however, waterbodies have been identified in case studies where impairment is due to smaller feedlots not subject to permits, e.g., the Chesapeake Bay.

Feedlots produce an estimated 400 million tons of animal waste per year, twice as much waste as humans produce. These wastes contain ammonia, phosphorus, nitrogen, oxygen demanding materials, and high levels of pathogenic bacteria. When used properly, animal wastes are a valuable resource, but when such wastes are discharged into surface or ground water, they often cause impairment.

High pollutant concentrations can be associated with feedlot runoff. Nutrients, oxygen demanding materials, and bacteria in runoff from feedlots are often present in concentrations that are 10 to 100 times those of untreated sanitary sewage[17] or combined sewer overflows.[18] Fish kills may result from runoff, wastewater, or manure entering surface waters, due to ammonia and dissolved oxygen depletion. The decomposition of organic materials can deplete dissolved oxygen supplies in water, resulting in anoxic or anaerobic conditions. Methane, amines, and sulfide are produced in anaerobic waters causing the water to acquire an unpleasant odor, taste, and appearance. Such waters can be unsuitable for drinking, fishing, and other recreational uses. Solids deposited in water bodies can

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[16] *Water Pollution from Feedlot Waste: An Analysis of its Magnitude and Geographic Distribution*, EPA Feedlot Workgroup, December 1992.

[17] *Report of the EPA/State Feedlot Workgroup*, EPA Feedlot Workgroup, September 1993.

[18] *Water Pollution from Feedlot Waste: An Analysis of its Magnitude and Geographic Distribution*, EPA Feedlot Workgroup, December 1992.

accelerate eutrophication through the release of nutrients over extended periods of time. Animal diseases can be transmitted to humans through contact with animal feces. Animal waste has been responsible for shellfish contamination in some coastal waters.[19] Animal wastes discharged to waterways perform the same nutritional function for aquatic plants as they do for field crops, with high levels of nitrogen and phosphorus promoting algae growth in receiving waters. Pathogens, nitrates, and salts in manure can impair ground water, with problems being reported in at least 17 States.

4.2.2 Geographic Extent of Facilities

This section addresses the extent of potential Phase II facilities through a geographic analysis of their location with respect to urbanized areas, regulated Phase I municipalities, and other population centers. The procedures used to generate this information were discussed in Chapter 2. This analysis does not provide any information on the quantity or quality of storm water discharged by these facilities. This is locational data only. Some facilities may have completely enclosed operations. Some may be connected to sanitary or combined sewers, rather than to separate storm sewer systems. Finally, some may have few pollutants of concern in use or in their discharges.

Even so, determining location and geographic distribution lends some valuable insights. The location of facilities is important for both environmental and for policy reasons. From an environmental perspective, facilities located in populous, urban, or dense areas may be larger and more heavily used, with the potential for larger amounts or concentrations of pollutants to be discharged. At the same time, however, runoff from these urban facilities may be more likely to discharge to storm or sanitary sewers, where it will mix with other storm water flows before ultimate discharge to receiving waters. Facilities located in more rural areas may be no different in terms of pollutant content but may have a greater potential for discharging directly into the Nation's waters.

[19] *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters*, EPA, January 1993.

From a policy perspective, urban and rural storm water discharges could also be treated differently. Industrial, commercial, and retail facilities in urban areas will more often fall within the boundaries of a municipal storm water control program. Thus, any control, detention, or sampling efforts by municipalities may help to locate and mitigate the impact of the storm water discharges within their jurisdictions, whether these discharges are federally regulated or not. The rural discharger, on the other hand, is more likely to be a direct discharger or to be located in a smaller municipality with no storm water program and, thus, may be relatively uncontrolled unless located in a high priority watershed that receives special State attention.

As discussed in Chapter 2, Phase II of the storm water program could cover additional commercial sources directly through permitting requirements for individual facilities or indirectly by requiring local governments to address commercial sources. With respect to the second approach, there are many ways of expanding control strategies to additional geographic areas and political jurisdictions, beyond those covered in Phase I. For example, EPA could expand regulatory or control requirements to:

- The urbanized fringe around existing Phase I cities
- All urbanized areas not covered in Phase I
- Additional cities (incorporated areas) based on size
- Growing areas, where both development pressures and opportunities for preventive measures are greatest
- Coastal areas, where storm water quality impacts have been identified.

Of course, a combination of options can also be considered, such as urbanized areas in coastal areas or cities of a certain size in fast growing counties. To evaluate alternatives, consideration must be given to how industrial, commercial, and retail establishments are distributed in different jurisdictions, such as cities or urbanized areas of a certain size. The analysis on the following pages demonstrates how these various options would affect industrial and commercial facilities (i.e., what portion of facilities in a given sector would be covered by a particular geographic approach). This analysis of location was completed for each of these perspectives. This section presents and discusses results for urbanized areas, primarily. Other relevant results are discussed in the text, but full numerical details are reported in Appendix G.

As discussed in Chapter 2, this presentation is based on the premise that individual commercial and retail activities are distributed similarly to the population at the county level. That is, if 40 percent of the people in a county live in urbanized areas, this analysis assumes that 40 percent of the industrial, commercial, and retail sources are located in urbanized areas. This premise may not hold true for activities that are usually located in rural areas, such as agricultural or silvicultural operations. However, because rural counties have a lower proportion of urbanized population, facilities that are commonly located in rural counties would be allocated to the non-urbanized portion of the county under this procedure. Thus, on average on a national scale,[20] the premise provides a useful estimation tool even for typically rural enterprises. This procedure is explained in more detail in Chapter 2.

The results of the distributional analysis of facilities and SIC-code activities are presented graphically in this section. Figure 4-1 shows the geographic distribution of facilities (by county) in the 90 selected four-digit SIC codes (potential Phase II) chosen for analysis. Counties are shaded in the map based on the number of facilities located in each. Counties with more than 1,000 facilities are shown in black, those with 500 to 999 facilities are shown in cross-hatch shading, and those with 250 to 499 facilities are shown in light shading. Counties with facility counts lower than 250 are shown in white but are not outlined.

Figure 4-2 shows similar information, except that counties are shaded on the basis of density of facilities (facilities per square mile) rather than straight facility counts. The

[20] The analysis does not address individual commercial and retail activities that are located in Territories other than the District of Columbus.

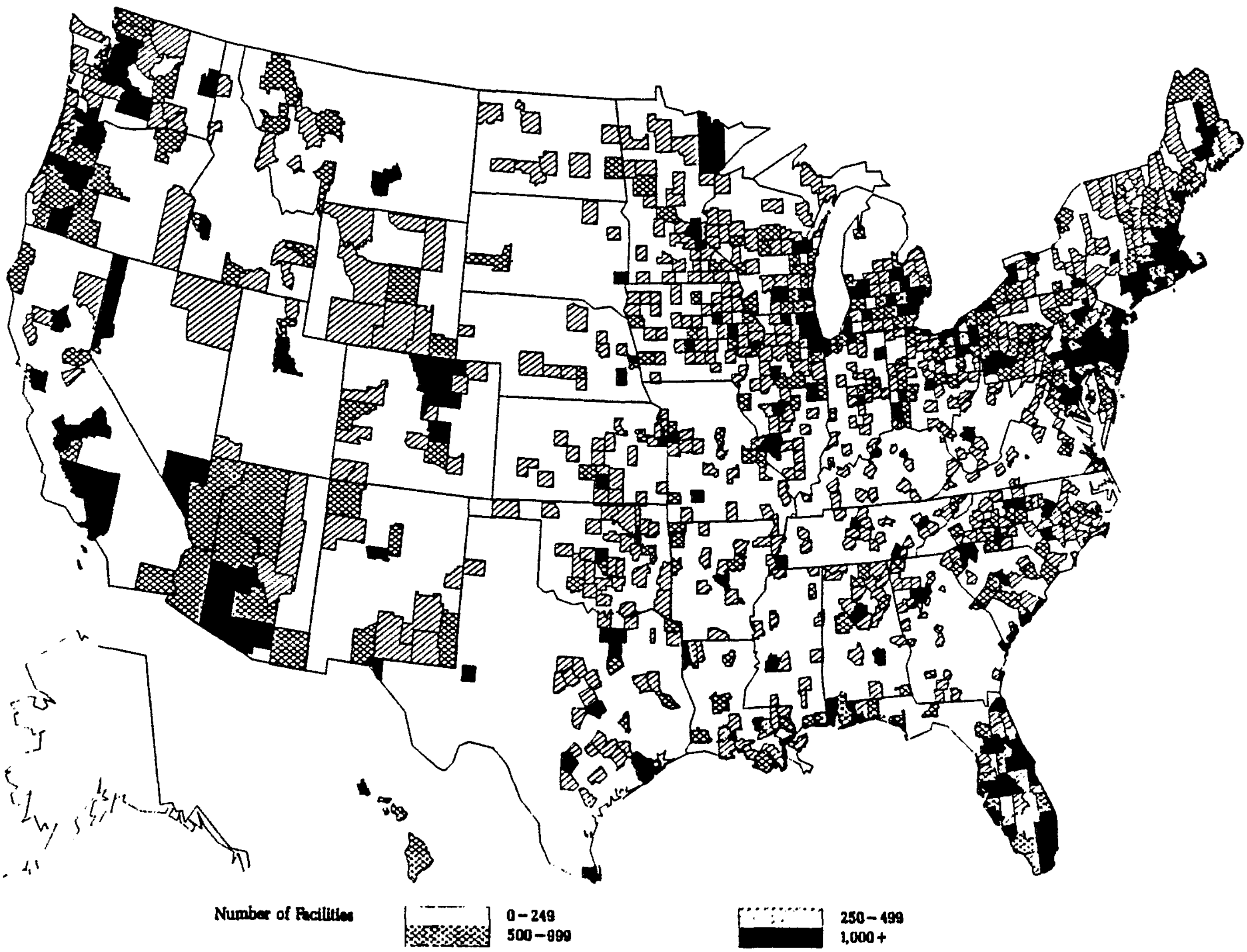

Figure 4-1. Geographic Distribution of Facilities With Selected 4-Digit SIC Codes (counties with less than 250 facilities are not shown)

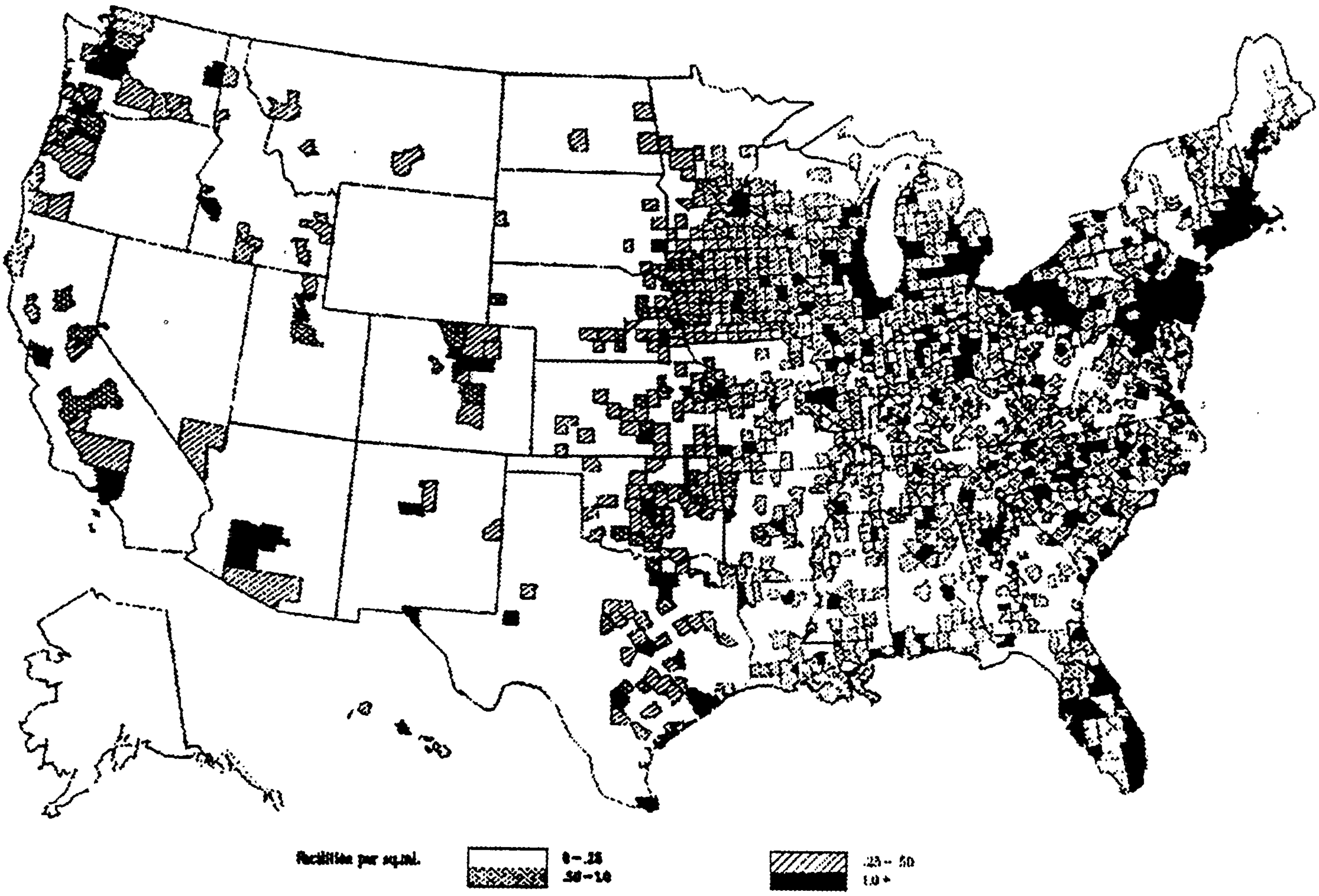

Figure 4-2. Geographic Distribution of Facilities With Selected 4-Digit SIC Codes by Density (counties with less than .25 facilities per square mile are not shown)

counties with the densest concentrations of facilities are shown in black, counties in the next density class are shown in cross-hatch shading, and the third density class is shown in light shading. Counties in the lowest density class are shown in white, but are not outlined.

As illustrated, the largest numbers and concentrations of facilities occur along the Eastern Seaboard; the industrialized southern Great Lakes Region; southern Florida; the Gulf Coast; and major cities of the southwest, California, and the Pacific Northwest. Although results for density show more focus around population centers, especially in the East and Midwest, both maps illustrate that potential Phase II facilities, which represent economic activity in industries, businesses, offices, and government services, are highly associated with population centers, in general. The same generalizations apply whether based on numbers of facilities or density of facilities, indicating that the most populous places tend also to have the greatest concentrations of potential Phase II facilities.

This geographic information on facility location is also presented quantitatively to lend additional insights. As described in the approach in Chapter 2, facility-specific information, including SIC code and county location, was combined with information from the 1990 census, which includes county population and area. These two sources of data were used to analyze the geographic distribution of all facilities in all two-digit SIC codes and of the 90 four-digit SIC codes selected as Group B Phase II categories. The results of this analysis are reported in detail in Appendix G. This section reviews some of the data and highlights important findings for the Group B sectors.

Table 4-9 presents information about the geographic distribution of industrial and commercial facilities in urbanized areas, based on the location with respect to Phase I cities. The columns of the table illustrate the locational relationships among jurisdictions when taking the perspective of expanding from current core (Phase I) cities out to the urbanized areas surrounding them, then on to remaining urbanized areas. Note that some urbanized areas encompass Phase I cities, while others are not contiguous with them.

Table 4-9. Geographic Distribution of Potential Phase II Facilities in Relation to Urbanized Areas

Potential Phase II Facilities Identified		Cumulative % of facilities located within:		
Description	**Count**	**Phase I Areas**	**Phase I Areas + UAs**	**All UAs**
Phase II - Group A	100,000[1]	32	45	61
Phase II - Group B	1,015,239	28	40	56
Group B Sectors				
Automotive Service	369,870	27	38	55
Machinery & Electrical Repair	135,744	29	40	56
Intensive Ag. Chemical Use	121,861	26	38	54
Wholesale, Machinery	77,562	32	47	65
Laundries	51,376	38	52	71
Wholesale, Wood Products	48,593	26	36	53
Livestock, Feedlots	43,421[2]	8	11	20
Petrol. Pipelines & Distributors	35,319	16	25	39
Photographic Activities	30,684	40	53	70
Various Utilities	22,242	24	36	53
Extensive Ag Chem Use	18,992	31	42	62
Transport, Rail and Other	14,808	47	64	81
Wholesale, Metal Products	14,303	36	54	75
Wholesale, Food	11,372	36	49	67
Laboratories	10,683	38	56	74
Munic. Services, Vehicle Maint	4,611	25	35	51
National Security	2,414	34	43	60
Wholesale, Coal & Ores	1,384	23	31	48

[1] This figure is an approximation based on the total number of facilities in SIC codes 10 through 45 after subtracting an estimate of the number of facilities covered under Phase I. Geographical distribution information is based on all facilities in SIC codes 10 through 45 and may not be representative of all classes of facilities in this group. For the geographic distribution of specific SIC codes, refer to Appendix G.

[2] This number is based on SIC codes and does not reflect all feedlots potentially subject to Phase II. The United States Department of Agriculture has estimated that there are approximately 378,000 animal feeding operations between 20 and 1,000 animal units. The facilities identified here should be representative of feedlots in general and allow estimation of the distribution of these facilities as a class.

The rows of the table show each potential Phase II sector and the proportion of industrial facilities located in each of the geographic jurisdictions. Other major groups of industries—all facilities nationally, agricultural and silvicultural categories, manufacturing categories, and all commercial and retail categories—are included in the table to show by comparison how the potential Phase II categories are distributed relative to other major industrial and commercial sectors. As shown in the table, about one-third of the potential Phase II industrial and commercial facilities within the United States are located within municipalities already covered under Phase I of the storm water program. As a point of reference, agricultural and silvicultural activities (SIC Codes 01xx to 09xx) are less often associated with cities or urban areas. Only about 14 percent of the facilities in these agricultural sectors are associated with Phase I cities. Only about half of them are associated with urban areas, as compared to three-quarters for other more industrial sectors. This distribution holds also for the Phase II sector containing livestock and feedlot activities.

The table also shows the cumulative effect of expanding control of individual sources outward from central cities to encompass larger urbanized areas. In general, 30 percent of facilities are located in regulated Phase I municipalities, an additional 15 percent are located in the urbanized areas associated with Phase I cities, and an additional 15 percent are found in the remaining urbanized areas. Thus, about twice as many industrial facilities are found in all urbanized areas as are found in Phase I cities alone. This result holds for most of the potential Phase II categories. However, there are some exceptions. Petroleum pipelines and distributors show a weaker association with urban areas. It also is not surprising that feedlots are less closely associated with highly urbanized areas.

In another series of analyses, the distribution of industrial facilities was examined according to other geographic areas of potential interest. The results of these analyses are reviewed briefly here; Appendix F contains complete results. Urbanized areas of various population size classes were analyzed. This analysis shows that most facilities (about 45 to 50 percent) are located in the largest urbanized areas (over 250,000 people). An additional 7 percent are found in medium UAs (from 100,000 to 250,000 people). An additional 5 percent are found in UAs containing 50,000 to 100,000 people. These results show that the majority of facilities are located in the largest UAs and only a small increment is gained by including smaller UAs in the regulatory scenario.

For additional perspective on potential Phase II areas of concern, an analysis was conducted on the relationship between facility distribution and fast growing geographic areas. This analysis focused on counties expected to grow by more than 15 percent in the 15 years between 1990 and 2005 (based on Census Bureau projections).[21] The results show that about a quarter of Phase II facilities are located in these fast-growing counties. Of these, almost three-quarters are located in urbanized areas.[22]

Because coastal areas are also a potential concern, as reflected in the CZARA program, another analysis addressed the geographic distribution of industrial and commercial facilities in coastal counties. The definition used by the National Oceanic and Atmospheric Administration and the Bureau of the Census of the Department of Commerce is used in determining coastal counties. Of the 3,141 counties in the United States, 672 are defined as coastal by NOAA and have at least 15 percent of their land area in a coastal watershed or in a coastal cataloging unit (note that this is quite different from the "coastal zone" definition used in CZARA). The results reveal that coastal areas represent an important component of the industrial and commercial base in the country. As many as 44 percent of the potential Phase II facilities are located in coastal areas. Of these, about one-third are in areas that are already regulated in Phase I and almost three-quarters are located in urbanized areas.

The results in this section covered the 18 Group B sectors. The detailed results of this analysis for all two-digit and selected four-digit SIC codes are reported in Appendix G. The four-digit analysis provides a more detailed look at certain subsets within the two-digit groups. Generally, the four-digit breakdowns follow the pattern of the major (two-digit) groups: for the most part, the additional detail about selected four-digit SICs does not reveal much beyond that provided by the major group distribution.

[21] Note that this designation of "growing counties" differs from that used in Chapter 3.

[22] While this result holds in general, petroleum pipelines, wholesale coal and ores, and livestock feedlots appear to be less closely associated with fast growing areas.

4.3 SUMMARY

This section summarizes the findings on individual sources in terms of the main elements identified by Congress for discussion in this report: identification, nature and extent of unregulated discharges. Due to very limited national data on which to base loadings estimates, the discussion of the extent of unregulated storm water discharges is limited to an analysis of the number and geographic distribution of potential Phase II facilities.

4.3.1 Identification of Phase II Sources

The effort to identify sources and categories of storm water discharges for which permits are not required in Phase I of the program resulted in the identification of two general classes of facilities. The first group includes sources that are very similar or identical to Phase I activities but that were omitted from Phase I for a variety of statutory and regulatory reasons (Group A). The second general class of facilities were identified on the basis of potential activities and pollutants that may contribute to storm water contamination (Group B). The report also discussed general sources of storm water contamination which are widespread and not necessarily associated with specific activities or facilities.

Although the difficulty in differentiating Group A facilities from existing Phase I regulated activities makes quantitative analysis difficult, EPA estimates that there are approximately 100,000 facilities in this group. Facilities in Group A, which may be of high priority for Phase II due to their similarity to Phase I industrial facilities, are described and categorized in this report but are not included in the subsequent geographical analysis in the same level of detail as Group B facilities. Activities identified in Group A can be classified into three distinct categories: auxiliary or secondary activities such as vehicle maintenance in support of an unregulated activity; facilities which are related to Phase I facilities but that were intentionally omitted such as POTWs with a capacity of less than 1 MGD; and facilities which were specifically exempted from Phase I by the Transportation Act which include industrial activities owned or operated by municipalities of less than 100,000 population.

Group B consists of over one million facilities in 90 SICs. These 90 SIC categories have been organized into 18 Phase II sectors for the purposes of this report. Of these 18 sectors, the automobile service sector (comprised of gas/service stations (SIC 5541), general automobile repair (SIC 7538), top, body repair (SIC 7532), repair shops and services (SIC 7699), car dealers, new & used (SIC 5511), car dealers, used only (SIC 5521), car washes (SIC 7542), passenger car rental (SIC 7514), truck rental (SIC 7513), parking structures (SIC 7521), and miscellaneous auto services (SIC 7549)), make up more than one-third of the total number of facilities identified in all 18 sectors.

Other general sources of storm water discharges discussed but not clearly identified in the report include parking lots, trash dumpsters, leaking and failing septic systems, and activities related to individual residences such as fertilizer and pesticide application. Facilities in the service sectors, such as banking, finance, insurance firms, and all types of food services, were also discussed but not included in much of the analysis.

4.3.2 Nature of Phase II Sources

There is little quantitative or comprehensive data from a national perspective on the concentrations and loadings of storm water discharges from the industrial, commercial, and retail facilities selected for study as potential Phase II sources. As a result, it is not currently possible to estimate national concentrations or loadings from these sources. It is clear, however, that a significant number of facilities remain in unregulated Phase II categories that conduct operations that have the potential to discharge contaminated storm water. It is possible to classify the unregulated categories into three major groups:

- All of the potential Phase II facilities in Group A may have discharges similar or identical to discharges associated with industrial activity regulated under Phase I.

- Of the facilities in Group B, 80 percent may have discharges similar or identical to discharges associated with industrial activity regulated under Phase I. Facilities in this class have activities analogous to Phase I activities but are covered by different SIC codes. These facilities are also likely to employ substances that could result in pollutants, such as toxics, metals, solvents and oil and grease, entering storm water.[23] This class includes wholesale operations and vehicle repair and maintenance categories.

- Almost 20 percent of the facilities in Group B had activities that resemble exempted agricultural sources but do not fall under the statutory exclusion of agriculture. These include smaller, currently unregulated feedlots, nurseries, and retailers of farm supply chemicals. Facilities in this class are likely to have activities that result in contributions of pesticides or fertilizers and nutrients to storm water.

In general, industries with large areas of industrial activity and significant materials exposed to storm water exhibited the highest concentrations of pollutants in their storm water discharges. Suspended solids, which can also carry metals and organic pollutants, appear to be the pollutant with the highest concentrations overall. Chemical oxygen demand appears at relatively high concentration levels in some industrial sectors. Oil and grease results were highly variable but highest in industrial sectors associated with transportation and vehicle and machinery maintenance. Results for metals varied across industrial sectors, but those that handle, process, manufacture, or mine metals, as well as landfills, had higher concentrations than other categories. Biochemical oxygen demand, and nutrients (nitrogen and phosphorus) were generally not found at high concentration levels in Phase I data, although results were variable for nutrients.

4.3.3 Geographic Distribution

The geographical analysis shows that the majority of industrial and commercial facilities are located in or near population centers (cities and other urban places). To the extent that they are located in populous, urbanized areas, they are more likely to be served by municipal storm sewers (either separate or combined) than to be discharging directly to streams.

[23] About 2 percent of these facilities conduct other activities that may use toxic pollutants but are not substantially similar to the other facilities in this group. These include research laboratories and some kinds of municipal or governmental entities, which may engage in a wide variety of activities. There is very little information available about the pollution potential of facilities in this class.

In general, about 30 percent of potential Phase II facilities are found within the geographic jurisdiction of a Phase I municipality. An additional 20 to 30 percent of Phase II facilities fall into Census-designated urbanized areas. Thus, nearly twice as many industrial facilities are found in all urbanized areas as are found in Phase I municipalities alone.

Notable exceptions to these generalizations include lawn/garden establishments, feedlots, wholesale livestock, farm and garden machinery repair, bulk petroleum wholesale, farm supplies, lumber and building materials, and petroleum pipelines, which are (relatively) more frequently associated with smaller municipalities or rural areas. Because a larger portion of these facilities are outside the confines of regulated municipalities, a larger portion of storm water discharges from these facilities may be going directly to receiving waters rather than into municipal separate storm sewer systems.

BIBLIOGRAPHY

BIBLIOGRAPHY

Alaska Health Project, Waste Reduction Assistance Program (WRAP). *On-Site Consultation Audit Report: Automobile Body Repair and Paint Shop.* August 14, 1987.

American Society of Civil Engineers (ASCE) and The Water Pollution Control Federation. *Design and Construction of Sanitary and Storm Sewers.* 1969.

Association of State and Interstate Water Pollution Control Administrators (ASIWPCA). *The National Water Quality Inventory.* 1990 Report to Congress. 1991

Association of State and Interstate Water Pollution Control Administrators (ASIWPCA). *The National Water Quality Inventory.* 1988 Report to Congress. 1989.

Association of State and Interstate Water Pollution Control Administrators (ASIWPCA). *America's Clean Water: The State's Nonpoint Source Assessment.* 1985.

Booth, D.B. and C.R. Jackson. *Urbanization of Aquatic Systems—Degradation Thresholds and the Limits of Degradation.* American Water Resources Association Summer Symposium, Jackson, Wyoming. 1994.

Brinkman, D.W. *Analysis of Potential Used Oil Recovery from Individuals: Final Report.* Report No. DOE/BC/10053-21, July, 1981.

Brown, R.C., R.H. Pierce, and S.A. Rice. *Hydrocarbon Contamination in Sediments from Urban Stormwater Runoff.* Mote Marine Law, Sarasota, FL. Report No. 85-108354, Mar. Pollu. Bulletin, Volume 16, Number 6, June, 1985.

California Department of Health Services. *Waste Audit Study: Automotive Paint Shops.* January 1987.

California Department of Health Services, Toxic Substances Control Division, Alternative Technology Section. *Waste Reduction For Automotive Repair Shops.* March 1989.

Caskins, Michael P. Senior Account Executive, Government Services, Dun & Bradstreet Information Services, 2700 S. Quincy Street, Arlington, VA. Personal Communication. June 17, 1992.

Census of Population and Housing. *1990: Summary Tape File 1 on CD-ROM Technical Documentation.* Prepared by the Bureau of Census. Washington, DC. 1991.

Charlton and Lean. 1987.

Cooper, Mary H. "Downtown Suburbia." *Editorial Research Reports*. November 14, 1986. Editorial Research Report. 1986. Volume II, No. 18. Congressional Quarterly, Inc. Washington, DC. 1986.

Culliton, T.J., M.A. Warren, T.R. Goodspeed, D.G. Remer, C.M. Blackwell, and J.J. McDonough III. *50 Years of Population Change Along the Nation's Coasts*. Coastal Trend Series Report No. 2. National Oceanic and Atmospheric Administration. Rockville, MD. 1990.

Driscoll, E.D., G.E. Palhegyi, E.W. Strecker, and P.E. Shelley. *Analysis of Storm Event Characteristics for Selected Rainfall Gages Throughout the United States*. Office of Water, U.S. Environmental Protection Agency. 1989.

Driver, Nancy E., and David J. Lystrom. *Estimation of Urban Storm-Runoff Loads: Urban Runoff Quality-Impact and Quality Enhancement Technology Proceedings*. American Society of Civil Engineers. 1986.

Driver, N.E., M.H. Mustard, R.B. Rhinesmith, and R.F. Middelburg. *U.S. Geological Survey Urban-Stormwater Data Base for 22 Metropolitan Areas Throughout the United States*. U.S.Geological Survey Report No. OF 85-0337. Lakewood. 1985.

Eadie et al. 1984.

"EPA Finds Most Electric Utility Wastes To Be Nonhazardous." *JAPCA*, Vol. 38, No. 5, p. 686-688. May 1988.

FACTS, Facility and County Tracking System. Data base leased by EPA from Dun & Bradstreet Information Services. 1990 update.

Federal Water Pollution Control Act of 1972 (The Clean Water Act), as amended. Section 402(p)(5)(A-C).

Field, R. and R. Turkeltaub. Urban Runoff, Receiving Water Impacts -- Program Overview. Report No. EPA-600/J-81/546. ASCE/Journal of the Environmental Engineering Division. Vol 107, No. EE1, pp. 83-100. Feb. 1981.

Galvin, David V. Municipality of Metropolitan Seattle. "Household Hazardous Wastes in Municipal Wastewaters and Storm Drains: An Important Target for Comprehensive Pollution Prevention Programs." Paper presented at the 64th Annual Conference of the Water Pollution Control Federation in Toronto, October 7-10, 1991.

General Accounting Office. *Illegal Disposal of Hazardous Waste: Difficult to Detect or Deter*. February 1985.

R0015239

Gupta, M.K., R.W. Agnew, and N.P. Kobringer. *Constituents of Highway Runoff, Volume I: State-of-the-Art Report.* Envirex, Incorporated Milwaukee, WI; United States Department of Transportation, Federal Highway Administration. Report No. PB81-241895. February 1981.

Harrington, B.W. Feasibility and Design of Wet Ponds to Achieve Water Quality Control. Maryland Department of Natural Resources. State of Maryland. 1986.

Heaney, J.P. and W.C. Huber. *Nationwide Assement of Urban Runoff Impact on Receiving Water Quality.* Florida Water Reser. Res. Cert. University FL, Gainesville, Florida. Water Resources Bulletin. Vol. 20, No. 1, pp. 35-42. 1984.

Heaney, J.P., W.C. Huber, M.A. Medina, Jr., M.P. Murphy, S.J. Nix, and S.M. Hasan. *Nationwide Evaluation of Combined Sewer Overflows and Urban Stormwater Discharges Volume II: Cost Assessment and Impacts.* U.S. Environmental Protection Agency. Washington, DC. 1977.

Illinois Environmental Protection Agency. *Phosphorus: A Summary of Information Regarding Lake Water Quality.* August 1986.

Jones, Jonathan E. Urban Runoff Impacts on Receiving Waters. *Urban Runoff Quality-Impact and Quality Enhancement Technology--Proceedings* ASCE, 1986.

Jones, R.C. and C.C. Clark. *Impact of Watershed Urbanization on Stream Insect Communities,* American Water Resources Association, Water Resources Bulletin 23 (6), December, 1987.

King County, *Local Hazardous Waste Management Plan for Seattle - King County.* November 1990.

Klein, R.D. *Urbanization and Stream Quality Impairment,* American Water Resources Association, Water Resources Bulletin 15 (4), August, 1979.

Kobriger, N.K. *Sources and Migration of Highway Runoff Pollutants.* Rexnord Inc., Milwaukee, WI. Energy Center, U.S. Department of Transportation, Federal Highway Administration. Report No. PB86-227923. Washington, DC. 1984.

Kobriger, N.K. *Sources and Migration of Highway Runoff Pollutants, Volume 1 - Executive Summary.* U.S. Department of Transportation, Federal Highway Administration. Report No. PB86-227899. Milwaukee, WI. 1984.

Leeman, James E. "Waste Minimization in the Petroleum Industry." *JAPCA,* Vol. 38, No. 6, p. 814-823. June 1988.

Limburg, K.E. and R.E. Schmidt. *Patterns of Fish Spawning in Hudson River Tributaries: Response to an Urban Gradient?* Ecology 71 (4), pp. 1238-1245, 1990.

Lung, W. Phosphorus Loads to the Chesapeake Bay: A Perspective. Journal Water Pollution Control Federation. Vol. 58, No. 7, pp 749-756, July, 1986.

Mancini, John L. and Alan H. Plummer. *Urban Runoff Quality Criteria. Urban Runoff Quality--Impact and Quality Enhancement Technology-Proceedings.* pp. ASCE, 133-149. 1986.

Maryland Soil Conservation Committee, University of Maryland. *Manure Management Handbook, A Producer's Guide to Proper Manure Management.* 1989.

McCuen, Richard H. *Hydrologic Analysis and Design.* Englewood Cliffs. 1989.

Metropolitan Washington Council of Governments, Department of Environmental Programs. *Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs.* Washington, DC. 1987.

Montoya, B. California Regional Water Control Board, Central Valley Region. 1987. *Urban Runoff Discharge from Sacramento, CA.* Report No. 87-ISPSS.

National Oceanic and Atmospheric Administration. *The Quality of Shellfish Growing Waters on the East Coast of the United States,* 1989.

National Oceanic and Atmospheric Administration. *The Quality of Shellfish Growing Waters in the Gulf of Mexico* 1989.

National Oceanic and Atmospheric Administration. *The Quality of Shellfish Growing Waters on the West Coast of the United States* 1990.

New Jersey Department of Environmental Protection, Division of Hazardous Waste Management, Hazardous Waste Advisement Program. *Vehicle Maintenance.*

North Carolina Department of Natural Resources and Community Development, Pollution Prevention Pays Program. *Waste Reduction Options: Radiator Service Firms.*

Novotny, V and G. Chesters. Handbook of Nonpoint Pollution Sources and Management Van Nostrand Reinhold Environmental Engineering Series, New York, NY. 1981.

NPDES Storm Water Program Question and Answer Document, U.S. Environmental Protection Agency. Washington, DC. March 1992.

NRDC v. Costle, 568 F.2d 1369 (DC Cir. 1977).

NRDC v. EPA, 966 F.2d 1291 and 1304-6 (9th Cir. 1992).

NRDC v. EPA, 673 F.2d 392 (DC Cir. 1980).

NRDC v. Train, 396 F.Supp. 1393 (D.D.C. 1975).

Office of Management and Budget. *Standard Industrial Classification Manual.* 1987.

Pedersen, E.R. and M.A. Perkins. *The Use of Benthic Invertebrate Data for Evaluating Impacts of Urban Runoff.* Hydrobiologia 139, pp. 13-22, 1986.

Petroleum Products Storage and Distribution and Information Processing. Frost and Sullivan. New York. January 1983.

Pitt, Robert, and James McLean. *Stormwater, Baseflow, and Snowmelt Pollutant Contributions from an Industrial Area.*

Pitt, Robert, and Ali Ayyoubi, Richard Field, and Marie O'Shea. *The Treatability of Urban Stormwater Toxicants.*

Pitt, Robert, and Richard Field. *Hazardous and Toxic Wastes Associated with Urban Stormwater Runoff.*

Reilly. *The Use of Land.* 1973.

Rensselaerville Institute. *Report on the EPA Storm Water Management Program.* U.S. Environmental Protection Agency. Report No. 830-R-92-001. Prepared for the Office of Water Enforcement and Compliance. October 1992.

Ross, B.E. and M. Ross. Nonpoint Pollution Abatement in Tampa Bay. University of South Florida. *Nonpoint Source Pollution Abatement Symposium,* Milwaukee, EPA 1985.

Schueler, Thomas R. "Mitigating the Adverse Impacts of Urbanization on Streams: A Comprehensive Strategy for Local Governments." *Watershed Restoration Sourcebook.* MWCOG. Washington, DC. April 1992.

Schueler, T.R. and John Galli. "The Environmental Impacts of Storm Water Ponds." *Watershed Restoration Sourcebook.* MWCOG. Washington, DC. April 1992.

Schueler, Tom, and Dave Shepp. *The Quality of Trapped Sediments and Pool Water Within Oil Grit Separators in Suburban Maryland.* (One phase of the MDE Urban Hydrocarbon Study.)

Scott, Steward, and Stober.

SCS Engineers. *Ground Water Quality Management Plan for the San Fernando Valley Basin: Industrial Survey and Development of Best Management Practices, Final Report.* Prepared for Southern California Association of Governments. August 1982.

Shahin, Mohamed Y. *Pavement Maintenance Management for Roads and Parking Lots.* 1981.

Shaver, Earl. *The State of Delaware Sediment Control and Stormwater Management Program.*

Stahl, Ralph G. and Ernst M. Davis. "The Quality of Runoff From Model Coal Piles." *Journal of Testing and Evaluation.* Vol. 12, No. 3, p. 163-170. May 1984.

Standard Industrial Classification Manual. Executive Office of the President, Office of Management and Budget. 1987.

Stankowski, Stephen J. *Magnitude and Frequency of Floods in New Jersey with Effects of Urbanization.* Special Report 38. U.S. Geological Survey. 1974.

Terstriep, Michael, and Ming T. Lee. *An Urban Runoff Quality/Quantity Model with a GIS Interface.*

Tourbier. 1981.

Toy, Wesley M. "Waste Minimization in the Automotive Repair Industry." *JAPCA,* Vol. 38, No. 11, p. 1422-1426. November 1988.

Urbonas and Roesner. *Urban Runoff Quality - Impact and Quality Enhancement Technology.* ASCE, 1986.

U.S. Bureau of Census. *Statistical Abstract of the United States: 1988.* 108th edition. Washington, DC. 1987.

U.S. Department of Agriculture, Forest Service. *Report of the Forest Service: Fiscal Year 1991.*

U.S. Department of Agriculture, Forest Service. *An Analysis of the Timber Situation in the United States: 1989-2040.*

U.S. Department of Agriculture, Forest Service. *A Brief Overview on the Condition and Trends of U.S. Forests.*

U.S. Department of Commerce, Bureau of the Census. *News.* August 16, 1991.

U.S. Department of Commerce, Bureau of the Census. *News.* March 11, 1991.

U.S. Department of Defense. *List of Military Institutions Worldwide - 1992.*

U.S. Department of Energy, Office of Environmental Programs. *Energy and Solid/Hazardous Waste.* December 1981.

U.S. Department of Interior, Geological Survey, Office of Water Quality Technical Memorandum 92.05 "Programs and Plans--Quality of Existing Dissolved Trace-Element Data" Reston, VA. March 20, 1992.

U.S. Department of Interior, Office of Environmental Affairs. "Warehousing and Inventory Control: No. 14 in a Series of Fact Sheets. *Pollution Prevention Handbook.*

U.S. Department of Interior, Office of Environmental Affairs. "Automotive Maintenance: No. 6 in a Series of Fact Sheets. *Pollution Prevention Handbook.*

U.S. Department of Transportation. *Highway Statistics 1991.*

U.S. Department of Transportation. *Pollutant Loadings and Impacts from Highway Stormwater Runoff.*

U.S. Department of Transportation. *Traffic Volume Trends.*

U.S. Environmental Protection Agency. *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters.* January 1993.

U.S. Environmental Protection Agency. *Investigation of Inappropriate Pollutant Entries Into Storm Drainage Systems: A User's Guide.* 1993.

U.S. Environmental Protection Agency, Office of Water. *Storm Water Management For Industrial Activities: Developing Pollution Prevention Plans and Best Management Practices.* September 1992.

U.S. Environmental Protection Agency, Office of Water. *Environmental Impacts of Storm Water Discharges: A National Profile.* Washington, DC. June 1992.

U.S. Environmental Protection Agency, Office of Water. Memorandum: *Office of Water Policy and Technical Guidance on Interpretation and Implementation of Aquatic Life Metals Criteria.* Martha G. Prothro, Acting Assistant Administrator for Water, Washington, DC. October 1, 1992.

U.S. Environmental Protection Agency, Office of Policy, Planning and Evaluation. *Evaluation of Wet Weather Design Standards for Controlling Pollution from Combined Sewer Overflows.* Washington, DC. March 1992.

U.S. Environmental Protection Agency, Office of Pollution Prevention and Toxics. *Pollution Prevention Options In Wood Furniture Manufacturing: A Bibliographic Report.* February 1992.

U.S. Environmental Protection Agency, Office of Wastewater Enforcement and Compliance. *NPDES Storm Water Program: Briefing of the Deputy Administrator.* October 15, 1991.

U.S. Environmental Protection Agency, Office of Research and Development. *Guides to Pollution Prevention: The Automotive Refinishing Industry.* October 1991.

U.S. Environmental Protection Agency, Office of Research and Development. *Guides to Pollution Prevention: The Automotive Repair Industry.* October 1991.

U.S. Environmental Protection Agency, Office of Research and Development. *Guides to Pollution Prevention: The Photoprocessing Industry.* October 1991.

U.S. Environmental Protection Agency, Office of Research and Development. *Industrial Pollution Prevention Opportunities for the 1990s.* August 1991.

U.S. Environmental Protection Agency, Office of Wastewater Enforcement and Compliance. *Report to Congress on the National Pretreatment Program.* Washington, DC. May 21, 1991.

U.S. Environmental Protection Agency, Region V, Water Division. *Urban Targeting and BMP Selection.* Chicago, IL. November 1990.

U.S. Environmental Protection Agency, Office of Research and Development, Center for Environmental Research Information, Risk Reduction Engineering Laboratory. *Guides to Pollution Prevention: Selected Hospital Waste Streams.* June 1990.

U.S. Environmental Protection Agency, Risk Reduction Engineering Laboratory. *Description of Risk Reduction Engineering Laboratory Test and Evaluation Facilities.* June 1989.

U.S. Environmental Protection Agency, Solid Waste and Emergency Response. *How To Set Up A Local Program To Recycle Used Oil.* May 1989.

U.S. Environmental Protection Agency, Office of Water Enforcement and Permits. *Report to Congress: The Identification, Nature, and Extent of Storm Water Discharges in the United States.* Draft. April 17, 1989.

U.S. Environmental Protection Agency. *Results of the Evaluation of Groundwater Impacts of Sewer Exfiltration.* Municipal Facilities Division. Washington, DC. February 1989.

U.S. Environmental Protection Agency, Office of Water, Storm Water Technical Task Group. *Qualitative Assessment of Potential Storm Water Discharges.* Unpublished draft. 1989.

U.S. Environmental Protection Agency. *Class V Injection Wells: Current Inventory; Effects on Ground Water; and Technical Recommendations.* 1987.

U.S. Environmental Protection Agency, Water Planning Division. *Results of the Nationwide Urban Runoff Program.* Washington, DC. December 1983.

U.S. Environmental Protection Agency, NERC. *Runoff of Oils from Rural Roads Treated to Suppress Dust.* Cincinnati, OH. 1972.

U.S. Environmental Protection Agency. *National Estuaries Program: Action Plan Demonstration Projects for Several Estuaries.*

U.S. Environmental Protection Agency/National Oceanic and Atmospheric Administration. *Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance.*

U.S. Environmental Protection Agency, Office of Solid Waste. *Final Regulatory Impact Analysis of Revisions to Subtitle D Criteria for Municipal Solid Waste Landfills.*

U.S. Golf Association. *Environmental Issues Related to Golf Course Construction and Management: A Literature Search and Review.* August 1990.

Washington State Department of Ecology. *Stormwater Management Manual for the Puget Sound Basin.* February 1992.

57 *Federal Register* 60444 (December 18, 1992).

57 *Federal Register* 11394 (April 2, 1992).

56 *Federal Register* 56548 (November 5, 1991).

56 *Federal Register* 12098 (March 21, 1991).

55 *Federal Register* 47990 (November 16, 1990).

53 *Federal Register* 49416 (December 7, 1988).

51 *Federal Register* 8012 (March 7, 1986).

50 *Federal Register* 9362 (March 7, 1985).

49 *Federal Register* 37998 (September 26, 1984).

45 *Federal Register* 33290 (May 19, 1980).

44 *Federal Register* 32854 (June 7, 1979).

41 *Federal Register* 11307 (March 18, 1976).

APPENDIX A

LIST OF PHASE I MUNICIPAL SEPARATE STORM SEWER SYSTEMS

List of Phase I Municipal Separate Storm Sewer Systems (Incorporated Places)

State	Place Name	Population	Area (sq.mi.)
Alaska	Anchorage city*	226,338	1697.65
Alabama	Adamsville city	4,161	3.07
	Alabaster city	14,732	18.85
	Bessemer city	33,497	38.70
	Birmingham city*	265,968	148.49
	Brighton city	4,518	1.40
	Brookside town	1,365	2.38
	Chickasaw city	6,649	3.58
	Creola city	1,896	14.60
	Daphne city	11,290	11.03
	Fairfield city	12,200	3.36
	Fairhope city	8,485	7.70
	Fultondale city	6,400	7.57
	Gardendale city	9,251	15.14
	Graysville city	2,241	2.79
	Helena city	3,918	13.73
	Homewood city	22,922	7.37
	Hoover city	39,788	23.85
	Hueytown city	15,280	8.65
	Huntsville city*	159,789	164.39
	Indian Springs	NA	NA
	Irondale city	9,454	8.83
	Leeds city	9,946	21.48
	Lipscomb city	2,892	1.15
	Madison city	14,904	20.01
	Maytown town	651	2.74
	Midfield city	5,559	2.45
	Mobile city*	196,278	118.03
	Montgomery city*	187,106	134.98
	Moody town	4,921	11.05
	Mountain Brook city	19,810	11.61
	Mulga town	261	0.19
	Pelham city	9,765	13.80
	Pleasant Grove city	8,458	6.17
	Prichard city	34,311	25.39
	Saraland city	11,751	11.40
	Satsuma city	5,194	5.97
	Tarrant city	8,046	6.36
	Trussville city	8,266	14.84
	Vestavia Hills city	19,749	8.83
Arkansas	Little Rock city*	175,795	102.86

NOTE: Unless indicated otherwise, municipalities have been designated.
* Identified in November 1990 rule.
† 1990 Census population increased to over 100,000 and municipality has been designated.
NA Not available

List of Phase I Municipal Separate Storm Sewer Systems (Incorporated Places) (continued)

State	Place Name	Population	Area (sq.mi.)
Arizona	Mesa city*	288,091	108.59
	Mesa city*	288,091	108.59
	Phoenix city*	983,403	419.91
	Tempe city*	141,865	39.52
	Tucson city*	405,390	156.29
California	Agoura Hills city	20,390	8.17
	Alameda city	76,459	10.75
	Albany city	16,327	1.70
	Alhambra city	82,106	7.62
	Anaheim city*	266,406	44.28
	Arcadia city	48,290	10.88
	Artesia city	15,464	1.62
	Atherton town	7,163	4.89
	Azusa city	41,333	9.00
	Bakersfield city*	174,820	91.84
	Baldwin Park city	69,330	6.60
	Bell city	42,355	2.51
	Bellflower city	34,365	2.56
	Bell Gardens city	61,815	6.08
	Belmont city	24,127	4.53
	Berkeley city*	102,724	10.46
	Beverly Hills city	31,971	5.68
	Big Bear Lake city	5,351	6.24
	Bradbury city	829	1.67
	Brisbane city	2,952	3.33
	Burbank city	93,643	17.35
	Burlingame city	26,801	4.35
	Camarillo city	52,303	18.44
	Campbell city	36,048	5.61
	Carlsbad city	63,126	37.67
	Carson city	83,995	18.84
	Cerritos city	53,240	8.61
	Chula Vista city†	135,163	28.99
	Claremont city	32,503	11.01
	Colma town	1,103	1.90
	Commerce city	12,135	6.53
	Compton city	90,454	10.17
	Concord city	111,348	29.47
	Contra Costa county (15 cities)	~553,831	~172.65
	Coronado city	26,540	7.71

NOTE: Unless indicated otherwise, municipalities have been designated.
* Identified in November 1990 rule
† 1990 Census population increased to over 100,000 and municipality has been designated.
NA Not available

List of Phase I Municipal Separate Storm Sewer Systems (Incorporated Places) (continued)

State	Place Name	Population	Area (sq.mi.)
California (continued)	Covina city	43,207	6.90
	Cudahy city	22,817	1.10
	Culver City city	38,793	5.10
	Cupertino city	40,263	10.30
	Daly City city	92,311	7.51
	Del Mar city	4,860	1.77
	Diamond Bar city	53,672	15.09
	Downey city	91,444	12.44
	Duarte city	20,688	7.21
	Dublin city	23,229	8.56
	East Palo Alto city	23,451	2.55
	El Cajon city	88,693	14.41
	El Monte city†	106,209	9.50
	El Segundo city	15,223	5.55
	Emeryville city	5,740	1.22
	Encinitas city	55,386	17.95
	Escondido city†	108,635	35.64
	Fairfield city	77,211	35.85
	Fillmore city	11,992	2.64
	Folsom city	29,802	21.43
	Foster City city	28,176	3.76
	Fremont city*	173,339	77.03
	Fresno city*	354,202	99.14
	Fullerton city*	114,144	22.12
	Galt city	8,889	5.60
	Gardena city	143,050	17.94
	Garden Grove city*	49,847	5.28
	Gilroy city	31,487	10.26
	Glendale city*	180,038	30.61
	Glendora city	47,828	19.47
	Half Moon Bay city	8,886	6.47
	Hawaiian Gardens city	13,639	0.95
	Hawthorne city	71,349	5.93
	Hayward city†	111,498	43.45
	Hermosa Beach city	18,219	1.43
	Hidden Hills city	1,729	1.62
	Hillsborough town	10,667	6.22
	Huntington Beach city*	181,519	26.42
	Huntington Park city	56,065	3.05
	Imperial Beach city	26,512	4.25
	Industry city	631	11.56
	Inglewood city†	109,602	9.17
	Irvine city†	110,330	42.32

NOTE: Unless indicated otherwise, municipalities have been designated.
* Identified in November 1990 rule.
† 1990 Census population increased to over 100,000 and municipality has been designated.
NA Not available

R0015251

List of Phase I Municipal Separate Storm Sewer Systems (Incorporated Places) (continued)

State	Place Name	Population	Area (sq.mi.)
California (continued)	Irwindale city	1,050	9.32
	La Canada Flintridge city	19,378	8.67
	Laguna Beach city	23,170	8.68
	La Habra Heights city	6,226	6.37
	Lakewood city	73,557	9.39
	La Mesa city	52,931	9.22
	La Mirada city	40,452	7.85
	La Palma city	15,932	1.82
	La Puente city	36,955	3.49
	La Verne city	30,897	7.79
	Lawndale city	27,331	1.98
	Lemon Grove city	23,984	3.79
	Livermore city	56,741	19.63
	Lomita city	19,382	1.89
	Long Beach city*	429,433	50.02
	Los Alamitos city	11,676	4.03
	Los Altos city	7,514	8.42
	Los Altos Hills town	26,303	6.37
	Los Angeles city*	3,485,398	469.34
	Los Gatos town	27,357	10.38
	Lynwood city	61,945	4.86
	Manhattan Beach city	32,063	3.93
	Maywood city	27,850	1.17
	Menlo Park city	28,040	10.06
	Millbrae city	20,412	3.21
	Milpitas city	50,686	13.76
	Modesto city*	164,730	30.18
	Monrovia city	35,761	13.37
	Montebello city	3,287	1.61
	Monterey Park city	59,564	8.26
	Monte Sereno city	60,738	7.64
	Moorpark city	25,494	12.26
	Moreno Valley city†	118,779	49.13
	Mountain View city	67,460	12.03
	National City city	54,249	7.57
	Newark city	37,861	13.96
	Norwalk city	94,279	9.76
	Oakland city*	372,242	56.06
	Oceanside city†	128,398	40.67
	Ojai city	7,613	4.43
	Ontario city†	133,179	36.75
	Orange city†	110,658	23.34
	Orange county (17 cities)	~841,825	~179.74

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NA Not available

List of Phase I Municipal Separate Storm Sewer Systems (Incorporated Places) (continued)

State	Place Name	Population	Area (sq.mi.)
California (continued)	Oxnard city*	142,216	24.44
	Pacifica city	37,670	12.64
	Palo Alto city	55,900	23.68
	Palos Verdes Estates city	13,512	4.81
	Paramount city	47,669	4.70
	Pasadena city*	131,591	22.99
	Pico Rivera city	59,177	7.98
	Piedmont city	10,602	1.68
	Pleasanton city	50,553	16.21
	Pomona city†	131,723	22.83
	Port Hueneme city	20,319	4.43
	Poway city	43,516	39.28
	Rancho Cucamonga city†	101,409	37.81
	Rancho Palos Verdes city	41,659	13.66
	Redondo Beach city	60,167	6.28
	Redwood City city	66,072	19.04
	Riverside city*	226,505	77.68
	Riverside county (10 cities)	~161,120	~133.44
	Rolling Hills city	7,789	3.54
	Rolling Hills Estates city	1,871	3.05
	Rosemead city	51,638	5.12
	Sacramento city*	369,365	96.29
	Salinas city†	108,777	18.63
	San Bernardino city*	164,164	55.08
	San Bernardino county (13 cities)	~558,047	~231.35
	San Bruno city	38,961	6.43
	San Carlos city	26,167	5.63
	San Diego city*	1,110,549	324.00
	San Dimas city	32,397	15.52
	San Fernando city	22,580	2.39
	San Gabriel city	37,120	4.14
	San Jose city*	782,248	171.26
	San Leandro city	68,223	13.11
	San Marcos city	38,974	23.19
	San Marino city	12,959	3.77
	San Mateo city	85,486	12.21
	Santa Ana city*	293,742	27.09
	Santa Clara	93,613	18.30
	Santa Clarita city†	110,642	40.48
	Santa Fe Springs city	15,520	8.67
	Santa Monica city	86,905	8.27
	Santa Paula city	25,062	4.60

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NA Not available

List of Phase I Municipal Separate Storm Sewer Systems (Incorporated Places) (continued)

State	Place Name	Population	Area (sq.mi.)
California (continued)	Santee city	52,902	15.87
	Saratoga city	28,061	11.97
	Seal Beach city	25,098	11.72
	Sierra Madre city	10,762	3.00
	Signal Hill city	8,371	2.22
	Simi Valley city†	100,217	33.03
	Solana Beach city	12,962	3.52
	South El Monte city	20,850	2.89
	South Gate city	86,284	7.35
	South Lake Tahoe city	21,585	10.06
	South Pasadena city	23,936	3.43
	South San Francisco city	54,312	8.96
	Stockton city*	210,943	52.57
	Suisun City city	22,686	3.56
	Sunnyvale city*	117,229	21.90
	Temple City city	31,100	4.01
	Thousand Oaks city†	104,352	49.56
	Torrance city*	133,107	20.52
	Union City city	53,762	18.76
	Vallejo city†	109,199	30.22
	Vernon city	152	4.93
	Vista city	71,872	17.94
	Walnut city	29,105	8.86
	West Covina city	96,086	16.20
	West Hollywood city	36,118	1.88
	Westlake Village city	7,455	5.21
	Whittier city	77,671	12.53
	Woodside town	5,035	11.74
Colorado	Aurora city*	222,103	132.53
	Colorado Springs city*	281,140	183.19
	Denver city*	467,610	153.28
	Lakewood city*	126,481	40.80
	Pueblo city	98,640	35.90
Connecticut	Stamford city*	108,056	37.72
District of Columbia	Washington city*	606,900	61.41
Delaware	Arden village	477	0.27
	Ardencroft village	282	0.11
	Ardentown village	325	0.17
	Bellefonte town	1,243	0.18
	Delaware City city	1,682	1.24
	Elsmere town	5,935	0.98
	Middletown town	3,834	3.41

NOTE: Unless indicated otherwise, municipalities have been designated.
* Identified in November 1990 rule.
† 1990 Census population increased to over 100,000 and municipality has been designated.
NA Not available

List of Phase I Municipal Separate Storm Sewer Systems (Incorporated Places) (continued)

State	Place Name	Population	Area (sq.mi.)
Delaware (continued)	Newark city	25,098	8.62
	New Castle city	4,837	2.22
	Newport town	1,240	0.37
	Odessa town	303	0.44
	Townsend town	322	0.21
	Wilmington city	71,529	10.78
Florida	Atlantis city	1,653	1.35
	Auburndale city	8,858	4.10
	Bartow city	14,716	8.59
	Belle Glade city	60	0.06
	Boca Raton city	61,492	27.19
	Boynton Beach city	46,194	15.14
	Briny Breezes town	400	0.07
	Broward County (24 cities)	1,050,742	322.96
	Century town	1,989	3.28
	Clearwater city	98,784	24.88
	Cloud Lake town	121	0.06
	Dade County (19 cities)	886,235	118.42
	Davenport city	1,529	1.47
	Delray Beach city	47,181	14.84
	Dundee town	2,335	3.10
	Eagle Lake city	1,758	0.72
	Fort Lauderdale city*	149,377	31.36
	Fort Meade city	4,976	3.17
	Frostproof city	2,808	2.39
	Glen Ridge town	207	0.23
	Golf village	234	0.83
	Golfview town	153	0.16
	Greenacres City city	18,683	4.05
	Gulf Stream town	11,727	2.84
	Haines City city	11,683	8.01
	Haverhill town	1,058	0.52
	Hialeah city*	188,004	19.24
	Highland Beach town	3,209	0.49
	Highland Park village	155	0.45
	Hillcrest Heights town	221	0.16
	Hollywood city*	121,697	27.26
	Homestead city	26,866	11.61
	Hypoluxo town	830	0.60
	Jacksonville city*	635,230	758.67
	Juno Beach town	2,121	1.08
	Jupiter town	405	0.18
	Jupiter Inlet Colony town	24,986	13.11

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NA Not available

List of Phase I Municipal Separate Storm Sewer Systems (Incorporated Places) (continued)

State	Place Name	Population	Area (sq.mi.)
Florida (continued)	Lake Alfred city	3,622	2.52
	Lake Clarke Shores town	3,364	0.98
	Lake Hamilton town	1,128	3.03
	Lakeland city	6,704	1.80
	Lake Park town	9,670	6.40
	Lake Wales city	28,564	5.62
	Lake Worth city	70,576	38.39
	Lantana town	8,392	2.28
	Longboat Key town	5,937	4.92
	Manalapan town	312	0.45
	Mangonia Park town	1,453	0.71
	Miami city*	358,548	35.57
	Miramar city	40,663	29.67
	Mulberry city	2,988	2.87
	North Palm Beach village	11,343	3.31
	North Port city	11,973	74.78
	Ocean Ridge town	1,570	0.86
	Orange County (8 cities)	239,522	103.68
	Orlando city*	164,693	67.27
	Pahokee city	6,822	5.34
	Palm Beach town	22,965	26.28
	Palm Beach Gardens city	1,040	0.25
	Palm Beach Shores town	9,814	3.93
	Palm Springs village	9,763	1.33
	Pembroke Pines city	65,452	31.94
	Pennsuee	NA	NA
	Pensacola city	58,165	22.64
	Pinellas County (21 cities)	586,612	NA
	Plant City city	66,692	21.75
	Polk City town	1,439	0.59
	Riviera Beach city	27,639	7.49
	Royal Palm Beach village	14,589	8.81
	St. Petersburg city*	238,629	59.19
	Sarasota city	50,961	14.62
	Seminole city	9,251	2.25
	South Bay city	3,558	1.93
	South Palm Beach town	1,480	0.13
	• Tallahassee city†	124,773	63.27
	Tampa city*	280,015	108.67
	Temple Terrace city	16,444	4.94
	Tequesta village	4,499	1.71
	Venice city	16,922	7.42
	West Palm Beach city	67,643	49.33

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NA Not available

List of Phase I Municipal Separate Storm Sewer Systems (Incorporated Places) (continued)

State	Place Name	Population	Area (sq.mi.)
	Winter Haven city	24,725	12.19
Georgia	Acworth city	4,519	4.63
	Alpharetta city	13,002	19.02
	Atlanta city*	394,017	131.78
	Austell city	4,173	4.97
	Bloomingdale city	2,271	9.23
	Buford city	8,771	13.35
	Chamblee city	7,668	3.14
	Clarkston city	5,385	1.05
	College Park city	20,457	9.70
	Columbus city*	178,681	216.14
	Decatur city	17,336	4.16
	Doraville city	7,626	3.58
	Duluth city	9,029	7.39
	East Point city	34,402	13.76
	Fairburn city	4,013	4.46
	Forest Park city	16,925	8.59
	Garden City city	7,410	5.10
	Hapeville city	5,483	2.37
	Jonesboro city	3,635	2.40
	Kennesaw city	8,936	5.58
	Lawrenceville city	16,848	12.34
	Lilburn city	9,301	6.20
	Lithonia city	2,448	0.79
	Macon city*	106,612	47.88
	Marietta city	44,129	20.38
	Morrow city	5,168	2.83
	Norcross city	5,947	3.92
	Palmetto city	2,612	5.02
	Pooler city	4,453	11.07
	Powder Springs city	6,893	5.35
	Riverdale city	9,359	4.10
	Roswell city	47,923	32.57
	Savannah city*	137,560	62.59
	Smyrna city	30,981	11.37
	Snellville city	12,084	9.13
	Stone Mountain city	6,494	1.62
	Sugar Hill city	4,557	5.91
	Thunderbolt town	2,786	1.28
	Union City city	8,375	8.04
Iowa	Cedar Rapids city*	108,751	53.46
	Davenport city	95,333	61.36
	Des Moines city*	193,187	75.26
Idaho	Boise City city*	125,738	46.13
	Garden City city	6,369	3.33
Illinois	Rockford city*	139,426	44.98

NOTE: Unless indicated otherwise, municipalities have been designated.
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NA Not available

List of Phase I Municipal Separate Storm Sewer Systems (Incorporated Places) (continued)

State	Place Name	Population	Area (sq.mi.)
Indiana	Fort Wayne city*	173,072	62.66
	Indianapolis city*	731,327	361.67
Kansas	Kansas City city*	149,767	107.79
	Topeka city*	119,883	55.16
	Wichita city*	304,011	115.14
Kentucky	Lexington-Fayette*	225,366	284.52
	Louisville city*	269,063	62.11
Louisiana	Baton Rouge city*	219,531	73.95
	Gretna city	17,208	3.2
	Harahan city	9,927	1.98
	Kerner city	72,033	15.13
	New Orleans city*	496,938	180.65
	Shreveport city*	198,525	98.61
	Westwego city	11,218	3.19
Massachusetts	Boston city*	574,283	48.42
	Lowell city	103,439	13.78
	Worcester city*	169,759	37.56
Maryland	Baltimore city*	736,014	80.81
	Aberdeen	13,087	5.29
	Annapolis	33,187	6.33
	Bowie	8,860	2.57
	Bel Air	37,589	12.86
	Havre de Grace	8,952	3.31
	Takoma Park city	16,700	2.01
Michigan	Ann Arbor city*	109,592	25.90
	Flint city*	140,761	33.83
	Grand Rapids city*	189,126	44.26
	Sterling Heights city*	117,810	36.64
	Warren city*	144,864	34.28
Minnesota	Minneapolis city*	368,383	54.93
	St. Paul city*	272,235	52.79
Missouri	Independence city*	112,301	78.19
	Kansas City city*	435,146	311.53
	Springfield city*	140,494	67.95
Mississippi	Jackson city*	196,637	109.01
Nebraska	Lincoln city*	191,972	63.29
	Omaha city*	335,795	100.65
New Mexico	Albuquerque city*	384,736	132.20
Nevada	Henderson city	64,942	71.54
	Las Vegas city*	258,295	83.29
	North Las Vegas city	47,707	60.97
	Reno city*	133,850	57.50
	Sparks city	53,367	14.25

NOTE: Unless indicated otherwise, municipalities have been designated.
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† 1990 Census population increased to over 100,000 and municipality has been designated.
NA Not available

List of Phase I Municipal Separate Storm Sewer Systems (Incorporated Places) (continued)

State	Place Name	Population	Area (sq.mi.)
New York	New York city* (Bronx Borough) (Brooklyn Borough) (Manhattan Borough) (Queens Borough) (Staten Island Borough)	7,322,564	308.95
North Carolina	Charlotte city*	395,934	174.26
	Durham city*	136,611	69.27
	Fayetteville city	75,695	40.60
	Greensboro city*	183,521	79.79
	Raleigh city*	207,951	88.13
	Winston-Salem city*	143,485	71.12
Ohio	Akron city*	223,019	62.19
	Cincinnati city*	364,040	77.22
	Cleveland city*	505,616	77.02
	Columbus city*	632,910	190.92
	Dayton city*	182,044	55.00
	Toledo city*	332,943	80.57
Oklahoma	Oklahoma City city*	444,719	608.16
	Tulsa city*	367,302	183.52
Oregon	Banks city	563	0.33
	Barlow city	118	0.06
	Beaverton city	53,310	13.82
	Cornelius city	6,148	1.79
	Durham city	748	0.43
	Eugene city*	112,669	38.04
	Fairview city	2,391	3.16
	Forest Grove city	13,559	40.22
	Gaston city	563	2.45
	Gladstone city	10,152	22.06
	Gresham city	68,235	2.30
	Happy Valley city	1,519	19.26
	Hillsboro city	37,520	0.06
	Johnson City city	586	0.41
	King City city	2,060	9.54
	Lake Oswego city	30,576	4.76
	Milwaukee city	18,692	1.63
	North Plains city	972	4.69
	Portland city*	437,319	0.18
	Rivergrove city	294	.13
	Sherwood city	3,093	3.21
	Tigard city	29,344	10.19
	Tualatin city	15,013	7.10
	West Linn city	16,367	6.63
	Wilsonville city	7,106	6.39
Pennsylvania	Allentown city*	105,090	17.71
	Philadelphia city*	1,585,577	135.13

NOTE: Unless indicated otherwise, municipalities have been designated.
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NA Not available

List of Phase I Municipal Separate Storm Sewer Systems (Incorporated Places) (continued)

State	Place Name	Population	Area (sq.mi.)
South Dakota	Sioux Falls city	100,814	45.05
Tennessee	Belle Meade city	2,839	3.14
	Berry Hill city	802	0.90
	Chattanooga city*	152,466	118.43
	Forest Hills city	4,231	9.28
	Goodlettsville city	11,219	13.65
	Knoxville city*	165,121	77.25
	Lakewood city	2,009	0.96
	Memphis city*	610,337	256.04
	Nashville-Davidson city*	488,374	473.33
	Oak Hill city*	4,301	7.88
	Ridgetop town	1,132	1.49
Texas	Abilene city†	106,654	103.09
	Amarillo city*	157,615	87.93
	Arlington city*	261,721	93.00
	Austin city*	465,622	217.78
	Beaumont city*	114,323	80.06
	Corpus Christi city*	257,453	134.97
	Dallas city*	1,006,877	342.41
	El Paso city*	515,342	245.36
	Fort Worth city*	447,619	281.08
	Garland city*	180,650	57.35
	Houston city*	1,630,553	539.88
	Irving city*	155,037	67.62
	Laredo city†	122,899	32.87
	Lubbock city*	186,206	104.11
	Mesquite city†	101,484	42.84
	Pasadena city*	119,363	43.77
	Plano city†	128,713	66.25
	San Antonio city*	935,933	333.03
	Waco city*	103,590	75.79
Utah	Salt Lake City city*	159,936	109.02
Virginia	Chesapeake city*	151,976	340.68
	Hampton city*	133,793	51.82
	Newport News city*	170,045	68.34
	Norfolk city*	261,229	53.76
	Portsmouth city*	103,907	33.14
	Roanoke city	96,397	42.90
	Virginia Beach city*	393,069	248.32
Washington	Seattle city*	516,259	83.89
	Tacoma city*	176,664	48.05
Wisconsin	Madison city*	191,262	57.76
	Milwaukee city*	628,088	96.08

NOTE: Unless indicated otherwise, municipalities have been designated.
* Identified in November 1990 rule
† 1990 Census population increased to over 100,000 and municipality has been designated.
NA Not available

List of Phase I Municipal Separate Sewer Systems (Counties)

State	County	Unincorporated/ Urbanized Population	Total Population
Alabama	Baldwin county[1]	0	98,380
	Jefferson county[1]	78,608	651,525
	Mobile county[2]	45,418	378,643
	Shelby county[3]	16,148	99,358
	St. Clair county[4]	0	50,009
Arizona	Pima County*	162,202	666,880
California	Alameda County*	115,082	1,279,182
	Contra Costa County*	131,815	803,732
	Kern County*	128,504	543,447
	El Dorado County	0	125,995
	Fresno County	48,863	667,490
	Los Angeles County*	886,780	8,863,164
	Orange County*	223,081	2,410,556
	Placer County	10,564	172,796
	Riverside County*	166,509	1,170,413
	Sacramento County	594,889	1,041,219
	San Bernardino County*	162,202	1,418,380
	San Diego County*	250,414	2,498,016
	San Mateo County	50,250	649,623
	Santa Clara County	75,464	1,497,577
	Ventura County	41,020	669,016
Colorado	Arapahoe County†	103,248	391,511
Delaware	New Castle County*	296,996	441,946
Florida	Broward County*	142,329	1,255,488
	Dade County*	1,014,504	1,937,094
	Escambia County*	167,463	262,798
	Hillsborough County*	398,593	834,054
	Lee County†	102,337	335,113
	Manatee County†	123,828	211,707
	Orange County*	378,611	677,491
	Palm Beach County*	360,553	863,518
	Pasco County†	148,907	281,131
	Pinellas County*	255,772	851,659
	Polk County*	121,528	405,382
	Sarasota County*	172,600	277,776
	Seminole County†	127,873	287,529

[1] County was listed in regulation; however, population dropped below 100,000 in 1990 census.

[2] Unincorporated areas defined as: beginning at the mouth of the South Fork Deer River and extending west to SW corner Section 18, Township 6 South, Range 2 West, thence north to NW corner, Section 6, Township 2 South, Range 2 West, thence east to the Mobile County line, thence south along the county line to U.S. Highway 90 bridge.

[3] All unincorporated areas of Shelby County within the drainage basin of the Cahaba River upstream of the confluence of Shoal Creek and the Cahaba River.

[4] Unincorporated areas of St. Clair County within the drainage basin of the Cahaba River.

*Identified in November 1990 rule

†1990 Census unincorporated, urbanized population increased to more than 100,000 and municipality has been designated.

List of Phase I Municipal Separate Sewer Systems (Counties) (continued)

State	County	Unincorporated/ Urbanized Population	Total Population
Georgia	Bibb County	19,340	149,976
	Chatham County	40,649	216,935
	Clayton County*	133,237	182,052
	Cobb County*	322,595	447,745
	DeKalb County*	448,686	545,837
	Fulton County†	127,776	648,951
	Gwinnett County†	237,305	352,910
	Muscogee County	0	179,278
	Richmond County*	126,476	189,719
Hawaii	Honolulu County*	114,506	836,231
Kentucky	Jefferson County*	239,430	664,937
Louisiana	East Baton Rouge Parish†	102,539	380,105
	Jefferson Parish*	331,307	448,306
Maryland	Anne Arundel County*	344,654	427,239
	Baltimore County*	627,593	692,134
	Carroll County	0	123,372
	Charles County	0	101,154
	Frederick County	14,100	150,208
	Harford County	82,302	182,132
	Howard County†	157,972	187,328
	Montgomery County*	599,028	757,027
	Prince George's County*	494,369	729,268
	Washington County	28,321	121,393
North Carolina	Cumberland County*	146,827	274,566
Nevada	Clark County*	327,618	741,459
	Washoe County	26,530	254,667
Oregon	Clackamas County	65,088	278,850
	Multnomah County	52,923	583,887
	Washington County*	116,687	311,554
South Carolina	Greenville County*	147,464	320,167
	Richland County*	130,589	285,720
Texas	Harris County*	729,206	2,818,199
Utah	Salt Lake County*	270,989	725,956
Virginia	Arlington County*	170,936	170,936
	Chesterfield County*	174,488	209,274
	Fairfax County*	760,730	818,584
	Henrico County*	201,367	217,881
	Prince William County†	157,131	215,686
Washington	King County*	520,468	1,507,319
	Pierce County*	258,530	586,203
	Snohomish County*	157,218	465,642

*Identified in November 1990 rule

†1990 Census unincorporated, urbanized population increased to more than 100,000 and municipality has been designated.

List of Municipal Separate Storm Sewer Systems (Boundaries Not Defined by Census)

State	Municipal Separate Storm Sewer System
Alaska	DOT[1] University of Alaska Port of Anchorage
Alabama	Highway Department
Arizona	DOT
California	Alameda County Flood Control District Zone 7 of the Alameda County Flood Control District DOT Calabases Flood Control District Coachella Valley Area Contra Costa County Flood Control District Fresno Metro Flood Control District Malibu Flood Control District Orange County Flood Control District Riverside Flood Control District San Bernardino Flood Control District San Diego Unified Port District Santa Clara Valley Water District
Colorado	DOT Highway Department
Delaware	DOT
Florida	DOT Reedy Creek Improvement District
Hawaii	DOT
Idaho	DOT
Illinois	DOT
Indiana	DOT
Kansas	Kaw Valley Drainage District
Louisiana	DOT Louisiana State University Southern University
Maryland	State Highway Administration
Michigan	University of Michigan DOT
Minnesota	DOT Herrepin County Public Works Minneapolis Parks and Recreation University of Minnesota
North Carolina	DOT
Nevada	Clark County Flood Control District DOT
New Mexico	Albuquerque Metropolitan Flood Control Authority DOT
Ohio	DOT

[1] Department of Transportation

List of Municipal Separate Storm Sewer Systems (Boundaries Not Defined by Census) (continued)

State	Municipal Separate Storm Sewer System
Oklahoma	DOT Turpike Authority
Oregon	DOT Port of Portland Multhomah County Drainage Districts (3)
Pennsylvania	DOT
South Carolina	Harbor of Charleston
Tennessee	DOT
Texas	Harris County Flood Control District DOT University of Texas-Arlington University of Texas-Austin
Utah	DOT
Washington	DOT
Wisconsin	DOT University of Wisconsin

APPENDIX B

OVERVIEW OF IMPACTS FROM STORM WATER DISCHARGES

APPENDIX B - OVERVIEW OF IMPACTS FROM STORM WATER DISCHARGES

This appendix provides an overview of the types of impacts that storm water discharges have on receiving waters. Section B.1 describes the role of storm water discharges and the physical nature of storm water discharges. Section B.2 discusses the types of adverse impacts on receiving waters caused by storm water discharges. Section B.3 gives a general description of adverse impacts on various types of receiving waters that may be associated with storm water discharges.

B.1 THE PHYSICAL NATURE OF STORM WATER DISCHARGES

B.1.1 The Hydrologic Cycle

The hydrologic cycle is the continuous, unsteady circulation of water from the atmosphere to the Earth's surface and back to the atmosphere. Major features of the hydrologic cycle include precipitation, snow melt, surface runoff and drainage, infiltration, interflow, ground water recharge, and evapotranspiration. Each of these factors is discussed briefly below:

- **Precipitation**—Precipitation occurs as rain, sleet, hail, and snow. Precipitation is one of the key factors in analyzing storm water discharges because it is the initiating force in creating a discharge. Precipitation events are highly variable in nature and extent. As discussed in more detail below, the nature of precipitation patterns varies greatly in different parts of the country. Seasonal patterns also are usually important considerations.

- **Snow Melt**—When precipitation falls in the form of snow, surface runoff does not occur until the snow melts. In this case, the rate and volume of surface runoff discharges is controlled by the rate of snow melt.

- **Infiltration**—Infiltration occurs as rain water passes into the soil. The ability of soil to infiltrate water depends on a number of factors, including soil properties, soil moisture content, vegetation cover, and the presence of impervious structures, such as pavement. Water that infiltrates into the soil can be subject to interflow, ground water recharge, and evapotranspiration.

- **Interflow**—Interflow (i.e., subsurface flow) occurs when water infiltrates into the soil and flows through the soil above the water table. Interflow can occur until water enters a drainage ditch, storm sewer, surface receiving water, or the ground water.

- **Ground Water Recharge**—Ground water recharge occurs when water infiltrates into the soil and enters the water table. Ground water then flows toward and into natural or artificial channels or other receiving waters. The flow of ground water to surface waters maintains flows in natural and manmade drainage ways and impoundments during dry weather conditions.

- **Evapotranspiration**—The term evapotranspiration describes two processes—evaporation and transpiration. Evaporation is the process where liquid water changes to a vapor. Transpiration occurs when water moves through vegetation and is then evaporated.

- **Surface Runoff and Natural Drainage**—Surface runoff (i.e., overland flow) occurs when water generated from precipitation or snow melt moves across the ground to a natural or constructed channel or some other receiving water. Natural drainage defines the flow of water through naturally occurring receiving waters and into the ocean. Because the natural drainage system contains a wide range of receiving waters, including wetlands and intermittent streams, it is often difficult to determine the point at which surface runoff ends and natural drainage begins. Although such distinctions may be important in our legal system, they have limited importance in the workings of the hydrologic cycle.

B.1.2 Impacts of Land Use Activities on the Hydrology of Watersheds

Typically, a watershed is a geographic region in which surface waters flow towards a common receiving point such as a stream, river, lake, or estuary. The natural drainage system of a watershed may comprise many types of surface water features, including wetlands, intermittent streams, small perennial streams, and larger receiving waters. In other uses of the term, watersheds may also be defined based on ground water flows and aquifers.

As watersheds are developed for urban or agricultural uses, resource extraction, or other purposes, the natural drainage features of the water are often altered. Wetlands are dredged or filled, reducing the natural storage capacity of the drainage system, which, prior to its loss, damped peak flows associated with storm events. Smaller streams can be channelized, rip-rapped, or diverted into underground culverts, all of which allow the flow rates in the channel to increase.

The hydrology of the watershed also is changed by activities occurring on land. The natural drainage features of undeveloped land slow the flow of runoff by incorporating rainfall into the natural hydrologic cycle. Many types of development cause an increase in the volume of surface runoff and its rate of discharge. A given storm event will yield more runoff with a faster rate of discharge for a developed area than for an undeveloped area of the same size. These increases in the rate of flow and the total volume of flow often have a decided effect on pollutant loads, erosion rates, and flooding.

A number of factors can increase the volume and rate at which runoff flows from a developed site. Clearing land removes the vegetation cover that previously intercepted precipitation before it hit the earth. The thick humus layer associated with the vegetative cover is often removed or eroded away during grading activities, decreasing the ability of the surface to infiltrate and retain precipitation. The land is graded to make the surface smoother by removing natural depressions. Site slopes may be increased as part of terracing to improve site drainage. Wetlands, which may have previously soaked up water associated with peak flows, are drained or filled. Impervious structures, such as roads, parking lots, driveways, rooftops and sidewalks, are built. In other heavily used areas, soils become compacted and lose their ability to infiltrate precipitation.

After development has occurred, the natural drainage system (e.g., streams, wetlands, and other receiving waters) is often unable to handle the higher volume flows, resulting in high erosion rates or flooding. Drainage systems that have undergone these changes often need additional "improvement" from channelization or lining projects. In addition, streams are often directed through underground culverts.

The same characteristics of land development that cause higher peak flows also cause less infiltration of rainfall to recharge ground water supplies and a lowering of the water table. One result of lowered water tables is that surface stream flows during dry weather can be lowered significantly. Lower flows during periods between storms may significantly affect the aquatic habitat and the ability of a stream to dilute toxic spills or other dry weather pollutants within the stream system (Bellevue NURP). In some cases, the installation of storm sewers in a watershed results in small, previously perennial, streams running dry several times a year (Long Island NURP).

B.1.3 <u>General Physical Characteristics of Storm Water Discharges</u>

Storm water discharges are diffuse in nature; discharges in a watershed are generated by an extremely large number of points. Three characteristics of storm water discharges are particularly important when analyzing potential impacts of these diffuse sources within a watershed. Storm water discharges 1) may affect broad portions of a watershed, 2) can have high volumes, and 3) are generally of limited duration.

B.1.3.1 Effects on Broad Portions of a Watershed

Unlike many other major point source discharges that are directed to larger receiving water bodies or to relatively remote offshore locations, storm sewers discharge to essentially all of the portions of the drainage system within developed areas of the watershed. As a result, the impacts of storm water discharges, although more subtle, may be more widespread and potentially may affect a greater degree of the natural drainage system than traditional point source discharges.

Perhaps the widespread nature of storm water discharges is most evident when considering large urbanized areas.[1] Essentially all receiving waters in urbanized areas receive storm water discharges from some type of urban land, regardless of the sensitivity of the receiving water to potential impacts. This is because typical storm water management practices attempt to drain water from the land as soon as possible and discharge it to the nearest receiving water whether or not the receiving water has the ability to handle increased flows and pollutant loads.

In heavily developed areas, urbanization results in widespread alteration or destruction of much of the natural drainage system. Many of wetlands in these areas are drained or filled, while smaller streams can be heavily modified. These alterations to the natural drainage system decrease the system's ability to remove pollutants, function as habitat, and handle large flows. The cumulative impacts of these widespread effects can potentially affect larger downstream components of the watershed.

B.1.3.2 High Volumes/Velocities

A typical storm may generate a large number of storm water discharges within a watershed. The cumulative volume of these discharges may be high relative to the typical volume of flow of receiving waters. These high volume discharges may dramatically increase flow velocities in streams and drainage channels. High volume storm water discharges and resultant rapid stream velocities cause the combined effect of increasing:

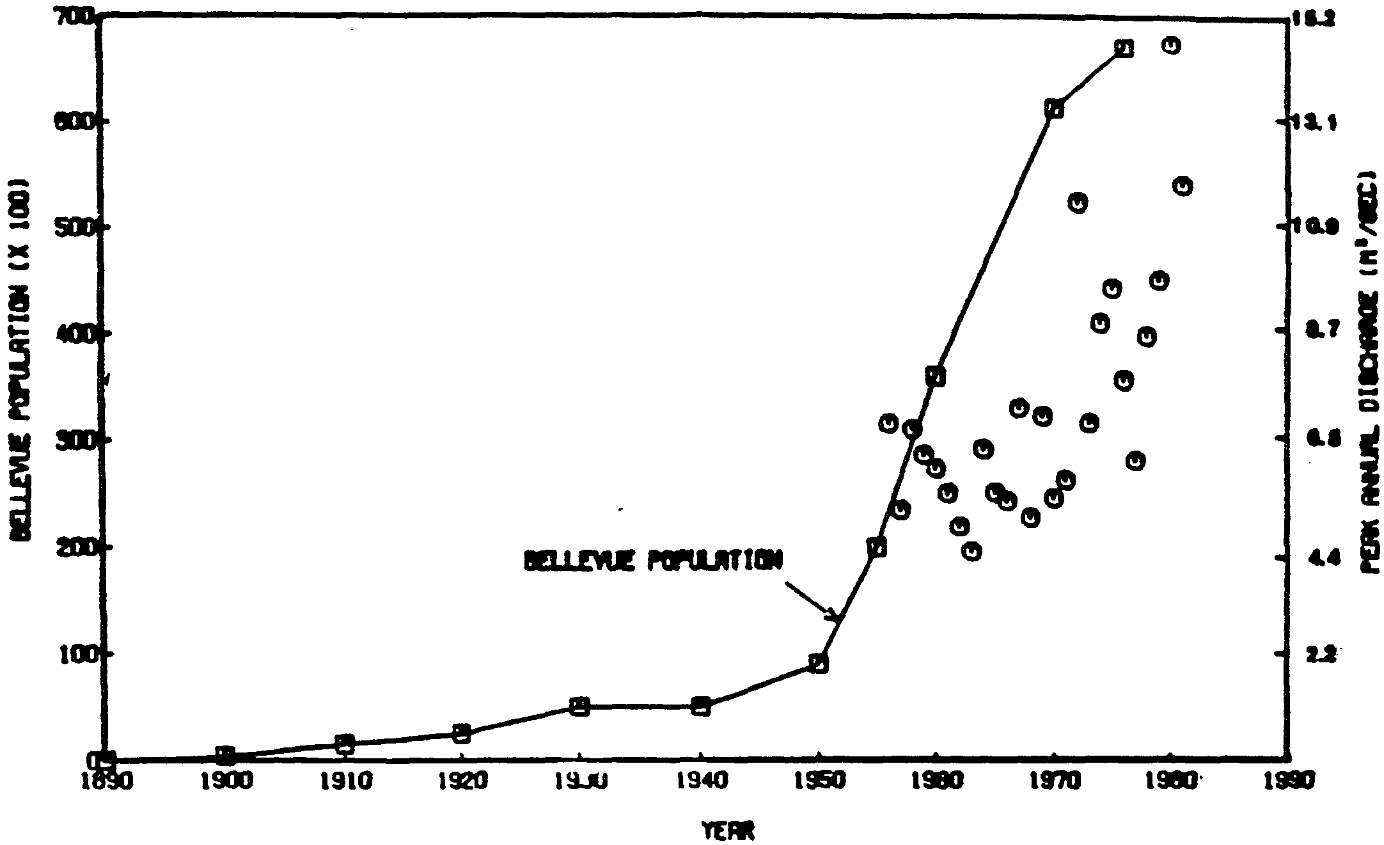
[1] As discussed in more detail in Chapter 3, the 366 urbanized areas designated by the Bureau of Census range in area from 17 square miles (Grand Forks, ND-MN) to more that 2,800 square miles (New York, NY-NJ).

- Pollutant loads
- The ability of discharges to erode the land and carry pollutants off the land
- The ability of streams to resuspend pollutants in bottom sediments and erode stream beds and stream banks
- The ability of streams to carry pollutants to slower flowing water bodies where pollutants may accumulate
- The need for stream channelization, installation of concrete walls, riprap, or other modification projects.

Figure B-1 shows the relationship between population and the volume of the peak annual flow in the Bellevue, Washington, watershed. The volume of the peak annual flow in the watershed almost doubled as the population in the city increased from 10,000 to 67,000. Peak flows that used to return every 10 years can now be expected to return at least every other year. Although the monthly average total volume of flows in the watershed increased only slightly over pre-urbanization years, the volume of flows during peak events increased two to three times as a result of urbanization. This increase in the volume of the peak annual watershed flow volumes increased stream bank erosion and stream bed scour, as well as the frequency of flooding. The increase in intensity of runoff has created unstable stream banks, which have eroded at a rapid rate. The stream channel is narrower and deeper than those of typical undisturbed streams serving similar watersheds. Pools and other sites along the stream bed that had slowed flows in the past have been removed by the higher flows.

B.1.3.3 Limited Duration

Although storm events and the resulting storm water discharges are of limited duration, pollutants in these discharges can cause both short- and long-term impacts on receiving waters. Short-term impacts generally occur during or shortly after a storm event. These impacts are usually caused by high levels of pollutants associated with the storm water discharges. Materials other than storm water, such as spills or dumped material, that discharge from a separate storm sewer may also cause short-term water quality impacts.



Source: Scott, Steward, and Stober

Figure B-1. Population of Bellevue and Peak Annual Discharge in Kelsey Creek (O). Data From U.S.G.S. and Bellevue Planning Dept. 1977

Long-term water quality impacts associated with storm water may be caused by pollutants accumulating in a watershed or by repeated exposures to pollutants from a large number of events. In addition, habitat destruction and other physical impacts, such as stream bed scour, can occur over a long period of time.

Although individual storm events are of relatively short duration, receiving waters may be affected by storm water discharges for time periods that are significantly longer than the storm event. The length of time that pollutants from storm water discharges remain in a receiving water will depend on four factors: 1) the duration of the storm event, 2) the size of the watershed, 3) flow rates in the receiving water, and 4) the tendency for pollutants to accumulate in bottom sediments.

Small streams with small drainage basins respond immediately to the pollutants in storm water discharges, with pollutants passing through at relatively high velocities as a discrete pulse. High pollutant levels in large flowing rivers may occur at downstream locations for an extended period of time. Pollutant concentrations in large rivers initially rise with the onset of a storm event. After a storm is over, pollutants from storm water discharges to feeder streams draining upstream portions of a watershed can keep pollutant levels elevated at downstream locations of the river for an extended period of time. Pollutants in storm water discharges from upstream land uses may continue to impact a location for several days after the event.

Receiving waters with slower flows and longer resident times, such as impoundments, lakes, reservoirs and estuaries, may be affected for long time periods by pollutants from short-duration storms. Hence, the limited duration of individual storm water discharge events is of less importance when considering potential impacts on these receiving waters. In these receiving waters, slower velocities will result in many types of pollutants accumulating in bottom sediments where they may cause long-term impacts.

B.2 TYPES OF ADVERSE IMPACTS ASSOCIATED WITH STORM WATER DISCHARGES

Table B-1 summarizes the pollutant classes and pollutant sources identified in the 1992 National Water Quality Inventory as major causes of water quality impairment. The National Water Quality Inventory summarizes information regarding water quality impacts that is submitted by States in Section 305(b) reports. The summary generally identifies conventional pollutants, such as nutrients, sediment (siltation), oxygen demand, and pathogens, as the leading causes of surface water impairment reported by the States. Toxicity, caused by metals, priority organics, pesticides, oil and grease, and inorganic pollutants, is also identified as a major cause of impairment.

Table B-1. Top Five Pollution Sources and Contaminants

Five Leading Sources of Water Quality Impairment			
Rank	**Rivers**	**Lakes**	**Estuaries**
1	Agriculture	Agriculture	Municipal Point Sources
2	Municipal Point Sources	Urban Runoff/Storm Sewers	Urban Runoff/Storm Sewers
3	Urban Runoff/Storm Sewers	Hydrologic/Habitat Modification	Agriculture
4	Resource Extraction	Municipal Point Sources	Industrial Point Sources
5	Industrial Point Sources	Onsite Wastewater Disposal	Resource Extraction
Five Leading Causes of Water Quality Impairment			
Rank	**Rivers**	**Lakes**	**Estuaries**
1	Siltation	Metals	Nutrients
2	Nutrients	Nutrients	Pathogens
3	Pathogens	Organic Enrichment/Low DO	Organic Enrichment/Low DO
4	Pesticides	Siltation	Siltation
5	Organic Enrichment/Low DO	Priority Organic Chemicals	Suspended Solids

Source: National Water Quality Inventory, 1992 Report to Congress, EPA, 1994.

The National Water Quality Inventory primarily addresses larger receiving water bodies and does not address major portions of the natural drainage system of most watersheds, such as smaller feeder streams and wetlands.

This section briefly describes the major classes of pollutants associated with water quality impacts. For each class, special considerations regarding storm water discharges are discussed. Three additional pollutant classes, acidity, temperature, and floatables, that are of special concern when addressing storm water discharges are also discussed.

B.2.1 Siltation/Sedimentation

Siltation from sediment pollutant loads can cause a broad range of interrelated impacts in receiving waters, including the following:

- **Loss of Benthic Habitat**—Increased stream flows and velocities produced by high volume storm water discharges may cause channel scour and bank erosion that result in habitat destruction. Suspended solids are deposited as sediment bars or sediment blankets in pools and other areas of reduced stream energy. These blankets can smother benthic organisms, including the eggs and immature forms of free-swimming organisms (Gupta, 1981; Novotny and Chesters, 1981).

- **Reduced Water Storage Capacity**—Increased sediment loads reduce water storage capacity in reservoirs (Novotny and Chesters, 1981). Nationwide, the average annual depletion rate of reservoir storage capacity caused by sedimentation is estimated at 0.2 percent (Tourbier, 1981). Sediment loads also decrease the depths of streams, which decreases the retention and conveyance capacity of streams and may result in increased flooding.

- **Impaired Oxygen Exchange**—Increased turbidity levels impair the ability of aquatic organisms to obtain dissolved oxygen from the water by interfering with the gill movements and associated water circulation (Novotny and Chesters, 1981).

- **Decreased Light Penetration**—The depth of light penetration into surface waters is sharply diminished by turbidity. As a result, photosynthetic activity and food sources are reduced. Loss of submerged aquatic vegetation may also remove habitat for juvenile fish and shellfish.

- **Impaired Navigation**—Accumulated sediments in river channels limit the passage of deeper draft boats, preventing navigational access or increasing the frequency of required channel maintenance dredging (Gupta et al., 1981; Novotny and Chesters, 1981). In some locations, sediments are so contaminated with pollutants that they should be handled as hazardous wastes, which dramatically increases disposal costs. Dredging activities result in re-suspension of pollutants in the sediment, causing additional water quality and aquatic habitat impacts (Novotny and Chesters, 1981).

- **Increased Water Treatment Costs**—Sediments can increase the costs of treating potable water supplies. Inadequate sediment removal may limit the germ-killing effects of chlorination.

- **Accumulation of Pollutants**—Many of the pollutants associated with many types of storm water discharges become chemically or physically bound with sediment particles. As these particles settle, the attached pollutants also sink (Brown et al., 1985; Novotny and Chesters, 1981). Sediments with attached pollutants can act as a source of contamination to the overlying water, to the benthic biota, and to the food chain. Over long periods of time, sediments may accumulate such high levels of toxics and other pollutants that exceedances of ambient water quality standards may occur in the water columns, increasing exposure of organisms to toxic chemicals (Harrington, 1986). Oxygen demanding pollutants in sediment deposits may also create oxygen deficits during and after storm water discharge events (Heaney and Huber, 1984; Mancini and Plummer, 1986; Novotny and Chesters, 1981).

- **Resuspension of Pollutants**—Highly variable flows in receiving waters can resuspend sediments, thereby increasing water column concentrations of those pollutants that had accumulated in bottom sediments. The repetitive process of deposition, re-suspension, and re-deposition of sediments may result in pollutants associated with sediments taking a long time to pass through a receiving stream (Novotny and Chesters, 1981).

B.2.2 Nutrients

Nutrients support and stimulate aquatic plant life. Natural nutrient cycles may be altered by land use activities within a watershed. Excessive nutrients overstimulate the growth of aquatic plants, which may result in low oxygen levels, accelerate eutrophication, cause unsightly conditions, interfere with navigation, interfere with treatment processes, and cause unpleasant and disagreeable tastes and odors. Eutrophic conditions are evidenced by surface algal scums, reduced water clarity, odors, and dense algal growth on shallow water substrates (Schueler, 1987). Algal blooms block light from submerged aquatic vegetation, which may remove habitat for juvenile fish and shellfish. After blooms or at the end of a growing season, the decomposition of dead vegetation may cause reduced oxygen levels. Reduced oxygen levels may, in turn, cause fish kills and mass mortality of benthic organisms.

Excessive nutrients may have more adverse effects in surface water bodies that have slow flushing rates, such as slow moving rivers, lakes, and estuaries. Nutrients delivered during storm events settle to sediments of such waters. Once in sediments, the nutrients can be solubilized or re-suspended by anaerobic conditions, currents, changes in concentration gradients, or the mixing effects of boat wakes (Field and Turkeltaub, 1981).

Aquatic vegetation requires both nitrogen and phosphorus to grow. Excess quantities of nitrogen are commonly present in fresh water, so plant growth is usually controlled by the levels of phosphorus input (Schueler, 1987). In marine waters, however, phosphorus is often in greater supply, and plant growth is controlled by nitrogen concentrations. In either case, when the controlling nutrient is added, greater plant growth is expected.

Several forms of phosphorus occur in the aquatic environment. Major forms of phosphorus include orthophosphorus (OP), dissolved or soluble phosphorus (DP), particulate phosphorus (PP), and total phosphorus. Orthophosphorus is the form immediately available for algal growth. Particulate phosphorus is considered to be potentially available after conversion to OP. During stream transport, OP is likely to become incorporated into the particulate fraction. A portion of the phosphorus bound to sediment particles can also be released as OP. Exchange between available and potentially available forms continues though processes of sediment and algal uptake and release. Transport distance from phosphorus sources to impacted receiving waters is recognized as a major factor in determining the availability and timing of load delivery. Strict control of phosphorus levels from direct and proximal discharges to affected receiving waters is recommended because of the high level of OP delivered from these discharges.[2]

Nutrient loading is directly related to the frequency of runoff events in developed watersheds and can vary by a factor of 3.5 between wet and dry years at the same location (Lung, 1986). High quantities of nitrogen and phosphorus may be transported in surface runoff in the dissolved form or attached to sediments; the relative significance of these two forms may vary seasonally, reflecting differing winter and summer runoff conditions (Jones, 1986; Urbonas and Roesner, 1986). Nitrogen and phosphorus concentrations in storm water from residential and commercial areas may occur at levels sufficient to stimulate excess growth of algae and aquatic macrophytes (i.e., eutrophication), partly because most of these nutrients occur in soluble forms that are readily assimilated by plants (Schueler, 1987).

Nitrate (generally the most stable form of nitrogen) at levels above the drinking water standard of 10 milligrams per liter can cause methemoglobinemia in infants under six months. This rare, but potentially fatal disease limits the oxygen carrying ability of the blood.

B.2.3 Organic Enrichment/Oxygen Demand

Aquatic organisms, such as fish and water-dwelling insects, require minimum levels of dissolved oxygen (DO). Excessive oxygen demanding pollutants can lead to periods of oxygen sag, which may cause fish kills and create anoxic conditions accompanied by foul-smelling odors. Oxygen levels in receiving waters can be lowered by the decomposition of organic matter by microorganisms, by the chemical oxidation of material, or by aquatic vegetation, which uses more oxygen at night than it produces.

Oxygen demand is the term applied to pollutant loads that result in reduced dissolved oxygen levels. The two parameters most commonly used to describe the oxygen demand of

[2] *Phosphorus: A Summary of Information Regarding Lake Water Quality*, IL EPA, August 1986.

pollutants are the 5-day biochemical oxygen demand (BOD5) and chemical oxygen demand (COD). BOD measures oxygen demanding substances that can be metabolized by bacteria and is an indicator of biodegradable organic matter. COD measures oxygen demanding substances that react with an oxidizing chemical in a heated acid bath. COD is an indicator of both organic matter and reduced inorganic chemicals. Of the two, COD is more accurate for the purpose of comparing the oxygen demand of storm water discharges to the oxygen demand of other types of discharges. The BOD5 test underestimates the true oxygen demand of storm water because the heavy metals in the storm water slow the bacterial action used in the test.

Storm water runoff may contain both organic and inorganic pollutants that consume oxygen in receiving waters. Storm water discharges generally occur on overcast days when the amount of sunlight available to oxygen producing plants in water is limited. Lower oxygen production rates increase the adverse impacts of oxygen demanding pollutant loads. Much of the oxygen demanding pollutant load of many types of storm water discharges is associated with suspended solids, which may form deposits in receiving waters. These deposits may result in long periods of low dissolved oxygen through gradual decomposition or may re-suspend during later runoff events. The impacts of oxygen demanding pollutants may be more dramatic in shallow, slow-moving waters due to limited aeration and the tendency of these pollutants to accumulate in bottom sediments of slow-moving waters.

Dissolved oxygen depletions may occur at times substantially different from the actual storm event, which originally discharged the oxygen demanding pollutants. Re-suspension of sediments with attached oxygen demanding pollutants during high flows worsen and delay the dissolved oxygen depletions.

B.2.4 Pathogens

Pathogens are disease-causing organisms, including viruses and some bacteria. Waterborne pathogens may be transmitted to humans or animals through direct recreational contact, drinking water supplies, or through eating contaminated shellfish. Major pathogen sources include human and animal wastes.

Separate storm sewers, unlike combined storm sewers, are not designed to carry sanitary sewage. However, pathogens may enter separate storm sewers from leaking sanitary sewers, illegal cross connections with sanitary sewers, and malfunctioning septic tanks. In addition, runoff can pick up pathogens from animal wastes on the land. Conditions inside a storm sewer system are often conducive to pathogen reproduction.

Due to difficulties and expenses associated with measuring pathogens directly, bacteria, including total coliform, fecal coliform, and fecal streptococci, are used as indicators of pathogens even though many of these bacteria are harmless. EPA studies indicate that although fecal coliforms are a good indicator of human pathogens for POTW discharges, they are inadequate indicators of human pathogens for many types of storm water discharges (51 *FR* 8012, March 7, 1986). However, most State and local health criteria for recreational contact and shellfish are based on fecal coliform levels, partially due to the low cost of testing procedures. As a result, storm water discharges are responsible for a significant number of restrictions placed on recreational uses and shellfishing.

B.2.5 Toxicity (metals, toxic organics, pesticides, inorganics, and oil and grease)

A wide range of chemicals may exhibit toxicity. Five major classes of chemicals that have toxic impacts recognized in the National Water Quality Inventory are metals, toxic organics, pesticides, inorganic pollutants, and oil and grease.

Toxic impacts may be classified in terms of acute and chronic effects. Acute toxicity refers to lethal concentrations or doses of toxic materials, which result in death of aquatic organisms in a relatively short time. Chronic toxicity refers to impacts, such as the formation of tumors, lowered reproductive, growth, or survival rates, that occur after a longer exposure to toxic substances. Bioaccumulation, or the accumulation of toxic chemicals in tissues of organisms, is another long-term effect of toxic substances that may affect the organism directly exposed to the chemical, or other animals, including humans, that consume contaminated organisms. For a given chemical constituent (or a mix of constituents) chronic toxicity occurs at lower concentrations than the concentrations that may cause acute effects. However, the exposure time necessary to trigger chronic effects is longer than the exposure times that cause acute effects.

Pollutants that are highly resistant to natural degradation processes are referred to as conservative pollutants. Conservative pollutants have a greater opportunity to cause chronic toxic effects or to bioaccumulate in organisms. Conservative pollutants also have the potential for wider dispersal in the environment through bioaccumulation and subsequent transfer in living organisms, such as fish, plankton, and fish eating birds and mammals. Toxic conservative pollutants include trace metals and some organic compounds, such as chlordane, polychlorinated biphenyls, and other halogenated hydrocarbons. Metals do not degrade, and some organic compounds degrade so slowly that they may remain in sediments for decades.

Many of the toxic metals and other toxic constituents in storm water discharges are attached to suspended solids in the discharge and settle out and accumulate in the bottom sediments of receiving waters where they may persist for long periods of time. Toxics concentrated in bottom sediments may cause adverse impacts on benthic organisms, may become resuspended during high flows resulting from other large storm events, or may dissolve into the water as parameters such as pH and dissolved oxygen change. Accumulated pollutants in bottom sediments may also adversely affect fish during periods of continuous low flow.

B.2.6 Flow Alterations

Activities on the land may cause dramatic changes to the natural hydrologic cycle. Changes in peak flow rates of receiving streams and associated increases in flow velocities cause changes in the stream shape and structure. Increased flow velocities have a greater ability to erode stream beds or stream banks. Stream channels may either be widened or made deeper, with large amounts of soils being swept downstream, forming shifting sandbars or other sediment deposits. Streams may widen to two to four times their pre-development width if storm water is uncontrolled from developed areas. High erosion rates adversely affect habitat by destroying benthic structures and habitat. High creek flows may also sweep poor swimming fish from the creeks and transport leaf material at higher rates, limiting the availability of food for macroinvertebrate organisms. Channelization projects that drain natural wetlands for development may dramatically alter natural flow patterns. These projects will greatly diminish or destroy the pollutant removal and flow attenuation abilities of the wetlands.

Increased flows associated with urbanization are often accompanied by the installation of extensive channelization projects to increase the flow capacity of the water course and limit erosion damage during storm conditions. Typical channelization projects include riprap, concrete retention walls or lining along stream banks, channel realignment, and diversion of streams through culverts.

After the initial construction of a channelization project is completed, both direct and indirect sources of pollution occur. Channelization projects reduce channel roughness to further increase flow velocities. Increased flow velocities that exceed the stability velocities of the bottom or bank materials cause erosion or scour. Such activity degrades the channel and furnishes sediment for stream transport, destroys natural habitats, and detracts from the aesthetics of the stream. In general, the more extensive the modification, the more damage caused to habitat areas. For example, concrete lining of channels eliminates habitat areas and aesthetic values for practical purposes. Increased channel dimensions may deprive the stream flow of shade from trees along streams banks, resulting in increased water temperatures. These types of projects may worsen downstream flood problems where storm flows are unable to spread out onto a flood plain and increased velocities increase erosion along unprotected banks downstream.

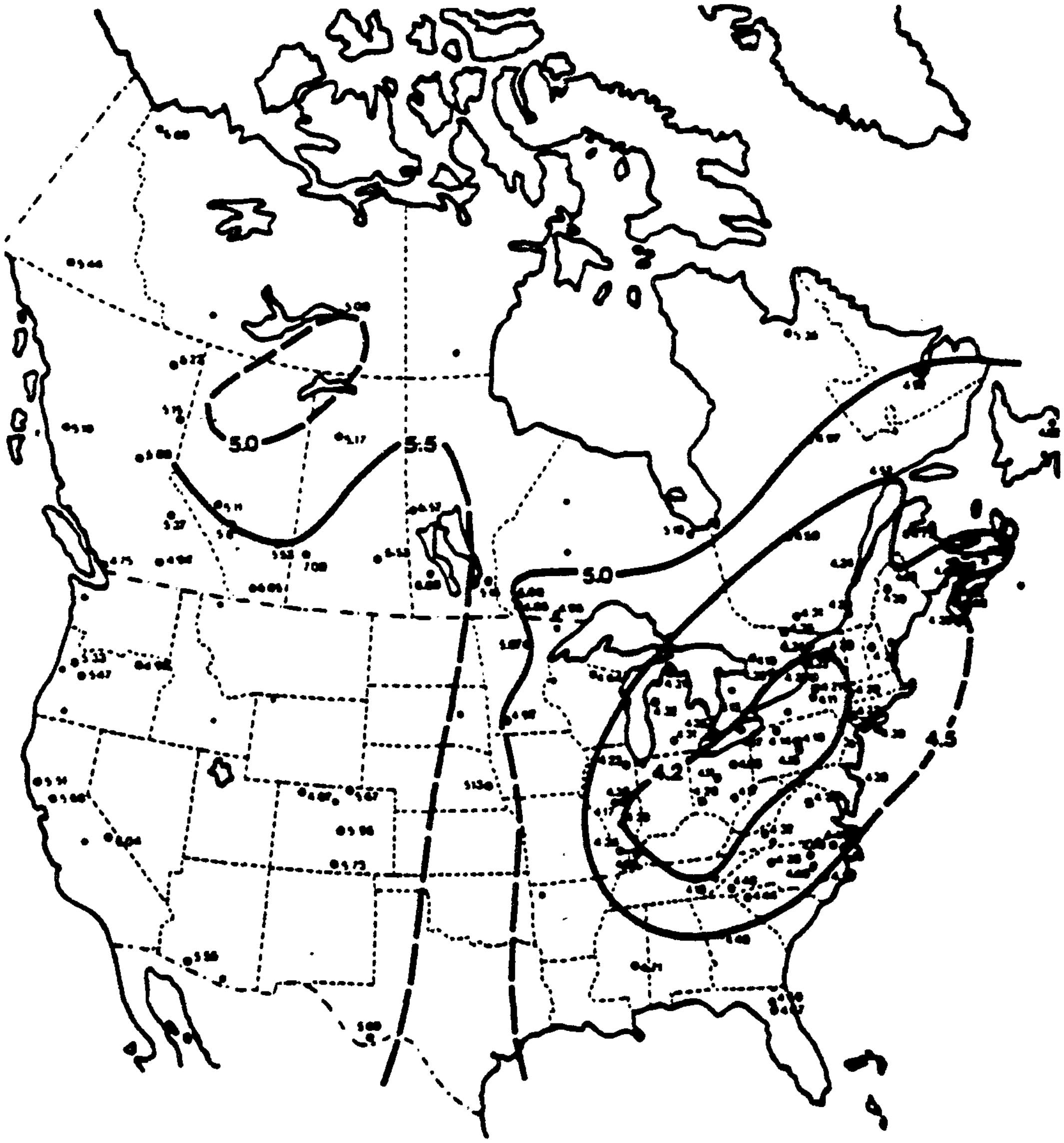
B.2.7 Acidity

Aquatic life may only be supported in a limited range of pHs. Receiving waters that are highly acidic (have a low pH) may be totally devoid of life. In other receiving waters, fish kills may be caused by periodic highly acidic conditions. Periodic episodes of acidity may be particularly harmful to juvenile fish, which tend to be more sensitive and reside in the smaller streams of a watershed, which are more likely to experience wider pH swings. In addition, acidic rain generally will have higher concentrations of heavy metals and other pollutants, which leach under acidic conditions.

Acidity in storm water may be caused by two sources—air pollutants and certain land use activities. Mining is the land use with the most well known acidic storm water discharges. Coal mining in the eastern United States generally involves coal that is high in sulfur and is historically associated with some of the most dramatic water quality impacts caused by acidity.

Nitrogen oxides (NO_x) and sulfur dioxide (SO_2) are the primary air pollutants that result in acid rain and, hence, highly acidic storm water. Acid rain occurs when SO_2, emitted primarily by electric utilities fired by eastern coal, and nitrogen oxides (NO_x), emitted primarily by transportation sources and utilities, are deposited in the form of wet or dry deposition. Rain in the western United States typically has a regional pH of 5.5 or above. Rain in the eastern United States is more acidic, with regional pH values below 4.2 in some regions. More than 80 percent of the SO_2 emissions in the United States originates in the 31 States bordering or east of the Mississippi River, with a heavy concentration from States in or adjacent to the Ohio River Valley. These airborne emissions are transported by prevailing winds to the east. Figure B-2 indicates regional acid rain patterns.

Several aspects of urbanization tend to create local conditions that may make receiving waters susceptible to impacts from acidity. High levels of airborne SO_2 and NO_x in large urbanized areas increases the acidity of the rainfall in the urbanized area to levels above those typically found for the region. Runoff from paved surfaces and other impervious surfaces



Data from four networks are plotted: Canada, CANSAP (circles) and AAPN (squares); United States, NADP (circles) and MAP3S (squares).

Source: Barrie and Hales, 1984.

Figure B-2. Spatial Distribution of the Precipitation-Amount-Weighted Annual Mean Hydrogen-Ion Concentration (expressed as pH) in North America in 1980

may have little or no opportunity to contact soils that may buffer the acidity of the rainfall. In urbanized areas with acidic rain, higher runoff volumes and rates associated with the urban development can increase the acidity of receiving streams rapidly and to high peak acidity levels. This results from more acid being deposited to receiving streams in a shorter amount of time.

B.2.8 Temperature

Increased temperature may have detrimental effects on fish and other aquatic life during various stages of their life cycle. Water holds less oxygen as it gets warmer, which may affect habitat and make the water more susceptible to oxygen demanding pollutants. Sustained water temperatures in excess of 70°F are considered stressful or lethal to many cold water fish species and stream insects. The availability of food, attendant life cycle chemistry, and water quality changes are all affected by water temperature.

During warm weather, the temperature of storm water discharges is generally higher than receiving water temperatures. High volumes of runoff from hot paved surfaces and rooftops may cause a rapid increase in surface water temperatures. Discharges from storm water management devices, which retain collected runoff in unshaded ponds for extended time periods, may also increase stream temperatures.

B.2.9 Floatables, Including Plastics

A large percentage of the litter and plastics that is found on land, if not removed, will eventually be flushed, swept, or blown down a storm sewer. Plastics, metals, and many other types of floatables degrade at extremely slow rates, increasing the time that they remain in receiving waters.

Litter and other floatables degrade aesthetic values, which play a role in the recreational uses of receiving waters, property values of nearby lands, and other broad community-level values. Economic losses caused by the aesthetic degradation of recreational areas, such as beaches, are significant. Plastic debris presents hazards to wildlife. Ingestion of plastic material by turtles and seabirds appears to present the biggest threat to wildlife. Floatables and plastics may also clog outlet structures of various types of storm water management devices, resulting in flooding or other system malfunctions.

B.3 ADVERSE IMPACTS BY TYPE OF RECEIVING WATER

Impacts on receiving waters associated with storm water discharges may be discussed in terms of three general classes: 1) short-term changes in water quality, 2) long-term water quality impacts, and 3) physical impacts.

Use impairment of receiving streams often is caused by a combination of all three types of impacts. Physical impacts and short-term water quality changes are generally more critical than long-term water quality impacts for receiving waters with relatively short residence times (such as smaller streams and rivers). Receiving waters with long residence times (lakes, estuaries) are generally more sensitive to long-term water quality changes, although certain physical changes, such as loss of reservoir capacity due to siltation, can be important.

Short-term changes in water quality occur during and shortly after storm events. Examples include periodic dissolved oxygen depressions due to oxidation of pollutants, short-term increases in the receiving water concentrations of one or more toxic pollutants, high bacteria levels, and high acidity. These conditions can result in fish kills, loss of submerged macrophytes, and other temporary use impairments.

Long-term water quality impacts are caused by the cumulative effects associated with repeated storm water discharges. These impacts often result from the cumulative effects of pollutants from a number of different types of sources. When evaluating long-term impacts, the cumulative and relative effects of seasonal and long-term pollutant loadings from all relevant sources (e.g., storm water, publicly owned treatment works, industrial discharges, nonpoint sources, atmospheric deposition, in-place pollutants) should be considered.

Examples of the long-term water quality impacts that storm water discharges may cause or contribute to include depressed dissolved oxygen caused by the oxygen demanding pollutants in bottom sediments, biological accumulation of toxics as a result of uptake by organisms in the food chain, chronic toxicity to organisms subject to repeated exposures of toxic pollutants, destruction of benthic habitat, loss of storage capacity in receiving waters, and increased lake eutrophication. Long-term water quality impacts are also caused by pollutants attached to suspended solids that settle in receiving waters and by nutrients that enter receiving water systems with long retention times. In both cases, long-term water quality impacts are caused by increased residence times of pollutants in receiving waters. Long-term water quality impacts of pollutants from storm water discharges may be manifested during critical periods other than during storm events (e.g., during low stream flow conditions and/or during sensitive life cycle stages of organisms).

Physical impacts may occur due to the erosional effects of high-volume flows and high-stream velocities that occur after the natural hydrologic cycle is altered. These changes are often accompanied by the installation of engineered structures, such as concrete walls or underground culverts, which may further degrade the habitat and aesthetic values of the receiving water. In addition, if ground water recharge is limited by the placement of impervious structures on the land, dry weather base flows may be lowered to the detriment of the receiving water.

B.3.1 Rivers and Streams

The *National Water Quality Inventory - 1992 Report to Congress* (EPA, 1992) indicates that the States identified the most extensive causes of impairment in the Nation's rivers as siltation (affecting 45 percent of impaired river miles), nutrients (affecting 37 percent), pathogen indicators (affecting 27 percent), pesticides (affecting 26 percent) organic enrichment/low dissolved oxygen (affecting 24 percent), and metals (affecting 19 percent). Discharges from storm sewers are identified as affecting 11 percent of the impaired river miles. The assessments focused primarily on larger streams and rivers and did not address many of the heavily degraded small streams found in urban areas and elsewhere.

The effect of human activities on the natural hydrologic system may be most evident on smaller streams. Development of a site may dramatically increase the volume and the maximum discharge rate of storm water discharges. Where a sufficient number of sites within the drainage basins of smaller rivers and streams occurs, the stream may experience increases in the magnitude and frequency of flooding, as well as extremely high-stream velocities associated with storm events.

Such changes in the hydrology of a stream may result in accelerated stream bank or stream bed erosion. Such erosion may cause or contribute to a number of generally detrimental effects, including widening or deepening of the stream channel, elimination of pools and other structures in the stream, and shifting of gravel or sand bars. In addition, base flows may be lowered during dry weather.

Streams that have experienced increased flooding or peak velocities often undergo a high degree of additional human flow modification, including channel excavation, lining, realignment, or diversion through underground culverts, which may have, for all practicable purposes, destroyed both fish and wildlife habitat and natural aesthetics. In many cases, highly modified streams are considered to be part of the storm sewer system.

Pollutant concentrations in smaller streams and rivers may experience relatively short-duration increases due to storm water discharges. However, in smaller streams, the concentration of pollutants may be almost as high as the concentrations found in discharges where dry weather base flows are significantly lower than wet weather flows and provide only limited dilution.

Larger rivers often respond slower to storm events than do smaller streams. After a storm event hits a large drainage basin, a given segment of the river may experience degraded water quality for several days because a single location on the river is sequentially affected by pollutants from different upstream sources caused by the same storm. For example, a segment may be influenced by urban runoff, only to then be influenced by agricultural runoff generated upstream of the storm water source, followed by silvicultural runoff from the river's headwaters.

In many streams, flow velocities slow substantially with increases in stream width or decreases in stream gradient. At these points, sedimentation of fine particles and associated pollutants result. The settled sediments can act as a reservoir for pollutants affecting the water column and the food chain long after the rain has ceased. In addition, disturbance of the deposited sediments by scouring from storm water discharges or combined sewer outfalls, navigation, construction, or dredging may re-introduce the sediments and their pollutants to the water column. The result can be a recurrence of adverse impacts originally associated with the storm water discharge.

The degree of impact on the river or stream depends on a number of factors, including the frequency and duration of the storm water discharges, the quality and quantity of storm water discharges, the occurrence of other wet weather discharges (combined sewer overflow discharges), and the quantity and quality of the base flow (dry weather flow) of the stream. Because larger rivers receive pollutants from a wide variety of sources in urbanized areas, the quality of the base flow may be marginal or poor, thereby increasing the sensitivity of the receiving stream to storm water discharges. In streams with very low base flows, on the other hand, the storm water discharge may be the major determinant of the water quality of the stream.

B.3.2 Lakes and Reservoirs

The most extensive causes of use impairment in lakes are metals (affecting 47 percent of impaired acres), nutrients (affecting 40 percent), organic enrichment/low dissolved oxygen (affecting 34 percent), siltation (affecting 42 percent of impaired acres), and priority organic chemicals (affecting 20 percent). The States reported that 63 percent of lake acres assessed were not fully supporting designated beneficial uses. In addition, the States reported that discharges from separate storm sewers affect 24 percent of the impaired acres of lakes excluding the Great Lakes. Onsite wastewater disposal impaired 16 percent of the impaired acres. For the Great Lakes, discharges from storm sewers were identified as affecting 11 percent of the impaired shore miles, and land disposal 31 percent of impaired shore miles.

Compared with rivers and streams, lakes and reservoirs have long residence times. The time scale of water quality impacts and recovery may be on the order of years, decades, or even centuries (Manning et al., 1977). The impacts that occur are more likely to be the result of seasonal or annual loadings of pollutants rather than loadings from individual events. Lakes and reservoirs, with longer residence times and slower flow rates, tend to become sinks for many pollutants that attach to the sediments typically carried by storm water. Longer residence time, coupled with poorer aeration, also increases the impacts of nutrients and other oxygen demanding pollutants. The peak concentrations of pollutants in storm water discharges are less important in determining the severity of adverse impacts than the total loading of pollutants delivered to the lake because of the larger capacitance of the system.

In lakes and reservoirs that are deep enough to become thermally stratified, the impacts of introduced pollutants vary seasonally. Pollutants that settled to the bottom attached to solids may become re-introduced into the water column during the strong currents and mixing that can accompany storms, particularly in autumn. This effect has been illustrated dramatically in the Great Lakes (Rosa, 1985; Eadie et al., 1984; Charlton and Lean, 1987).

B.3.3 Estuaries and Coastal Waters

The States reported that the most extensive causes of use impairment in estuaries are nutrients (affecting 55 percent of impaired square miles), pathogen indicators (affecting 42 percent) and organic enrichment/low dissolved oxygen (affecting 34 percent). Discharges from separate storm sewers affected 43 percent of the impaired estuarine area. The States reported that storm sewers affected 59 percent of ocean shore miles and land disposal affected 42 percent of ocean shore miles.

The pattern of water flow in a given estuary results from the effects of tides and density differences between surface and deeper waters. In most estuaries, fresh waters have an outward, seaward current. Pollutants are initially carried by the fresh water currents. As pollutants attach to sediment and as the flow rates in the estuary slow due to larger flow basins, the pollutants and sediment sink and their outward flow is reversed when they enter heavier, saltier bottom waters that have a net flow landward. As a result, many pollutants remain trapped in estuaries and never reach open waters. Once these sediments have been deposited, they exert long-term effects on water quality through toxicity, bioaccumulation, or nutrient release.

Much of the nutrient load that is present in surface waters can be incorporated into algae, which then settle. As the algae settle, nutrients are released back into the deeper, inflowing waters. As the inflowing waters mix with outflowing surface waters, the nutrients are once again incorporated into algae. This vertical cycling of nutrients in estuaries, referred to as the nutrient trap, allows the slow accumulation of nutrients in the water column. Contributions of nutrients from storm water discharges increase the rate of this nutrient accumulation, worsening the problems of estuarine eutrophication, which is increasingly one of the major focuses of many of the National Estuary Program projects.

B.3.4 Wetlands

Wetlands are generally located adjacent to the other kinds of surface waters. Wetlands buffer the ultimate receiving water by slowing and storing high, wet weather flows and by removing pollutants. In addition, the intensive levels of biological activity in wetlands play an important role in the ecology of the receiving water.

Wetlands are often dredged or filled when development occurs near surface water or near the floodplain. The destruction of wetlands without appropriate storm water management destroys the capability of wetlands to hold runoff and remove pollutants before discharging to other surface waters. This, in turn, results in higher runoff volumes, which discharge to receiving waters at a faster rate.

Wetlands that are used to receive storm water discharges from upland development may also experience impacts. In some cases, the large flow volumes, flow velocities, and pollutant loads delivered by storm water discharges can alter or destroy stable wetland ecosystems. Storm water discharges with high sediment levels from sources such as uncontrolled construction site runoff may fill or alter flow patterns in wetlands over a long time period. Persistent toxics may also accumulate in sediments, vegetation, and the food chain.

If the adverse physical impacts of the storm water discharges can be minimized, the organically rich, shallow, biologically productive wetlands may act as a buffer or treatment for nutrients in storm water, thereby mitigating the impacts of storm water discharges on the receiving waters.

B.3.5 Ground Water

Due to hydrological connections between surface water and ground water, storm water management may affect ground water in two major ways. First, human activities on the land may have dramatic impacts on the hydrologic cycle, increasing the amount of surface runoff and decreasing the amount of infiltration that recharges ground water supplies. Decreasing ground water recharge can lower the water table, which results in lower dry weather base flows in surface waters and may make the operation of wells more costly. Second, pollutants in precipitation and runoff that infiltrates into an aquifer may not be removed by the soil and may enter an aquifer. This may be a particular concern where storm water management techniques used to control flooding and to improve surface water quality infiltrate surface runoff generated by development to an aquifer.

The types of pollutants in the infiltrated precipitation and the subsurface geology determine the beneficial value of infiltrated precipitation for recharging an aquifer or the potential for polluting ground water. Pollutants that are highly soluble in water (e.g., chlorides, nitrates) pass through the overlying soils into the ground water without attenuation. For example, chlorides from highway runoff containing road salt are shown to have adverse impacts on ground water, as well as surface waters. Other chemical parameters that are less soluble in water tend to adsorb to the soils before reaching ground water supplies.

The potential for ground water contamination strongly depends on the types of land use activities occurring on the surface. Two NURP projects (Long Island, New York, and Fresno, California) addressed sole-source aquifers recharged by runoff from residential and commercial areas for more than two decades. These studies concluded that no change in the use of these practices was warranted. Both studies found that soil processes at the sites were efficient in retaining the pollutants in the runoff close to the land surface, and pollutant breakthrough of the upper soil had not occurred. The EPA report *Class V Injection Wells: Current Inventory; Effects on Ground Water; and Technical Recommendations* (1987), rated the ground water contamination potential of storm water and industrial drainage wells as moderate.

B.4 REGIONAL AND SEASONAL DIFFERENCES

Precipitation patterns vary dramatically in different parts of the United States. A number of parameters are important in characterizing these regional differences, including the duration, intensity, frequency, and annual number of storm events of a given region. Variations in the precipitation patterns of a given region also occur seasonally. These variations affect the volume of storm water discharges produced, can result in seasonal impacts, and may affect management practices. In addition, snow removal and management activities have a special impact on the quality of discharges.

Among the more dominant regional characteristics are the dry summers on the west coast, the abrupt changes in the desert States of the southwest, the peaks occurring in spring and winter in the central gulf and Ohio Valley States, the uniformity of monthly totals throughout the year in the New England States, and snowfall and melt runoff occurring in the northern States.

Seasonal differences may change the nature of storm water discharges and the characteristics of receiving waters. Many smaller rivers in areas with extended dry seasons do not flow all year. The dry seasons in areas like the west coast result in higher than normal pollutant loads associated with the first several storms of the wet season. These discharges may occur when rivers and receiving waters are at low flow levels. Areas with higher intensity storms are prone to flooding and high erosion. Accumulation of pollutants in snow and snow removal activities may adversely affect the quality of snowmelt. In areas were rainfall patterns are non-uniform, soils can become saturated during wet seasons, resulting in higher storm water discharge volumes and erosion rates, as well as overloading of storm water management controls, such as retention and infiltration basins.

Figure B-3 shows 15 rainfall zones for the continental United States that EPA has defined based on annual precipitation statistics.[3] These zones are defined to provide a guide for defining regional patterns, with the geographical area assigned to a zone made as large as possible. Table B-2 summarizes annual precipitation statistics for these zones. The annual precipitation statistics shown in the table only include storm events that were greater than 0.1 inches and consider multiple storms separated by less than a 6-hour period of dry weather as one event. It should be noted that, in general, site-specific data should be used for developing designs for a specific location and that local deviations could be significant, particularly in western parts of the country where mountains, deserts, and coastal patterns result in large differences over relatively small distances.

[3] EPA, *Analysis of Storm Event Characteristics for Selected Rainfall Gages Throughout the United States*, Draft, Driscoll, E.D., et al., November 1989. These 15 rainfall zones represent a refinement of the 10 rainfall zones which appeared in a 1986 draft of the Driscoll reference and which are used in 40 CFR Part 122 Appendix E for the purposes of group applications for storm water discharges associated with industrial activity.

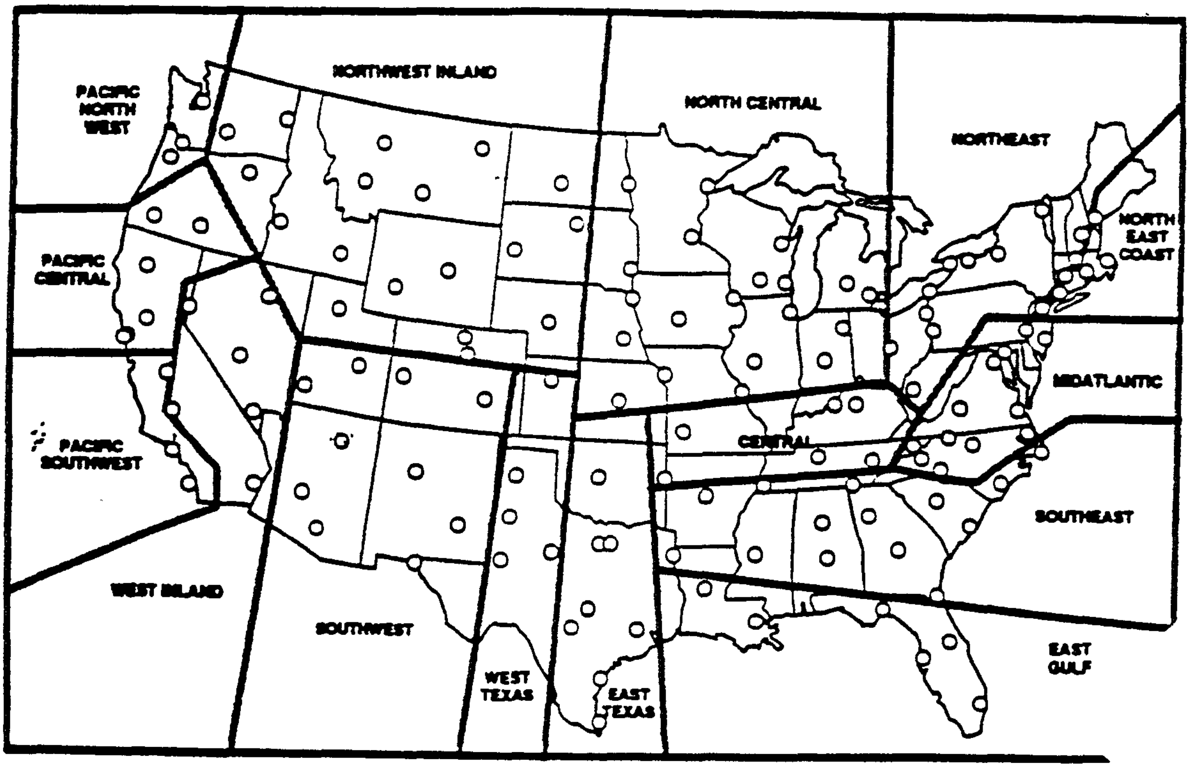


Figure B-3. Rain Zones of the United States

Table B-2. Typical Values of Annual Storm Event Statistics for Rain Zones

	Annual Statistics				Independent Storm Event Statistics							
	No. of Storms		Precipitation		Duration		Intensity		Volume		DELTA	
Rain Zone	Avg	COV	Avg (in)	COV	Avg (hrs)	COV	Avg (in/hr)	COV	Avg (in)	COV	Avg (hr)	COV
Northeast	70	0.13	34.6	0.18	11.2	0.81	0.067	1.23	0.50	0.95	126	0.94
Northeast-Coastal	63	0.12	41.4	0.21	11.7	0.77	0.071	1.05	0.66	1.03	140	0.87
Mid-Atlantic	62	0.13	39.5	0.18	10.1	0.84	0.092	1.20	0.64	1.01	143	0.97
Central	68	0.14	41.9	0.19	9.2	0.85	0.097	1.09	0.62	1.00	133	0.99
North Central	55	0.16	29.8	0.22	9.5	0.83	0.087	1.20	0.55	1.01	167	1.17
Southeast	65	0.15	49.0	0.20	8.7	0.92	0.122	1.09	0.75	1.10	136	1.03
East Gulf	68	0.17	53.7	0.23	6.4	1.05	0.178	1.03	0.80	1.19	130	1.25
East Texas	41	0.22	31.2	0.29	8.0	0.97	0.137	1.08	0.76	1.18	213	1.28
West Texas	30	0.27	17.3	0.33	7.4	0.98	0.121	1.13	0.57	1.07	302	1.53
Southwest	20	0.30	7.4	0.37	7.8	0.88	0.079	1.16	0.37	0.88	473	1.46
West Inland	14	0.38	4.9	0.43	9.4	0.75	0.055	1.06	0.36	0.87	786	1.54
Pacific South	19	0.36	10.2	0.42	11.6	0.78	0.054	0.76	0.54	0.98	476	2.09
Northwest Inland	31	0.23	11.5	0.29	10.4	0.82	0.057	1.20	0.37	0.93	304	1.43
Pacific Central	32	0.25	18.4	0.33	13.7	0.80	0.048	0.85	0.58	1.05	265	2.00
Pacific Northwest	71	0.15	35.7	0.19	15.9	0.80	0.035	0.73	0.50	1.09	123	1.50

COV = Coefficient of Variation = Standard Deviation/Mean
DELTA = Interval between storm midpoints

APPENDIX C

NON-STORM WATER DISCHARGES TO STORM WATER CONVEYANCES

APPENDIX C—NON-STORM WATER DISCHARGES TO STORM WATER CONVEYANCES

Although separate storm sewers are primarily designed to remove runoff from storm events, materials other than storm water find their way into and are ultimately discharged from separate storm sewers. Non-storm water discharges to storm sewers come from a variety of sources (EPA, 1990), including:

- Illicit connections and cross connections from industrial, commercial, and sanitary sewage sources
- Improper disposal of wastes, wastewaters, and litter
- Spills
- Leaking sanitary sewage systems
- Malfunctioning septic tanks
- Infiltration of ground water contaminated by a variety of sources, including leaking underground storage tanks.

One of the significant differences between storm water discharges and discharges from separate storm sewers affected by non-storm water is that non-storm water discharges may occur during dry weather when certain recreational uses of the receiving waters are more prevalent and stream flows are lower. In addition, pollutants from non-storm water discharges may accumulate in separate storm sewers until they are flushed out during a storm event, thereby contributing to higher pollutant concentrations and loads.

A wide range of pollutants may be contributed to storm sewers from non-storm water discharges, including pathogens, metals, nutrients, oil and grease, metals, phenols, and solvents. Removal of these non-storm water sources of pollutants often improves the quality of discharges from separate storm sewers dramatically.

The non-storm water discharges listed previously have a high potential for contributing pollutants to storm sewers (EPA, Pitt, 1992). Other non-storm water discharges may have less potential for contributing pollutants[1]:

- Water from street cleaning drainage
- Water from fire hydrant flushing
- Water from fire fighting activities
- Runoff from noncommercial residential activities, such as lawn watering, car washing, swimming pool discharges
- Water from water line breaks
- Certain cleaning water from commercial activities
- Condensate from residential and commercial air conditioning units
- Infiltration of uncontaminated ground water
- Industrial process wastewater, which has been issued a National Pollutant Discharge Elimination System (NPDES) permit.[2]

C.1 ILLICIT OR CROSS CONNECTIONS

Illicit connections, also referred to as cross connections, to separate storm water sewers are physically connected conveyances used to carry untreated wastewaters other than storm water. For many of these connections, there is a mistaken belief that materials are going to a sanitary sewer or some other type of treatment facility.

[1] See 55 *FR* 47990 (November 16, 1990) and "Investigations of Inappropriate Pollutant Entries Into Storm Drainage Systems", EPA, January 1993.

[2] EPA has clarified that it does not interpret the effective prohibition on non-storm water discharges to municipal separate storm sewers of Section 402(p)(3) of the CWA to prohibit non-storm water discharges in compliance with the conditions of an NPDES permit that discharge through a municipal separate storm sewer (see November 16, 1990, 55 *FR* 48037).

Illicit connections may take a variety of forms, including improper connections of residential sewer service lines or sumps, cross-connections with sanitary sewers, improper connections of industry sewer lines, and improper disposal of wastes to floor drains or outdoor drains connected to the separate storm sewer.

C.1.1 Improper Installation

In older sections of cities with separate storm sewers, the potential for improper connections to a separate storm sewer may be high. Problems with illicit connections in the oldest developed areas are often traced to the initial development of the storm sewer system (AWPA, 1990). Early storm sewers preceded the development of sanitary sewers. Once storm sewers were in place, however, they received other non-storm water sources of pollutants, some by direct connections and others from wastes dumped into the streets or storm sewers. Many cities prohibited the discharge of domestic sewage to storm sewers but failed to provide public sanitary sewers, resulting in secret illegal connections built without public supervision. Other illegal connections to the storm sewer were overlooked by municipal officials because of the lack of proper sanitary sewers or because the municipality did not have a program addressing the quality of discharges from the storm sewer system.

During redevelopment or infill development, illicit connections may arise when storm sewers are either mistaken for sanitary lines or the developer intentionally installs improper connections to a storm sewer that is more easily accessed than a sanitary sewer. Expanding or retrofitting large, older industrial complexes creates special problems if maps of the sanitary and storm sewer lines do not exist or are inaccurate and confusion arises regarding the appropriate function of the sewer lines. In addition, when the activities within an industrial facility change, floor drains and other discharge points, which are connected to the separate storm sewer, may begin to receive drainage and discharges that should be sent to a treatment plant. Such floor drains may receive a wide variety of discharges, including spills, rinse waters, cooling waters, and even process wastewaters.

Numerous factors may cause floor drains to be directed toward separate storm sewers. Many floor drains in commercial and industrial facilities are positioned so that they collect storm water running into a building, as well as cleaning water, spillage, and other non-storm water discharges generated within a building. Urbanized areas have experienced rapid growth since 1950. During much of that time, many municipalities did not provide adequate publicly owned treatment works (POTW) service; the development of POTW capacity often lagged far behind the rapid development of the urbanized area. When faced with limited POTW capacity or inadequate POTWs, which could not handle toxic materials (e.g., solvents and heavy greases), many municipalities encouraged developers to connect floor drains and other nonsanitary sewage lines from commercial and industrial facilities to separate storm sewers. Some municipal ordinances prohibited floor drains from being connected to the sanitary sewer system.[3] The operators of facilities with these types of improper connections usually do not know whether floor drains and other types of drains discharge to a separate storm sewer or to a sanitary sewer.

Recent studies in Michigan recognized that development that occurred while undersized POTWs were in operation can create wide-spread illicit connections. For example, the Huron River Pollution Abatement Program inspected 660 businesses, homes, and other buildings discharging storm water to the Allen Creek drain in Washtenaw County, Michigan. Of the buildings inspected, 14 percent were identified as having improper storm drain connections. Illicit discharges were detected at a higher rate of 60 percent for automobile-related businesses, including service stations, automobile dealerships, car washes, body shops, and light industrial facilities. While some of the problems discovered in this study were the result of improper plumbing or illegal connections, most connections were approved at the time they were built.

[3] Some municipalities have prohibited floor drain connections to sanitary sewers in overbroad efforts to comply with EPA regulations at 40 *CFR* 35.927-4, which require grant applicants to demonstrate that municipalities have sewer use ordinances prohibiting any new connections from inflow sources into the sanitary sewer portions of the sewer system.

C.1.2 Sewer Maintenance/Restoration

As urban development grows, flows in the sanitary sewer system increase. In some systems where flows during dry or wet weather have grown to exceed the hydraulic capacity of sanitary sewers, the sanitary sewer has been intentionally cross connected to a storm sewer systems. In some cases, formal connections or overflow devices have been installed and, in others, holes are punched into the sanitary sewer to relieve the sanitary sewer of high flows. Some cross-connections result in wet weather combined sewer overflows; others discharge during dry weather events. Discharges from malfunctioning sanitary sewage pumping stations are often directed toward storm sewers.

Incomplete separation of combined sewers may result in significant numbers of cross-connections between the sanitary sewer system and the storm sewer system. Most municipalities separate sewers primarily to prevent basement and street floodings, with secondary consideration given to water quality concerns. Because separation operations are expensive and can cause significant disruptions to street usage, short cuts may be taken to satisfy flooding concerns at the lowest cost. EPA has recently issued a Combined Sewer Overflow (CSO) Control Policy.[4]

C.2 INTERACTIONS WITH SEWAGE SYSTEMS

As sanitary sewage collection systems age, the systems develop leaks and cracks. Municipalities have long recognized the problems of storm water infiltrating <u>into</u> sanitary sewers, because this type of infiltration disrupts the operation of a POTW. However, the reverse problem of sewage exfiltrating out of the sanitary sewer collection system can occur during dry weather periods. Many sanitary collection systems were initially built between the early 1900s and the mid-1950s. Sewer mains were constructed of asbestos cement, bituminous fiber, brick, cast iron, redwood, or vitrified clay. Manholes were prepared from brick and mortar or reinforced concrete. These aged materials, poorly constructed manholes and joints, and main breaks may permit exfiltration. Sewage from a leaky sanitary system

[4] Combined Sewer Overflow (CSO) Control Policy, EPA, 59 *FR* 18688 (April 19, 1994)

can flow to a storm sewer or contaminate ground water supplies. An EPA study on sewer exfiltration found significant ratios of the rate of exfiltration of raw sewage to the rate of infiltration of ground water or storm water into sanitary sewers. Field and laboratory results determined that this ratio varied between 1.5 to 1 and 14 to 1.[5] Not only are the ratio to rates high, but exfiltration can occur during dry periods, as well as wet weather periods; infiltration is more limited to wet weather periods or periods when the water table is high.

Separate storm sewers and sanitary sewers interactions can be caused by numerous conditions. For example, interaction may occur at manholes and where sanitary sewer laterals and storm sewer trenches cross. In addition, separate storm sewers and sanitary sewers may share the same trench, which is generally filled with very porous material, such as gravel.

C.3 IMPROPER DISPOSAL

Improper disposal of materials may result in contaminated discharges from separate storm sewers in two major ways. First, materials may be disposed of directly to a catchbasin or other storm water conveyance. Second, materials disposed of on the ground may either drain directly to a storm sewer or be washed into a storm sewer during a storm event.

Improper disposal to a separate storm sewer often occurs because many believe that disposal of materials to street catchbasins and other separate storm sewer inlets is an environmentally sound practice. Part of the confusion occurs because some areas are served by combined sewers, which are part of the sanitary sewer collection system, and people assume materials discharged to a catchbasin will reach an appropriate sewage treatment plant.

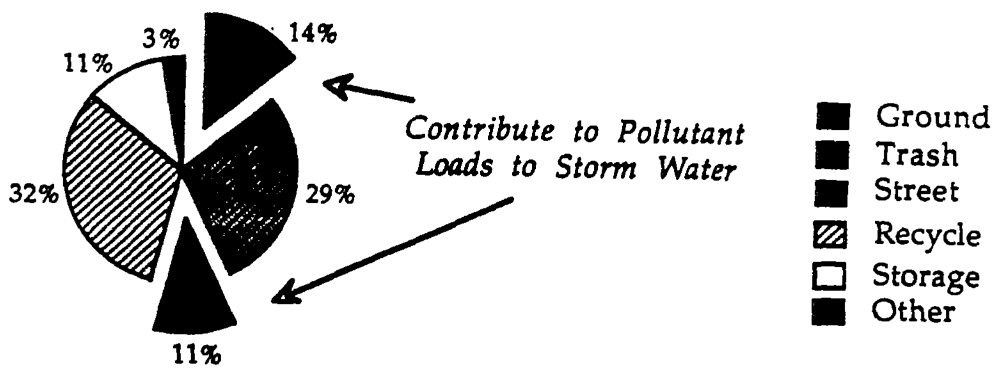
Materials that are commonly disposed of improperly include used oil; household toxic materials; radiator fluids; and litter, such as disposable cups, cans, and fast-food packages.

[5] U.S. EPA, "Results of the Evaluation of Groundwater Impacts of Sewer Exfiltration", Municipal Facilities Division, February 1989, Washington, DC.

A 1984 survey of household disposal practices estimated that the following percentages of households typically disposed of the materials listed directly to a storm sewer or a street:

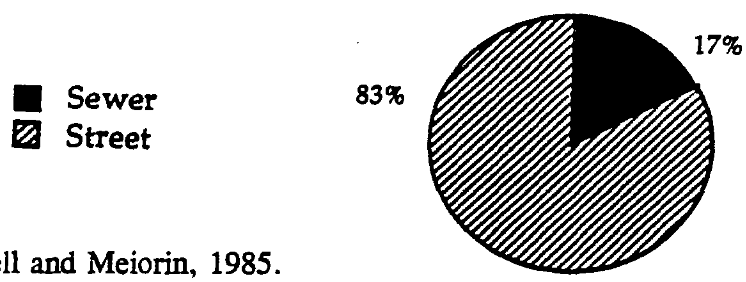
- 3 percent of households—paints and thinners
- 11 percent of households—used motor oil
- 83 percent of households that flushed their own auto radiators—used radiator fluid (anti-freeze contaminated with metals).

In addition, although common practice may have changed since 1985, the study estimated that an additional 14 percent of households that changed their own motor oil disposed of the motor oil by pouring it on the ground. Figures C-1 through C-3 depict these data.



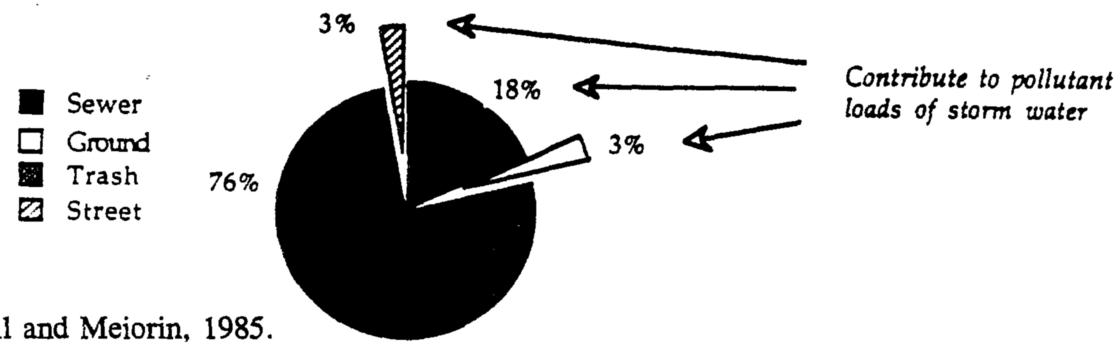
Source: Russell and Meiorin, 1985.

Figure C-1. Disposal Practices of Households Generating Used Motor Oil



Source: Russell and Meiorin, 1985.

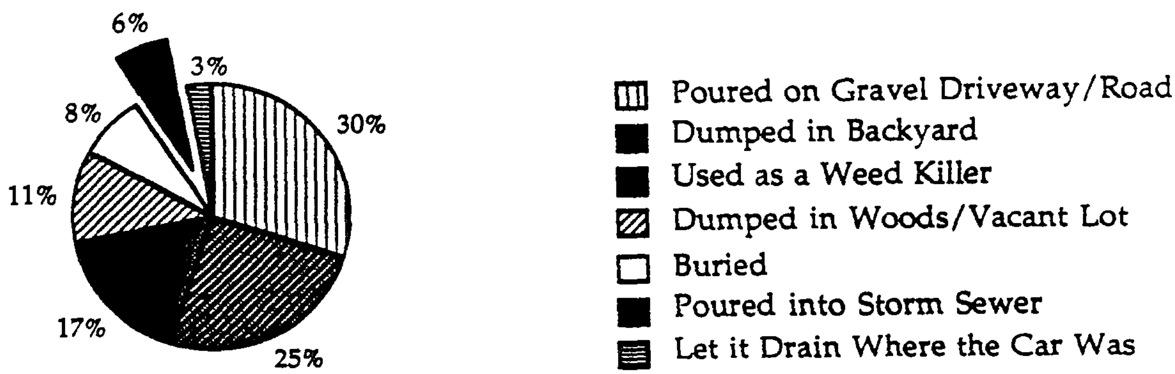
Figure C-2. Disposal Practices of Households Generating Radiator Flushings



Source: Russell and Meiorin, 1985.

Figure C-3. Disposal Practices for Households Generating Waste Paints and Thinner

A Department of Energy study (Brinkman, 1981) addresses common disposal methods of used oil produced by do-it-yourself (DIY) oil changers. The study estimated that 342 million gallons of used oil were drained during DIY oil changes annually and that 40 percent of this used oil was poured on the ground. Figure C-4 shows the variety of types of oil disposal methods used for the 40 percent of DIY oil disposed of by pouring on the ground. EPA estimates that, 267 million gallons of used oil, including 135 million gallons of used oil from DIY automobile oil changes, are disposed of improperly each year.



Source: Brinkman, 1981.

Figure C-4. Disposal Practices of Households Pouring Used Oil on the Ground

The General Accounting Office (GAO) report, *Illegal Disposal of Hazardous Waste: Difficult to Detect or Deter* (1985) investigated illegal dumping of materials defined as hazardous wastes under the Resource Conservation and Recovery Act (RCRA). Although the report was unable to estimate the extent of illegal dumping of hazardous wastes, it reported that, based on surveyed officials in four States (i.e., Illinois, California, New Jersey, and Massachusetts), some officials believed that many cases of illegal disposal occurred. The report indicated that the Director of EPA's National Enforcement Investigation Center thinks that many cases of criminal disposal occur on a widespread basis, and that EPA receives more allegations than it can handle. The Director stated that the center received about 240 allegations that were judged as having good potential to involve violations during fiscal years 1982 through 1984.

The report indicated that cases of onsite waste disposal where pollutants were added to runoff, which eventually ended up in drainage systems, and cases where a generator dumped wastes directly down a drain, were common. Of the 36 cases of illegal dumping investigated in the GAO report, 14 cases involved disposal of hazardous material directly to or with drainage to a storm sewer, flood control structure, or side of a road. An additional 10 sites involved disposal to the ground, landfills (other than those receiving hazardous wastes), trash bins, which can then result in adding pollutants to subsequent storm water discharges. Disposal scenarios in several other cases could not be determined.

The GAO report concluded that because RCRA regulations and compliance inspections for generators and transporters were not designed to detect illegal disposal, local government agencies, including flood control agencies and departments of transportation were particularly important for detecting illegal dumping.

Businesses disposing of small amounts of hazardous waste may be of concern because they do not fully understand hazardous waste disposal regulations and employee training programs necessary to ensure proper disposal.

C.4 SPILLS

Spilled material may have a have a high potential for entering human-made drainage systems. Until recently, an accepted practice to responding to spills was to flush the spilled material away. These removal methods may often result in flushing the spilled material into a separate storm sewer.

A wide variety of materials, such as petroleum products, other liquid products, and waste chemicals, may spill during transportation, transfer, use, and storage. The U.S. Coast Guard's National Response Center (NRC) receives thousands of incident reports, involving hundreds of substances each year. Summary data, provided by the NRC, categorized spilled materials as either oil or hazardous substances defined under the CWA or the Comprehensive Environmental Response, Compensation, and Liability Act. The term oil is used to represent more than 90 different materials, including various grades of crude oil, naphtha, coal tar, creosote, refined oils, gasoline, and jet fuel.

Table C-1 summarizes the amounts of reported oil and hazardous substances discharged and the amounts reported in water during 1987 and 1988. As this table shows, significant quantities of pollutants are reported to the NRC as spilled or dumped each year. Cleanup activities are not initiated for each reported discharges. Where cleanup occurs, a significant portion of a spill is often not recoverable. Although no data are available to substantiate the number of unreported discharges, Merryman (1989) estimated that less than half of the reportable incidents occurring each year are reported to the NRC. Many of these incidents probably involve little cleanup activity because they were not reported to responsible authorities.

C.5 MALFUNCTIONING SEPTIC SYSTEMS

In rural and suburban areas served by septic systems, malfunctioning septic systems can contribute pollutants to separate storm sewers. Although septic systems work well in rural, low-density areas with suitable soil and a deep water table, septic systems are often installed in inappropriate areas, such as coastal areas, where rapid residential growth, particularly in second-home development areas, has outdistanced the ability of local governments to build sanitary sewers.

Table C-1. Summary of U.S. Coast Guard National Response Center Data on Discharges of Oil and CERCLA-Regulated Materials During 1987 and 1988

	1987 Gallons	1987 Pounds	1988 Gallons	1988 Pounds
Oil Spills Affecting Land	4,988,282	--	6,426,228	--
Oil Spills Affecting Water	3,613,555	--	4,637,600	--
Oil Spills Amount in Water	5,278,773	--	2,949,694	--
Hazardous Substances Spills Affecting Land	1,969,080	3,354,591	4,201,392	2,565,142
Hazardous Substances Spills Affecting Water	3,664,065	656,843	5,244,696	856,852
Hazardous Substances Spills Amount in Water	3,636,764	347,230	2,320,874	415,204

Oil is defined by the NRC to include 94 materials, including gasoline, crude and refined oils, creosote, jet fuel, diesel, naphtha, and coal tar.

Hazardous Substances include 494 materials either required by or containing substances regulated by CERCLA.

Surface malfunctions are caused by clogged or impermeable soils or when stopped up or collapsed pipes force untreated wastewater to the surface. Surface malfunctions can vary in degree from occasional damp patches on the surface to constant pooling or runoff of wastewater to a storm sewer. These discharges have high bacteria, nitrate, and nutrient levels and can contain a variety of household chemicals. One type of improper remedy to a surface malfunction is to install a pipe or trench over soil absorption systems to route untreated surface malfunction overflow away from the septic system, resulting in direct discharges to drainage ditches, empty lots, or surface waters.

Malfunctioning septic systems may be a more significant surface runoff pollution problem than a ground water problem. This is because a malfunctioning septic system is less likely to cause ground water contamination where a bacterial mat in the soil retards the downward movement of wastewater. (Poorly located septic systems that are operating properly are the greatest threat to ground water.)

In addition to surface malfunctions, insufficiently treated wastewater from a septic system may contaminate ground water, which may infiltrate into storm sewers, which serve as a conduit to surface waters. Also, seepage of sewage or effluent into underground portions of buildings can be pumped to separate storm sewers.

The 1992 Needs Survey estimates that approximately 30 percent of the population in the United States is served by septic systems[6].

C.6 INFILTRATION OF CONTAMINATED GROUND WATER

Many separate storm sewers discharge ground water that infiltrates into the storm sewer. Usually, these discharges are not contaminated and, in general, do not pose direct pollutant threats to surface waters. However, if ground water sources are contaminated by industrial or other sources, the separate storm sewer serves as a conduit for the contaminated ground water to surface waters. This process can greatly reduce pollutant removal associated with ground water migration through soils, as well as reduce the dilution processes associated with ground water plume migration. Conversely, observing contaminated discharges from separate storm sewers during dry weather may be used as a tool to detect sources of ground water contamination.

In addition to traditional industrial sources, ground water may be contaminated by a number of commercial activities. One leading cause of ground water contamination from commercial activities includes leaks from underground storage tanks (USTs) and underground pipes. Underground storage tanks are used to store large amounts of potential pollutants, such as petroleum products and chemicals. In 1987, EPA estimated that 676,000 UST systems stored retail motor fuel, 651,000 stored other petroleum products, and 54,000 stored hazardous chemicals in the United States. In addition, EPA estimated that potentially millions of other small UST systems, such as hydraulic lift tanks and power cable conduits, contain dielectric fluid. Pollutants leaking from these tanks may infiltrate through soil into either nearby ditches or storm water pipes (Fields, 1989). A draft EPA report (Kaschak and Hargrove, 1988) reviewed corrective action case histories of 50 leaking UST sites. The report indicated

6 "1992 Needs Survey Report to Congress", EPA, September 1993.

that surface water impacts were of concern at 14 percent of these sites, where fuels entered storm drains or flowed over the surface, or where the source was located close to a stream or surface waters.

C.7 ROAD OILING

EPA estimates that 70 million gallons of used oil, primarily supplied by service stations and repair shops, are used for road oiling.

A study of two rural roads in New Jersey treated with waste crankcase oil indicated that only 1 percent of the total oil applied to the road may remain on the road surface (Freestone "Runoff of oils from rural roads treated to suppress dust" NERC, EPA, Cincinnati, OH, 1972). The study concluded that oil could have left the road surface by several means such as volatilization, runoff, adhesion to vehicles, adhesion to dust particles with wind transport, and biodegradation.

APPENDIX D

NPDES STORM WATER PROGRAM QUESTION AND ANSWER DOCUMENT VOLUMES I AND II

NPDES

Storm Water Program

Question and Answer Document

U.S. Environmental Protection Agency
Office of Wastewater Enforcement and Compliance
Permits Division
401 M Street, SW
Washington, DC 20460

March 1992

R0015312

INDUSTRIAL PERMIT APPLICATION QUESTIONS AND ANSWERS

Category i - Facilities subject to storm water effluent guidelines, new source performance standards, or toxic pollutant effluent standards.

1. **What kinds of facilities are included under category (i)?**

Category (i) includes facilities subject to storm water effluent limitations guidelines, new source performance standards, or toxic pollutant effluent standards under Title 40 subchapter N of the Code of Federal Regulations (CFR) (except facilities with toxic pollutant effluent standards which are exempted under category (xi) of the definition of storm water discharge associated with industrial activity). The term "storm water" modifies only "effluent limitations guidelines." Facilities subject to subcategories with new source performance standards, toxic pollutant effluent standards, or storm water effluent limitation guidelines are required to submit a National Pollutant Discharge Elimination System (NPDES) permit application for storm water discharges associated with industrial activity.

2. **What kinds of facilities are subject to storm water effluent guidelines?**

The following categories of facilities have storm water effluent guidelines for at least one of their subcategories: cement manufacturing (40 CFR 411); feedlots (40 CFR 412); fertilizer manufacturing (40 CFR 418); petroleum refining (40 CFR 419); phosphate manufacturing (40 CFR 422); steam electric power generation (40 CFR 423); coal mining (40 CFR 434); mineral mining and processing (40 CFR 436); ore mining and dressing (40 CFR 440); and asphalt (40 CFR 443). A facility that falls into one of these general categories should examine the effluent guideline to determine if it is categorized in one of the subcategories that have storm water effluent guidelines. If a facility is classified as one of those subcategories, that facility is subject to the standards listed in the CFR for that category, and as such, is required to submit a storm water discharge permit application.

3. **What kinds of facilities are subject to "toxic pollutant effluent standards"?**

First, it is important to understand the term toxic pollutant. Toxic pollutants refers to the priority pollutants listed in Tables II and III of Appendix D to 40 CFR part 122 (not 40 CFR Part 129). If any of these toxic pollutants are limited in an effluent guideline to which the facility is subject (including pretreatment standards), then the facility must apply for a storm water permit.

The following categories of facilities have toxic pollutant effluent standards for at least one subcategory:

Textile mills (40 CFR 410)
Electroplating (40 CFR 413)
Organic chemicals, plastics, and synthetic fibers (40 CFR 414)
Inorganic chemicals (40 CFR 415)
Petroleum refining (40 CFR 419)
Iron and steel manufacturing (40 CFR 420)
Nonferrous metals manufacturing (40 CFR 421)
Steam electric power generating (40 CFR 423)
Ferroalloy manufacturing (40 CFR 424)
Leather tanning and finishing (40 CFR 425)
Glass manufacturing (40 CFR 426)
Rubber manufacturing (40 CFR 428)
Timber products processing (40 CFR 429)
Pulp, paper, and paperboard (40 CFR 430)
Metal finishing (40 CFR 433)
Pharmaceutical manufacturing (40 CFR 439)
Ore mining and dressing (40 CFR 440)
Pesticide chemicals (40 CFR 455)
Photographic processing (40 CFR 459)
Battery manufacturing (40 CFR 461)
Metal molding and casting (40 CFR 464)
Coil coating (40 CFR 465)
Porcelain enameling (40 CFR 466)
Aluminum forming (40 CFR 467)
Copper forming (40 CFR 468)
Electrical and electronic components (40 CFR 469)
Nonferrous metals forming and metal powders (40 CFR 471)

4. What kinds of facilities are subject to "new source performance standards"?

Most effluent guidelines listed in subchapter N contain New Source Performance Standards (NSPS). A facility that is subject to a NSPS as defined for that particular effluent guideline is required to submit a permit application for the storm water discharges associated with industrial activity at that site. The definition of a new source varies based on the publication date of the particular effluent guideline.

The following categories of 40 CFR Subchapter N facilities do not have new source performance standards. All other categories have at least one subcategory with new source performance standards.

Oil and Gas Extraction (40 CFR 435)
Mineral Mining and Processing (40 CFR 436)
Gum and Wood Chemicals Manufacturing (40 CFR 454)
Pesticide Chemicals (40 CFR 455)
Explosives Manufacturing (40 CFR 457)
Photographic (40 CFR 459)
Hospital (40 CFR 460)

5. If a facility is included under the description of both category (i) and category (xi), is that facility required to submit a storm water permit application if material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, or industrial machinery are not exposed to storm water?

The answer depends on why the facility is included in category (i). If the facility is included in category (i) because it is subject to storm water effluent standards or new source performance standards, the facility is required to apply for a permit regardless of whether it has exposure or not. Facilities that are included in category (i) only because they have toxic pollutant effluent standards are not required to submit an application if they indeed have no exposure to material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, or industrial machinery.

Categories ii, iii, vi, viii, and xi

6. What industrial groups are covered by Standard Industrial Classification (SIC) codes that are used in the definition of storm water discharge associated with industrial activity?

The following SIC codes and associated industries are included in the indicated categories of the definition:

Category (ii)
- 24 (except 2434) - Lumber and Wood Products (except wood kitchen cabinets)
- 26 (except 265 and 267) - Paper and Allied Products (except paperboard containers and products)
- 28 (except 283 and 285) - Chemicals and Allied Products (except drugs and paints)
- 29 - Petroleum Refining Industries
- 311 - Leather Tanning and Finishing

- 32 (except 323) - Stone/Clay/Glass and Concrete Products (except glass products made of purchased glass)
- 33 - Primary Metal Industries
- 3441 - Fabricated Structural Metals
- 373 - Ship and Boat Building and Repairing

Category (iii)

- 10 - Metal Mining
- 12 - Coal Mining
- 13 - Oil and Gas Extraction
- 14 - Nonmetallic Minerals

Category (vi)

- 5015 - Motor Vehicles Parts, Used
- 5093 - Scrap and Waste Materials

Category (viii)

- 40 - Railroad Transportation
- 41 - Local Passenger Transportation
- 42 (except 4221-4225) - Trucking and Warehousing (except public warehousing and storage)
- 43 - U.S. Postal Service
- 44 - Water Transportation
- 45 - Transportation by Air
- 5171 - Petroleum Bulk Stations and Terminals

Category (xi)

- 20 - Food and Kindred Products
- 21 - Tobacco Products
- 22 - Textile Mill Products
- 23 - Apparel Related Products
- 2434 - Wood Kitchen Cabinets Manufacturing
- 25 - Furniture and Fixtures
- 265 - Paperboard Containers and Boxes
- 267 - Converted Paper and Paperboard Products
- 27 - Printing, Publishing, and Allied Industries
- 283 - Drugs
- 285 - Paints, Varnishes, Lacquer, Enamels, and Allied Products
- 30 - Rubber and Plastics
- 31 (except 311) - Leather and Leather Products (except leather tanning and finishing)
- 323 - Glass Products
- 34 (except 3441) - Fabricated Metal Products (except fabricated structural metal)

35 - Industrial and Commercial Machinery and Computer Equipment
36 - Electronic and Other Electrical Equipment and Components
37 (except 373) - Transportation Equipment (except ship and boat building and repairing)
38 - Measuring, Analyzing, and Controlling Instruments
39 - Miscellaneous Manufacturing Industries
4221-4225 - Public Warehousing and Storage

Category iii - Mining and Oil & Gas Operations

7. Are inactive mines included in the regulation?

Two conditions must be met for an inactive mine to be required to submit a storm water discharge permit application. First, the facility must have a discharge of storm water that has come into contact with any overburden, raw material, intermediate products, finished products, byproducts, or waste products located on the site of the facility. The second condition depends on the type of mining activity.

Inactive non-coal mining operations must apply until such sites are released from applicable State or Federal reclamation requirements after December 17, 1990. Non-coal mining operations released from applicable State or Federal requirements before December 17, 1990, must apply for an NPDES storm water discharge permit if the storm water discharges are contaminated as discussed above.

Inactive coal mining operations must apply unless the performance bond issued to the facility by the appropriate Surface Mining Control and Reclamation Act (SMCRA) authority has been released.

8. Are any oil & gas exploration, production, processing, or treatment operations, or transmission facilities classified under SIC code 13, exempt from having to apply for a storm water permit?

Yes, such facilities are exempt unless they have discharged storm water after November 16, 1987, containing a Reportable Quantity (RQ) of a pollutant for which notification is or was required pursuant to 40 CFR 117.21, 40 CFR 302.6, or 40 CFR 110.6; or if a storm water discharge from the facility contributes to a violation of a water quality standard, as set forth in 40 CFR 122.26(c)(1)(iii).

9. What is a reportable quantity for discharges from an oil or gas operations?

As defined at 40 CFR 110.6, an RQ is the amount of oil that violates applicable water quality standards or causes a film or sheen upon or a discoloration of the surface of the water or adjoining shorelines or causes a sludge or emulsion to be deposited beneath the surface of the water or upon adjoining shorelines (40 CFR part 110.6). The RQs for other substances are listed in 40 CFR 117.3 and 302.4 in terms of pounds released over any 24-hour period.

10. Are access roads for mining operations covered?

Any construction that disturbs 5 acres or more of total land area must apply for a storm water discharge permit.

After construction, roads for mining operations would not be included unless storm water runoff from such roads mixes with storm water that is contaminated by contact with overburden, raw materials, intermediate products, finished products, byproducts, or waste products. When roads are constructed out of materials such as overburden or byproducts, an application for an NPDES storm water discharge permit would be required.

Category iv - Hazardous Waste Treatment, Storage, or Disposal Facilities

11. Is a facility that stores hazardous waste less than 90 days required to submit an application?

It is EPA's intent to cover those facilities that are operating under interim status or permit under the Resource Conservation and Recovery Act (RCRA) subtitle C. As such, only facilities meeting the definition of a hazardous waste treatment, storage, or disposal facility under RCRA are expressly included in this category. A facility that stores hazardous waste less than 90 days is not considered to be a treatment, storage, or disposal facility, and therefore is not required to submit a storm water permit application.

Category v - Landfills, Land Application Sites and Open Dumps

12. Do closed or inactive landfills need to apply for a permit?

Yes. Any landfill, active, inactive or closed, must apply for a permit if it receives, or has received, wastes from the industrial facilities identified under 122.26(b)(14)(i)-(xi). To the extent that control measures and best management practices address storm water, the permit may incorporate those control measures.

13. Does a landfill that receives only the office waste and/or cafeteria waste from industrial facilities have to apply for an NPDES permit?

No. Only landfills that receive or have received waste from manufacturing portions of industrial facilities need to apply for a permit.

Category vi - Recycling Facilities

14. Are gas stations or repair shops that collect tires or batteries classified in the "recycling" category?

No. Only those facilities classified in SIC codes 5015 (used motor vehicle parts) and 5093 (scrap and waste materials) are in the "recycling" category. This includes facilities such as metal scrap yards, battery reclaimers, salvage yards, and automobile junk yards.

15. Are municipal waste collection sites included in category (vi)?

No. Municipal waste collection sites where bottles, cans, and newspapers are collected for recycling purposes are not classified as SIC codes 5015 or 5093.

Category vii - Steam Electric Power Generating Facilities

16. Are offsite transformer areas regulated under the NPDES storm water rule?

No. Upon examination of the Toxic Substances Control Act, EPA determined that the regulation of storm water discharges from these facilities should be studied under Section 402(p)(5) of the Clean Water Act (CWA) (55 FR 48013). Future regulations may be developed to address these areas.

17. Are storm water discharges from electrical substations included in the definition of industrial activity?

No. Electrical substations are not covered by this regulation.

18. Are storm water discharges from coal piles that are located offsite from the power station included in the definition of industrial activity?

No. Offsite coal piles are not covered by this regulation. In order to be included, a coal pile must be located on the site of a facility defined by the regulation as being "engaged in an industrial activity."

19. Are storm water discharges from co-generation facilities included in the definition of industrial activity?

A heat capture co-generation facility is not covered under the definition of storm water discharge associated with industrial activity; however, a dual fuel co-generation facility is included and therefore must submit an application for the storm water discharges associated with industrial activity.

20. Are university power plants included in the definition of industrial activity?

Yes. A university steam electric power generating facility is required to apply for a storm water discharge permit.

Category viii - Transportation Facilities

21. Are gas stations and automotive repair shops required to apply for an NPDES storm water discharge permit?

No. These facilities are classified in SIC codes 5541 (gasoline filling stations) and 7538 (automotive repair shops). The storm water rule generally does not address facilities with SIC classifications pertaining to wholesale, retail, service or commercial activities. Additional regulations addressing these sources may be developed under Section 403(p)(6) of the CWA if studies required under Section 402(p)(5) indicate the need for regulation.

22. Does a vehicle maintenance shop or an equipment cleaning facility need to apply for a permit?

Yes, if the shop is categorized by the SIC codes listed in the transportation category of facilities engaged in industrial activity [i.e., SIC codes 40, 41, 42 (except 4221-25) 43, 44, 45 and 5171]. Only the vehicle maintenance (including vehicle rehabilitation, mechanical repairs, painting, fueling, and lubrication) and equipment cleaning areas (such as truck washing areas) must be addressed in the application.

As explained above, gas stations are classified in SIC code 5541 and automotive repair services are classified as SIC code 75, which are not included in the regulatory definition of industrial activity, and therefore are not required to submit NPDES storm water discharge permit applications.

23. Are municipally owned and/or operated school bus maintenance facilities required to apply for an NPDES permit?

No. The SIC Manual states that "school bus establishments operated by educational institutions should be treated as auxiliaries" to the educational institution. Since the SIC code assigned to educational institutions is 82, the municipally operated (i.e., by a school board, district, or other municipal entity) school bus establishments would not be required to apply for an NPDES permit for their storm water discharges. Private contract school bus services are required to apply for an NPDES permit for their storm water discharges.

24. Is SIC code 4212 always assigned to facilities with dump trucks?

No. The maintenance facility must be primarily engaged in maintaining the dump truck to be characterized as SIC code 4212. Dump trucks used for road maintenance and construction and facilities that maintain these trucks are classified under SIC code 16 (heavy construction other than building construction) and therefore would not be characterized as engaging in industrial activity.

25. How does a municipality determine what type of vehicle a particular maintenance facility is primarily engaged in servicing?

The SIC Manual recommends using a value of receipts or revenues approach to determine what is the primary activity of a facility. For example, if a maintenance facility services both school buses and intercity buses, the facility would total receipts for each type of vehicle and whichever generated the most revenue, would be the vehicle type that the facility is primarily engaged in servicing. If data on revenues and receipts are not available, the number of vehicles and frequency of service may be compared. If a facility services more than two types of vehicles, whichever type generates the most (not necessarily greater than half of the total) revenue, or is most frequently serviced, is the vehicle type the facility is primarily engaged in servicing.

26. Is a municipal maintenance facility that is <u>primarily</u> engaged in servicing garbage trucks required to apply for a permit?

The answer depends on the SIC code assigned to the establishment. If the municipality also owns the disposal facility (e.g., landfill, incinerator) that receives refuse transported by the trucks, then the maintenance facility would be classified as SIC code 4953 and thus would not be required to apply for a permit unless the maintenance facility was located at a facility covered under one of the other categories of industrial activity (e.g., a landfill that receives industrial waste). If, however, the municipality does not own the disposal facility, the truck maintenance facility would be classified as SIC code 4212 and thus would be required to apply for a permit. If other vehicles are serviced at the same maintenance facility, the facility may not be required to submit a permit application (see question #25 above).

27. Are fire trucks or police cars included in the transportation SIC codes?

No. The operation of fire trucks and police cars are classified under public order and safety (SIC code 92); therefore, the operator of a facility primarily engaged in servicing those vehicles would not be required to apply for a permit.

28. Do all airports need to apply for a storm water discharge permit?

No, only those airports classified as SIC code 45. Only those portions of the facility that are either involved in vehicle maintenance (including vehicle rehabilitation, mechanical repairs, painting, fueling, and lubrication), equipment cleaning, or airport deicing or which are otherwise identified under 122.26(b)(14)(i)-(vii) or (ix-xi) are required to be permitted. Airports that are not engaged in such activities do not require storm water discharge permits. Facilities primarily engaged in performing services that incidentally use airplanes (e.g., crop dusting and aerial photography) are classified according to the service performed.

29. Is the deicing of airplanes, runways, or both included in airport deicing operations?

Airports or airline companies must apply for a storm water discharge permit for locations where deicing chemicals are applied. This includes, but is not limited to, runways, taxiways, ramps, and areas used for the deicing of airplanes. The operator of the airport should apply for the storm water discharge permit with individual airline companies included as co-applicants.

30. Who is responsible for seeking permit coverage at an airport that has many companies using the facility and discharging storm water?

The operator is responsible for seeking coverage. EPA strongly encourages cooperation between the airport authority and all operating airlines at that airport. Each operator is responsible for coordinating with the others and they may act as co-applicants. Please note that under 122.26(a)(6) the Director has the discretion to issue individual permits to each discharger or to issue an individual permit to the airport operator and have other dischargers to the same system act as co-permittees to the permit issued to the airport operator.

31. Are railroad facilities included?

Railroad facilities, classified as SIC code 40, which have vehicle maintenance activities, equipment cleaning operations or are otherwise identified under 122.26(b)(14)(i)-(vii) or (ix)-(xi) need to apply for a permit.

32. Are repairs along a railroad system considered to be vehicle maintenance and thus regulated?

No. Only nontransient vehicle maintenance shops are included in the transportation category.

33. Are tank farms at petroleum bulk storage stations covered by the rule?

No, unless the storm water discharge from the tank farm area commingles with storm water from any vehicle maintenance shops or equipment cleaning operations located onsite. However, tank farms located onsite with other industrial facilities, as defined in 122.26(b)(14), are included in the regulation.

34. Is a parking lot associated with a vehicle maintenance shop included in the regulation?

Yes. Under 122.26 (b)(14)(viii) vehicle maintenance and equipment cleaning operations are considered industrial activity. Parking lots used to store vehicles prior to maintenance are considered to be a component of the vehicle maintenance activity.

35. Is the fueling operation of a transportation facility (SIC codes 40 through 45) covered if there are no other vehicle maintenance activities taking place at the facility?

Yes. A nonretail fueling operation is considered vehicle maintenance [see 122.26(b)(14)(viii)] and requires an NPDES storm water discharge permit application.

36. Is a manufacturing facility's offsite vehicle maintenance facility required to apply for a permit under the transportation category?

No. An offsite vehicle maintenance facility supporting one company would not be required to apply for a permit if that company is not primarily engaged in providing transportation services and therefore would not be classified as SIC code 42. The maintenance facility would be considered an auxiliary operation to the manufacturing facility. For a full discussion on auxiliary facilities see page 13 through 17 of the 1987 Standard Industrial Classification Manual. If the maintenance facility is located on the same site as the manufacturing operation, it would be included in the areas associated with industrial activity and must be addressed in an application.

37. Is a marina required to apply for a storm water permit if it operates a retail fueling operation, but other vehicle maintenance or equipment cleaning activities are not conducted onsite?

Facilities that are "primarily engaged" in operating marinas are best classified as SIC 4493 - marinas. These facilities rent boat slips, store boats, and generally perform a range of other marine services including boat cleaning and incidental boat repair. They frequently sell food, fuel, fishing supplies, and may sell boats. For facilities classified as 4493 that are involved in vehicle (boat) maintenance activities (including vehicle rehabilitation, mechanical repairs, painting, fueling, and lubrication) or equipment cleaning operations, those portions of the facility that are involved in such vehicle maintenance activities are considered to be associated with industrial activity and are covered under the storm water regulations.

Facilities classified as 4493 that are not involved in equipment cleaning or vehicle maintenance activities (including vehicle rehabilitation, mechanical repairs, painting, and lubrication) are not intended to be covered under 40 CFR Section 122.26(b)(14)(viii) of the storm water permit application regulations. The retail sale of fuel alone at marinas, without any other vehicle maintenance or equipment cleaning operations, is not considered to be grounds for coverage under the storm water regulations.

Marine facilities that are "primarily engaged" in the retail sale of fuel and lubricating oils are best classified as SIC code 5541 - marine service stations - and are not covered under 40 CFR Section 122.26(b)(14)(viii) of the storm water permit application regulations. These facilities may also sell other merchandise or perform minor repair work.

Facilities "primarily engaged" in the operation of sports and recreation services such as boat rental, canoe rental, and party fishing, are best classified under SIC code 7999 - miscellaneous recreational facilities - and are not covered under 40 CFR Section 122.26(b)(14)(viii).

Category ix - Sewage Treatment Works

38. Are storm water permit applications required for offsite (i.e., physically separated from the main treatment works property) pumping stations?

No, storm water permit applications are not required for such sites.

39. Are separate permit applications required for vehicle maintenance/ washing facilities (located either onsite or offsite) associated with a wastewater treatment plant and owned/operated by the wastewater treatment agency?

Offsite vehicle maintenance facilities would not be required to submit applications unless they serve multiple clients since they do not fit the SIC codes listed in the transportation category of facilities engaged in industrial activity. Onsite vehicle maintenance/cleaning operations are associated with industrial activity and must be included in the application.

40. Do wastewater treatment facilities that collect their storm water runoff and treat the storm water as part of the normal inflow that is processed through the treatment plant have to apply for a permit?

No. If a facility discharges its storm water into the headworks of the treatment plant, it is essentially the same as discharging to a combined system or to a sanitary system and is therefore exempt from the requirements of 122.26(c).

41. The definition states that offsite areas where sludge is beneficially reused are not included as storm water discharges associated with industrial activity. How is beneficial reuse defined?

Beneficial sludge reuse is the application of sludge as a nutrient builder or soil conditioner. Examples include agricultural or domestic application.

Category x - Construction Activities

42. Is a construction site of five acres or more subject to the same deadline as other industrial facilities?

The individual application deadline for all storm water discharges associated with industrial activity is 10/1/92. If a construction activity is completed by 10/1/92, an application is not required.

43. What is the duration of an NPDES permit issued for a construction activity?

The permit will be effective as long the construction activity continues, but no longer than five years. If the construction continues beyond five years, the owner/operator must apply for a new permit.

44. Does the construction category only include construction of industrial buildings?

No. Any construction activity, including clearing, grading, and excavation, that results in the disturbance of five acres of land or more in total is covered by the rule. Such activities may include road building, construction of residential houses, office buildings, or industrial buildings, and demolition activity. However, this does not apply to agricultural or silvicultural activities, which are exempt from NPDES permit requirements under 40 CFR 122.4.

45. Does the rule require that storm water discharges after construction be addressed?

Yes. The individual application must describe proposed measures to control pollutants in storm water discharges that will occur after construction operations are complete, including a description of State and local erosion and sediment control specifications.

<u>Please Note</u>: **EPA believes that construction activities should be covered under a storm water general permit wherever possible. 40 CFR 122.21(c)(1) allows the permitting authority to establish different and shorter submittal dates under the specific terms of a particular general permit.**

46. The definition states that the operators of construction activity that disturb less than five acres are not required to apply for a permit unless that construction is part of a larger common plan of development or sale. What is meant by "part of a larger common plan of development or sale"?

"Part of a larger common plan of development or sale" is a contiguous area where multiple separate and distinct construction activities may be taking place at different times on different schedules under one plan. Thus, if a distinct construction activity has been identified onsite by the time the application would be submitted, that distinct activity should be included as part of the larger plan.

47. Who is responsible for applying for a storm water permit?

The operator is responsible for applying for the permit as required by 122.21(b). In the case of construction, the owner may submit an application for a construction activity if the operators have not yet been identified. However, once the operators have been identified, they must become either sole permittees or co-permittees with the owner. The operator is determined by who has day to day supervision and control of activities occurring at a site. In some cases, the operator may be the owner or the developer, at other sites the operator may be the general contractor.

Category xi - Light Industrial Facilities

48. If a category (xi) facility has determined that there is no exposure of certain activities or areas listed in the definition to storm water and the operator does not file a permit application, how does the operator prove, if asked, that he/she did not need to apply?

There are no requirements set forth under the November 16, 1990, rule. However, the operator may want to document the facility evaluation which led to the conclusion that there is no exposure to storm water. This documentation should be retained onsite. Some States may have specific requirements. A facility is advised to check with its NPDES permitting authority for additional requirements.

49. Do those industries listed in 122.26(b)(14)(xi) that only have access roads and rail lines exposed to storm water need to apply for a permit?

No. As stated in 122.26 (b)(14), facilities in category (xi) do not have to apply for a permit if storm water only is exposed to access roads and rail lines.

50. If air pollution control equipment vents on the roof are exposed to storm water, does this constitute exposure and trigger a permit condition?

No. The exposure of air pollution control equipment vents does not in itself constitute exposure. It is possible, however, that even with the use of air pollution control equipment, significant pollutants may be exposed to storm water. For example, if a cyclone, a common particulate control device, is used alone, only about 80 percent of the potential pollutants would be removed. 20 percent of the pollutants may then come into contact with storm water. In this case, a permit application is required.

51. If there has been past exposure, can a facility change its operation to eliminate exposure, and thus become exempt?

Yes. If a category (xi) facility can change its operation and eliminate all exposure, the facility may be exempt from the regulation. It is important to note, however, that eliminating exposure may include clean up as well.

52. Is a covered dumpster containing waste material kept outside considered exposure?

No, as long as the container is completely covered and nothing can drain out holes in bottom, or is lost in loading onto a garbage truck, this would not be considered exposure.

General Applicability

53. How is a storm water outfall from an industrial site defined for the purpose of sampling?

An industrial outfall is the point at which storm water associated with industrial activity discharges to waters of the United States or a separate storm sewer. Separate storm sewers may be roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains.

54. Are tank farms considered to be associated with industrial activity?

Yes, if they are located at a facility described in the definition of storm water discharge associated with industrial activity. Tank farms are used to store products and materials used or created by industrial facilities, and therefore are directly related to manufacturing processes. However, tank farms associated with petroleum bulk storage stations, classified as SIC code 5171, at which no vehicle maintenance or equipment cleaning operations occur, are exempt.

55. Is an offsite warehouse associated with a regulated industrial facility required to submit an application?

No. As stated on page 48011 of the preamble to the November 16, 1990, rule, warehouses of either preassembly parts or finished products that are not located at an industrial facility are not required to submit an application unless otherwise covered by the rule.

56. If a facility has more than one industrial activity, how many applications are required?

Only one application is required per facility. Permit conditions will address the various operations at the facility. The application must reflect all storm water discharges from areas associated with industrial activity as described in the definition at 122.26(b)(14). The activity in which a facility is primarily engaged determines what SIC code is assigned to that facility. To determine the activity in which a facility is primarily engaged, The SIC Manual recommends using a value of receipts or revenues approach. For example, if a facility manufactures both metal and plastic products, the facility would total receipts for each operation and the operation that generated the most revenue for the facility is the operation in which the facility is primarily engaged. If revenues and receipts are not available for a particular facility, the number of employees or production rate may be compared. If a facility performs more than two types of operations, whichever operation generates the most (not necessarily the majority) revenue or employs the most personnel, is the operation in which the facility is primarily engaged.

57. Are industrial facilities located in municipalities with fewer than 100,000 residents required to apply for a permit?

Yes. All industrial discharges of storm water through separate storm sewers or into waters of the United States must apply for an NPDES permit.

58. If the SIC code for the activity in which a facility is primarily engaged is not included in the definition of storm water discharge associated with industrial activity, but the facility has a secondary SIC code that is included in the definition, is the facility required to submit an NPDES storm water permit application?

For purposes of this regulation, a facility's SIC code is determined based on the primary activity taking place at that facility. In the case described above, the facility is not required to apply for an NPDES storm water discharge permit. However, if the facility conducts an activity on the site identified in the narrative descriptions of categories (i), (iv), (v), (vii), or (x), then the facility would be required to submit an NPDES storm water permit application for portions of the facility used for the activities described in those categories.

59. Are military bases or other Federal facilities regulated under this rule?

Yes. Industrial activities identified under 122.26(b)(14)(i)-(xi) that Federal, State, or Municipal governments own or operate are subject to the regulation.

60. Does the regulation require a permit for storm water discharges to a publicly owned treatment works?

No. A discharge to a sanitary sewer or a combined sewer system is not regulated under the storm water regulation. Storm water discharges either to waters of the United States or separate storm sewer systems require a permit if associated with any of the industrial facilities listed in 122.26(b)(i) - (xi).

61. Are there any limits or size restrictions which narrow the scope of facilities requiring an application?

The only restrictions regarding size are for construction activities and sewage treatment works. All construction activities must apply for permit coverage except for operations that disturb less than five acres of total land which are not part of a larger common plan of development or sale. Sewage treatment works designed to treat one million gallons per day or more must submit an NPDES permit application.

62. Do pilot plants or research and development facilities classified within one of the regulated SIC codes need to apply for a permit?

A pilot plant or research facility classified by an SIC code which is specified under 122.26(b)(14)(i)-(xi) would be required to submit an application. A pilot plant or research facility's operations can be directly related to the manufacturing operations of the full-scale facility and therefore warrant a permit.

63. Are stockpiles of a final product from an industrial site that are located away from the industrial plant site, included under the definition of storm water discharge associated with industrial activity?

Such stockpiles would not be covered because they are not located at the site of the industrial facility.

64. If a facility has a NPDES permit for its process wastewater and some, but not all, of its storm water discharges associated with industrial activity, does the operator need to apply?

The operator must ensure that all storm water discharges associated with industrial activity are covered by an NPDES permit. The operator may wish to submit an individual application, participate in a group application, or seek coverage under a general permit for any remaining outfalls that are not covered by an existing NPDES permit. The permitting authority may also wish to modify the existing NPDES permit to cover the other storm water discharges.

65. A facility holds a recently renewed NPDES permit which does not cover storm water discharges. Does that facility need to apply?

Yes. If the facility is identified in paragraph 122.26(b)(14)(i) through (xi) of the rule, that facility may wish to submit an individual application, participate in a group application, or seek coverage under a general permit for any remaining outfalls that are not covered by an existing NPDES permit. The permitting authority may also wish to modify or reissue the existing NPDES permit to cover the other storm water discharges.

66. If a regulated company owns and operates a subsidiary which is of a wholesale or commercial nature, would the subsidiary need to apply?

No. Since the subsidiary facility's operations are of a wholesale or commercial orientation, the operations are not considered to be industrial and therefore would not be covered by this rule unless they are specifically covered by one of the SIC codes or narrative descriptions in 122.26(b)(14).

67. Can an applicant claim confidentiality on information contained in an NPDES permit application?

No. Under 40 CFR 122.7(b), the permitting authority will deny claims of confidentiality for the name and address of any permit applicant or permittee, permit applications, permits, and effluent data.

68. Do the November 16, 1990, regulations modify the requirements of existing storm water effluent guidelines?

No. Existing storm water effluent guidelines are still applicable.

69. Which application forms are industries responsible for submitting?

- For discharges composed entirely of storm water, operators should submit Form 1 and Form 2F.

- For discharges of storm water combined with process wastewater, operators should submit Form 1, Form 2F, and Form 2C.

- For storm water discharged in combination with nonprocess wastewater, operators should submit Form 1, Form 2F, and Form 2E.

- For new sources or new discharges of storm water which will be combined with other non-storm water, operators should submit Form 1, Form 2F, and Form 2D.

70. Are Superfund sites regulated under this rule?

Yes, if the site is assigned an SIC code or fits the description of one of the categories listed in the definition of storm water discharge associated with industrial activity. Under the Superfund Amendment and Reauthorization Act (SARA) section 121(E), Superfund sites are required to "substantively comply" with all environmental regulations.

71. Are areas used for the disposal of industrial wastewaters and sanitary wastewaters included in the definition of "associated with industrial activity"?

Yes, the definition includes sites used for process water land application that are not used for agricultural activities.

72. Do inactive industrial facilities need to apply?

Yes, if the facility is included in the definition of storm water discharge associated with industrial activity and significant materials remain on site and are exposed to storm water runoff (p.48009 of 11/16/91 Federal Register). The regulation defines significant materials at 122.26 (b)(13) as including, but not limited to, raw materials; fuels; materials such as solvents, detergents, and plastic pellets; finished materials such as metallic products; raw materials used in food processing or production; hazardous substances designated under section 101(14) of the Comprehensive Environmental Response, Compensation, and Liability Act; any chemical the facility is required to report pursuant to section 313 of title III of SARA; fertilizers; pesticides; and waste products such as ashes, slag and sludge that have the potential to be released with storm water discharges.

73. Can a facility apply for an individual permit after completing the group application or applying for coverage under a general permit?

This option is available, but the operator is advised to discuss the matter directly with the permitting authority.

74. If a facility is totally enclosed with no materials or activities exposed to storm water, but has a point source discharge of storm water, is a permit application required?

If the facility is described in categories 122.26(b)(14)(i-x) a permit application is required regardless of the actual exposure of materials or activities to storm water. If the facility is described in 122.26(b)(14)(xi), a permit application is required only if there is exposure of materials or activities to storm water.

75. How does a municipally owned industrial facility apply for an NPDES permit?

Such a facility must meet the same application requirements as any other industrial facility. The facility may submit an individual permit application (Forms 1 and 2F), participate in a group application, or seek coverage under an available general permit.

76. Who is required to submit Form 1?

Anyone submitting NPDES application Forms 2C, 2D, 2E, 2F, or a construction individual application is required to submit Form 1.

77. Before the October 1, 1992, individual application deadline, which forms must a facility submit to renew its NPDES permit for a storm water discharge?

Since the individual storm water application is not due until October 1, 1992, EPA is allowing such facilities to choose whether the storm water discharges are identified on a Form 2C or a Form 2F. After October 1, 1992, a facility must submit an application in accordance with 40 CFR 122.26(c) (i.e., Forms 1 and 2F).

78. Are washwaters and/or noncontact cooling waters (e.g., air conditioner condensate) included in the definition of storm water?

No. "Storm water" means storm water runoff, snow melt runoff, and surface runoff and drainage. Washwaters are usually considered to be process wastewater. Noncontact cooling waters are considered a nonprocess wastewater.

NPDES
Storm Water Program

Question and Answer Document

Volume II

U.S. Environmental Protection Agency
Office of Wastewater Enforcement and Compliance
Permits Division
401 M Street, SW
Washington, DC 20460

July 1993

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USEFUL ACRONYMS

BAT	Best Available Technology
BCT	Best Conventional Technology
BMP	Best Management Practice
CFR	Code of Federal Regulations
CSO	Combined Sewer Overflow
CWA	Clean Water Act
CZARA	Coastal Zone Act Reauthorization Amendments
DMR	Discharge Monitoring Report
EPA	Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
FR	Federal Register
MS4	Municipal Separate Storm Sewer System
NOI	Notice of Intent
NOT	Notice of Termination
NPDES	National Pollutant Discharge Elimination System
NRDC	Natural Resources Defense Council
OMB	Office of Management and Budget
POTW	Publicly Owned Treatment Works
RCRA	Resource Conservation and Recovery Act
RQ	"Reportable Quantity" release
SIC	Standard Industrial Classification
TSDF	Treatment, Storage or Disposal Facility (hazardous waste)
TSS	Total Suspended Solids
WQA	Water Quality Act
WRDA	Water Resources Development Act

STORM WATER QUESTIONS AND ANSWERS PART II

I. General Applicability

1. **What kinds of storm water discharges are required to obtain an NPDES permit under Phase I of the storm water program?**

A. The National Pollutant Discharge Elimination System (NPDES) storm water permit application regulations, promulgated by the U.S. Environmental Protection Agency (EPA), require that the following storm water discharges apply for an NPDES permit: (1) a discharge associated with industrial activity; (2) a discharge from a large or medium municipal separate storm sewer system; or (3) a discharge which EPA or the State determines to contribute to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States. The permit application deadlines are specified in EPA's regulations.

2. **What is a "storm water discharge associated with industrial activity?"**

A. The term "storm water discharge associated with industrial activity" means a storm water discharge from one of the eleven categories of industrial activity defined at 40 Code of Federal Regulations (CFR) 122.26(b)(14)(i) through (xi). Five of these categories are identified by Standard Industrial Classification (SIC) code and the other six categories provide narrative descriptions of the industrial activity. The complete definition is included in Section XIII of this document.

If any activity at a facility is covered by one of the five categories which provide narrative descriptions, storm water discharges from that activity of facility are subject to storm water permit application requirements. If the primary SIC code of the facility is identified in one of the remaining six categories, the facility is subject to the storm water permit application requirements. Note that only those facilities/activities described above having point source discharges of storm water to waters of the United States or to a municipal separate storm sewer system or other conveyance are required to submit a storm water permit application. The definition of "point source" is provided at 40 CFR 122.2. The definition is included in Section XIII of this document.

3. **What are SIC codes and how can a facility find out its proper SIC code?**

A. SIC codes are four-digit industry codes that were created by the Office of Management and Budget (OMB) for statistical purposes. Other governmental organizations sometimes use these codes when classifying business establishments. To find the correct SIC code, an applicant might check his or her unemployment insurance forms or contact the appropriate State unemployment services department. In addition, applicants may consult the Standard Industrial Classification Manual (SIC Manual), published by OMB in 1987. This manual is available in the resource section of most public libraries. Questions regarding assignment of particular codes can be addressed to your State permitting authority. A list of telephone numbers and addresses for State storm water contacts is provided as an attachment to this document.

4. **What SIC code should a facility use when there are multiple activities occurring at the site?**

A. For the purposes of the storm water program, a facility must determine its primary SIC code based on the primary activity occurring at the site. To determine the primary industrial activity, the SIC Manual recommends using the value of receipts or revenues. If such information is not available for a particular facility, the number of employees or production rate for each process may be compared. The operation that generates the most revenue or employs the most personnel is the operation in which the facility is primarily engaged. For case-specific determinations, contact the permitting authority for your State.

5. **How is a facility regulated when multiple activities conducted by different operators are occurring on the same site (airports, for example)?**

A. When multiple activities are conducted by different operators at a single location, each industrial activity is assigned its own SIC code. At an airport, for example, a passenger airline carrier will receive one SIC code, but an overnight courier located in the same hanger may receive another SIC code. Whereas the SIC codes may differ, if both are regulated industrial activities, EPA generally encourages these operators to become co-applicants (submit storm water permit application forms together) when they are located at the same site and when industrial areas/drainage basins are shared. When a permit is issued (or if the operators are filing for a general permit) the co-applicants will become co-permittees and share responsibility of permit compliance.

6. **If a facility's primary SIC code is not listed in the regulations, but an activity that occurs on site is described in one of the narrative categories of industrial activity, does that facility have to apply for a permit?**

A. If a facility conducts an activity on the site identified in the narrative descriptions of categories (i), (iv), (v), (vii), (ix) or (x), then the facility would be required to submit a storm water permit application for discharges from those portions of the facility where the activity occurs. Such narrative activities/facilities include: (i) activities subject to storm water effluent limitations guidelines, new source performance standards, or toxic pollutant effluent standards; (iv) hazardous waste treatment storage, or disposal facilities including those that are operating under interim status or a permit under subtitle C of the Resource Conservation and Recovery Act (RCRA); (v) landfills, land application sites and open dumps that receive or have received industrial wastes; (vii) steam electric power generating facilities; (ix) sewage treatment works with a design flow of 1.0 mgd or more; and (x) construction activity disturbing five or more acres of land.

7. **Do storm water discharges from non-industrial areas at an industrial facility (employee parking lots, rental car operations at an airport) have to be addressed in an NPDES permit?**

A. No. Only storm water discharges from those areas that are associated with industrial activity, as defined at 40 CFR 122.26(b)(14) must be addressed in the permit. However, if storm water runoff from a non-industrial area commingles with runoff from a regulated industrial area, the combined discharge would require permit coverage.

8. **How are off site facilities (such as distribution centers, storage facilities, vehicle maintenance shops) regulated under the storm water program?**

A. To determine the regulatory status of off site facilities, first the operator of a facility must determine if that off site operation can be classified according to its own SIC code. If there is no SIC code which describes the off site facility independently, then it would assume the SIC code of the parent facility it supports. However, certain off site facilities that fall within the categories of auxiliary facilities described in Section XIV of this document (or which are specifically described in the SIC code description) would, in most cases, be classified according to the parent facility they support. Such supporting establishments include central administrative offices, research and development laboratories, maintenance garages, and local trucking terminals.

EPA has determined that off site vehicle maintenance facilities that service trucks used for local transportation of goods or for local services are generally considered supporting establishments which would not be assigned a transportation SIC code; rather, such facilities are classified according to the SIC code of the facility they support. Please refer to Section II of this document for a discussion of off-site vehicle maintenance facilities.

9. **Can authorized NPDES States be more expansive in their use of the assignment of SIC codes? For example, can they make the rule applicable to secondary activities?**

A. Yes, State storm water regulations can be more expansive and cover more activities than the Federal regulations.

10. **Are all storm water discharges to sanitary sewers exempt from storm water permitting requirements? What about discharges to combined sewer systems?**

A. Any storm water discharge to a Publicly Owned Treatment Works (POTW) or to a sanitary sewer is exempt from storm water permit application requirements. However, it may be subject to EPA's pretreatment program under Section 307(b) of the CWA. Discharges to combined sewer systems are also exempt from NPDES permitting but may be subject to pretreatment requirements.

11. **Is a storm water permit application required for an industrial facility that has constructed a holding pond that usually does not discharge storm water, but could in the event of a large enough storm?**

A. All point source discharges of storm water associated with industrial activity that discharge to waters of the U.S. or through a municipal separate storm sewer system must be permitted. Therefore, if an industrial facility does not have a storm water discharge from its holding pond during typical storm events but has a storm water discharge in the event of a large storm, that discharge must be covered under an NPDES permit. In NPDES authorized States (a list is provided in Section XII of this document), facilities should consult their permitting authority for State-specific determinations on such "potential discharges."

12. **If a facility is not engaged in industrial activity as defined under 40 CFR 122.26(b)(14)(i)-(xi), but discharges contaminated flows comprised entirely of storm water into a nearby municipal separate storm sewer system, is the facility required to obtain a storm water permit?**

A. No, unless EPA or the State designates the discharge as contributing to a violation of a water quality standard or as significantly contributing pollutants to waters of the United States. However, industrial dischargers should note that large and medium municipalities (population 100,000 or more) are currently designing storm water management programs that will control contaminated storm water discharges from entering their separate storm sewer systems. Additional storm water discharges may be regulated under Phase II of the storm water program. EPA is currently in the process of developing Phase II.

13. **Are activities associated with industrial activity that occur on agricultural lands exempted from storm water permitting requirements?**

A. No. If a storm water discharge is associated with industrial activity as defined at 40 CFR 122.26(b)(14), it is subject to permit application requirements regardless of the location of the industrial activity. For example, if a gravel extraction activity occurred on land leased from a farm, the activity would be classified as mining under SIC code 1442 or 1446 and therefore would be considered a storm water discharge associated with industrial activity and require a permit.

14. **Are NPDES permits transferable from one facility owner to the next?**

A. Individual NPDES permits may be transferred to a new owner or operator if the permit is modified. These procedures are described at 40 CFR 122.61. Under the general permits for storm water discharges, issued by EPA in the September 9, 1992 and September 25, 1992, Federal Register notices (57 FR 41176 and 57 FR 44412), the new operator can submit an NOI two days prior to the change of ownership but must include the facility's existing general permit number on the NOI form. Many NPDES authorized States have similar provisions in their general permits.

15. **How does storm water permitting differ in States with approved State NPDES programs compared to States without NPDES State permit programs?**

A. While Federal storm water regulations (i.e., the November 16, 1990, storm water permit application regulations) establish minimum requirements nationwide. State permitting authorities may impose more stringent requirements or decide to expand the scope of its program to meet State priorities. EPA Regional offices are the permitting authorities for 12 States and most Territories; the remaining 38 States and the Virgin Islands administer their own storm water programs and issue permits to regulate municipalities and industries in their States. Regulated facilities in these States should contact the appropriate State permitting authority for guidance, application forms, general permits and other materials. Please note that some of the NPDES States do not issue permits for Federal facilities located in their States.

For regulated facilities in the 12 non-delegated States (MA, NH, ME, FL, TX, OK, LA, NM, SD, AZ, AK, ID), the Territories (all except the Virgin Islands), the District of Columbia, and for facilities located on Indian lands (in most, if not all, delegated States and in all non-delegated States), and for Federal facilities in the States of DE, CO, IA, KS, NH, NY, OH, SC, VT and WA, the storm water program is administered through EPA Regional offices. Such facilities may be eligible for coverage under the general permits issued by EPA in the September 9, 1992, and September 25, 1992, Federal Register notices (57 FR 41176 and 57 FR 44412).

II. Definition of Storm Water Discharge Associated With Industrial Activity

Category (i): Facilities subject to storm water effluent limitations guidelines, new source performance standards or toxic pollutant effluent standards under 40 CFR subchapter N.

16. What are toxic pollutant effluent standards?

A. 40 CFR 122.26(b)(14)(i) includes facilities that are subject to storm water effluent limitations guidelines, new source performance standards, or toxic pollutant effluent standards. The phrase "toxic pollutant effluent standards" refers to the standards established pursuant to CWA section 307(a)(2) and codified at 40 CFR Part 129. Part 129 applies only to manufacturers of six specific pesticide products which are defined as toxic pollutants. Please note that the phrase "facilities subject to toxic pollutant effluent standards" does not refer to those industries subject to effluent limitation guidelines for toxics under 40 CFR subchapter N.

Category (iii): Mining and oil and gas operations classified as SIC codes 10-14.

17. What constitutes "contamination" at an oil and gas facility?

A. Oil and gas facilities classified as SIC code 13 are required to apply for a storm water permit if the facility has had a release of a Reportable Quantity (RQ) in storm water for which notification has been required any time since November 16, 1987, or if the discharge contributes to a violation of a water quality standard. RQs for which notification is required are defined at 40 CFR Parts 110, 117, and 302. An RQ for oil is defined at 40 CFR 110 as the amount of oil that violates applicable water quality standards or causes a film or sheen upon or a discoloration of the water surface or adjoining shorelines, or causes a sludge or emulsion to be deposited beneath the water surface or upon adjoining shorelines. For other substances, RQ levels are expressed in terms of pounds released over any 24 hour period and are listed at 40 CFR 117.3 and 40 CFR 302.4. A list of these RQ levels is available from the Storm Water Hotline at (703) 821-4823.

18. **Do EPA's industrial storm water general permits apply to discharges from mine sites that are subject to storm water effluent limitations guidelines, but which are not covered by an existing NPDES permit?**

A. No, storm water discharges from mine sites that are subject to storm water effluent limitation guidelines are not authorized by industrial storm water general permits issued by EPA in the September 9, 1992, and September 25, 1992, Federal Register notices (57 FR 41176 and 57 FR 44412). In States without NPDES permitting authority, the mine operators submit an individual application to address those storm water discharges, or could have participated in a group application prior to October 1, 1992 (note: any facility which did not submit an individual application prior to October 1, 1992 or participate in a timely group application missed EPA's regulatory deadline and may be subject to enforcement action). However, certain authorized States may issue general permits authorizing such storm water discharges from mine sites provided that those permits contain the applicable guideline requirements.

19. **Can point source discharges of contaminated ground water from mine adits and seeps at active or inactive mine sites be permitted under the storm water program?**

Point source discharges of non-storm water to waters of the United States must be authorized by an NPDES permit. Point source discharges of either contaminated ground water from a mine adit or seep that are not related to specific storm events would not be considered to be storm water. Discharges that are composed in whole or in part of non-storm water cannot be addressed solely by the permit applications for storm water (Forms 1 and 2F), and cannot be authorized by NPDES permits that only authorize discharges composed entirely of storm water. Rather, Forms 1 and 2C or 2D (and Form 2F if the discharge is mixed with storm water) must be used when applying for a NPDES permit for non-storm water.

Category (iv): Hazardous waste treatment, storage or disposal facilities.

20. **If the primary SIC code of a facility is not covered under the regulations, but there is a hazardous waste treatment, storage or disposal facility (TSDF) on site, is the TSDF subject to storm water permitting requirements?**

A. Yes. If the hazardous waste TSDF is or should be operating under interim status or a permit under Subtitle C of the Resource Conservation and Recovery Act (RCRA), regardless of the facility's primary activity, the storm water discharges from that portion of the site are subject to the narrative definition of storm water discharges associated with industrial activity under category (iv). Even if a facility's SIC code is not included in the regulations, any activity described by one of the narrative categories of "industrial activity" that is occurring on the site would be regulated under the storm water program.

Category (v): Landfills, land application sites and open dumps that receive industrial waste.

21. **At what point does an inactive, closed, or capped landfill cease being an industrial activity?**

A. An inactive, closed or capped landfill is no longer subject to storm water permit application requirements when the permitting authority determines the land use has been altered such that there is no exposure of significant materials to storm water at the site. For example, if an impervious surface (such as a parking lot or shopping center) now covers the closed landfill, the permitting authority could determine that storm water discharges from the area are no longer associated with the previous landfill activity. These determinations must be made by the permitting authority on a case-by-case basis.

22. **If construction of cells at a landfill disturbs greater than five acres of land, is coverage under EPA's construction general permits required?**

A. No. EPA considers construction of new cells to be routine landfill operations that are covered by the landfill's industrial storm water general permit. However, the storm water pollution prevention plan for the landfill must incorporate best management practices (BMPs) that address sediment and erosion control. Where a new landfill is being constructed and five or more acres of land are being disturbed, such activity would need to be covered under EPA's construction general permit until the time that initial construction is completed and industrial waste is received. Please note that NPDES authorized States may address this situation differently.

Category (viii): Transportation facilities

23. If all vehicle maintenance and equipment cleaning operations occur indoors at a transportation facility, as defined at 40 CFR 122.26(b)(14)(viii), is a permit application required for discharges from the roofs of these buildings?

A. Yes. Storm water discharges from all areas that are "associated with industrial activity," described at 40 CFR 122.26(b)(14), are subject to the storm water permit application requirements. This would include discharges from roofs of buildings that are within areas associated with industrial activity. In addition, storage areas of materials used in vehicle maintenance or equipment cleaning operations and holding yards or parking lots used to store vehicles awaiting maintenance are also considered areas associated with industrial activity.

24. For a facility classified as SIC code 5171 (bulk petroleum storage), is the transfer of petroleum product from the storage tanks to the distribution truck considered "fueling", and therefore an industrial activity as defined by the regulations?

A. No. The transfer of petroleum product from the storage tanks to the tanker truck is not considered fueling and would not require a storm water permit. However, fueling of the tanker truck itself at the 5171 facility is considered to be part of routine vehicle maintenance, and storm water discharges from these areas must be covered under a storm water permit application.

25. Is a retail fueling operation that occurs at an SIC code 5171 petroleum bulk storage facility regulated?

A. No. The provisions of 40 CFR 122.26(b)(14)(viii) apply to fueling operations conducted at petroleum bulk storage facilities where the vehicles being fueled are involved with the petroleum bulk storage operation. Retail fueling of vehicles at such sites does not constitute "vehicle maintenance" (as defined in the November 16, 1990 Federal

Register page 48066), and a storm water permit is not required for the discharges from that area. Only those portions of the SIC code 5171 facility where vehicle maintenance operations (including vehicle rehabilitation, mechanical repairs, painting, fueling, and lubrication) and equipment cleaning take place are required to be covered under a storm water permit application.

26. **Are off site vehicle maintenance areas required to submit permit applications for their storm water discharges?**

A. As discussed in Section I of this document, to determine the regulatory status of off site vehicle maintenance operations, the operator of a facility must first determine if that off site operation can be classified according to its own SIC code. If there is no SIC code which describes the off site facility independently, then it would assume the SIC code of the parent facility it supports. However, please note that off-site facilities that fall within the nine categories listed on page 17 of the SIC Manual (or which are specifically described in the SIC code description) would, in most cases, be classified according to the parent facility they support. See Section XIII of this document for the complete list. Such supporting establishments include central administrative offices, research and development laboratories, maintenance garages, and local trucking terminals. EPA has determined that off site vehicle maintenance facilities that primarily service trucks used for local transportation of goods or for local services are generally considered supporting establishments which do not assume a transportation SIC code; rather, such facilities are classified according to the SIC code of the facility they support. Long-distance trucking centers, on the other hand, are generally classified as SIC code 4213, and are subject to regulation under 40 CFR 122.26(b)(14)(viii)).

Category (x): Construction activity

27. **Who must apply for permit coverage for construction activities?**

A. Under the NPDES storm water program, the operator of a regulated activity or discharge must apply for a storm water permit. EPA clarified that the operator of a construction activity is the party or parties that either individually or taken together meet the following two criteria: (1) they have operational control over the site specifications (including the ability to make modifications in specifications); and (2) they have the day-to-day operational control of those activities at the site necessary to ensure compliance with plan requirements and permit conditions (9/9/92 Federal Register page 41190). If more than one party meets the above criteria, then each party involved must become a co-permittee with any other operator(s). For example, if the site owner has operational control over site specifications and a general contractor has day-to-day operational control of site activities, then both parties will be co-permittees.

When two or more parties meet EPA's definition of operator, each operator must submit an NOI, and either include a photocopy of the other operators' NOI(s) or the general permit number that was assigned for that project. Under EPA's storm water construction general permits, the co-permittees are expected to join in implementing a common pollution prevention plan prior to submittal of the NOI, and in the retention of all plans and reports required by the permit for a period of at least three years from the date that the site is finally stabilized.

For individual storm water discharge permits, applications must be filed 90 days prior to the commencement of construction. If a contractor has not been selected at the time of application, the owner of the project site would initially file the application and the contractor should sign on when selected. Under an individual storm water permit for construction, multiple operators would have to sign onto the permit, instead of submitting a new application. Please note that authorized NPDES States may have varying NOI and/or permit requirements and should be contacted on this issue.

28. What are the responsibilities of subcontractors at the construction site under EPA's storm water construction general permits?

A. EPA storm water construction general permits require subcontractors to implement the measures stated in the pollution prevention plan and to certify that he/she understands the terms and conditions of the permit requirements. Under EPA's general permits, subcontractors are not required to submit NOIs.

29. What is meant by a "larger common plan of development or sale?"

A. A "larger common plan of development or sale" is a contiguous area where multiple separate and distinct construction activities may be taking place at different times on different schedules under one plan. For example, if a developer buys a 20-acre lot and builds roads, installs pipes, and runs electricity with the intention of constructing homes or other structures sometime in the future, this would be considered a common plan of development or sale. If the land is parceled off or sold, and construction occurs on plots that are less than five acres by separate, independent builders, this activity still would be subject to storm water permitting requirements if the smaller plots were included on the original site plan.

30. **Does construction activity encompass repaving of roads?**

A. Repaving is not regulated under the storm water program unless five or more acres of underlying and/or surrounding soil are cleared, graded or excavated as part of the repaving operation.

31. **Is clearing of lands specifically for agricultural purposes regulated construction activity (40 CFR 122.26(b)(14)(x)) under the storm water program?**

A. No. Although the clearing of land may be greater than five acres, any amount of clearing for agricultural purposes is not considered an industrial activity under the storm water regulations. Section 402(l)(1) of the 1987 Water Quality Act exempts agricultural storm water discharges from NPDES permitting requirements including storm water permitting. This exemption only applies, however, if the clearing of land is solely for agricultural purposes. (See Question 13).

32. **If a construction activity that disturbs five or more acres commences on a site covered by an existing industrial storm water permit, are the storm water discharges from the construction area covered by the existing permit or is a separate permit required?**

A. If the existing permit is an individual permit, then the operator must either request a modification of the existing permit to include the construction storm water discharges or apply for coverage under a separate permit that specifically addresses that construction activity. If the permittee decides to modify the existing individual permit, permit modifications must be approved prior to initiating any construction activity. If the existing permit is an EPA storm water industrial general permit, the operator should submit an NOI for coverage under EPA's storm water general permit for construction activities. States with NPDES permitting authority may have different requirements.

33. **If a construction activity that disturbs less than five acres occurs on site of a regulated industrial activity currently covered by EPA's industrial storm water general permit, does the regulated industry have to modify its pollution prevention plan to include controls for the area of construction?**

A. Yes. Regulated industrial activities covered by EPA's storm water industrial general permit must revise their pollution prevention plan to address all new sources of pollution and runoff including those from construction activities disturbing less than five acres, that occurred on the site of the regulated industry. However, if less than five acres, a separate storm water permit for the construction activity is not required (see Question 32).

34. **For projects such as a 100-mile highway construction project, what location should be provided on the NOI?**

A. The midpoint of a linear construction project should be used as the site location on EPA's NOI form. For construction projects that span across more than one State, the project must meet the application requirements of each State.

35. **Are long-term maintenance programs for flood control channels (such as vegetation removal) or similar roadside maintenance programs subject to permitting if five or more acres are disturbed?**

A. If grading, clearing or excavation activities disturb five or more acres of land either for an individual project or as part of a long-term maintenance plan, then the activity is subject to storm water permit application requirements.

36. **For a construction activity that uses off site "borrow pits" for excavation of fill material or sand and gravel, should the number of disturbed acres at the borrow pit be added to the number of acres at the construction site to determine the total number of disturbed acres?**

A. No, off site borrow pits are not considered part of the on site construction activity. If a borrow pit is specifically used for the removal of materials such as sand, gravel, and clay, the pit is considered a mine and is classified under SIC code 14. Such sites would be regulated as industrial activity as defined at 40 CFR 122.26(b)(14)(iii). However, if the borrow pit is utilized for the removal of general fill material (e.g. dirt) and disturbs five or more acres of land, the pit would be considered a construction activity as defined at 40 CFR 122.26(b)(14)(x).

37. **Would building demolition constitute a land disturbing activity and require a storm water construction permit application?**

A. The definition of land disturbing activity includes but is not limited to clearing, grading and excavation. At a demolition site, disturbed areas might include the site where building materials, demolition equipment, or disturbed soil are situated, which may alter the surface of the land. Therefore, demolition activities that disturb five or more acres of land would be subject to storm water construction permit application requirements.

38. **What are the legal responsibilities and liabilities for construction activities disturbing less than five acres, pursuant to the Ninth Circuit U.S. Court of Appeals decision on June 4, 1992?**

A. In NRDC v. EPA, 966 F.2d 1292, the Ninth Circuit U.S. Court of Appeals remanded for further rulemaking, EPA's exemption of construction sites less than five acres which are not part of a larger common plan of development or sale. The Agency intends to undergo further rulemaking proceedings for construction sites less than five acres. Until further rulemaking is completed, permit applications for such activities need not be submitted to EPA. However, States with NPDES permitting authority may have more stringent requirements.

39. **Do storm water construction general permits authorize non-storm water discharges?**

A. Under EPA's storm water construction general permits, issued on September 9, 1992, and September 25, 1992, the following non-storm water discharges are conditionally authorized (57 FR 41219) and (57 FR 44419): discharges from fire fighting activities; fire hydrant flushings; waters used to wash vehicles or control dust; potable water sources including waterline flushings; irrigation drainage; routine external building washdown which does not use detergents; pavement washwaters where spills or leaks of toxic or hazardous materials have not occurred (unless all spilled material has been removed) and where detergents are not used; air conditioning condensate; springs; uncontaminated ground water; and foundation or footing drains where flows are not contaminated with process materials such as solvents. These discharges, except for flows from fire fighting activities, must be identified in the pollution prevention plan and the plan must address the appropriate measures for controlling the identified non-storm water discharges. Other non-storm water discharges not listed above or not identified in the storm water pollution prevention plan, must be covered by a different NPDES permit.

Category (xi): Light manufacturing facilities

40. **If oil drums or contained materials are exposed during loading or unloading at a category (xi) facility, are storm water discharges from this area subject to the storm water regulations?**

A. The storm water regulations require category (xi) facilities to apply for a storm water permit where material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, or industrial machinery are exposed to storm water. If there is a reasonable potential for leaks or spills from these drums which could be exposed to storm water, discharges from that area would be subject to storm water permitting requirements. Completely covering loading and unloading activities may eliminate exposure. Note that permitting authorities may have more stringent interpretations with respect to exposure on industrial sites and should be consulted for case-by-case determinations. For a discussion on the 9th Circuit Court of Appeals decision (June 1992) and future EPA rulemakings on category (xi) facilities, please refer to Section IX of this document.

41. **Does the storage of materials under a roof at a category (xi) facility constitute exposure?**

A. If materials or products at a light industrial facility are stored outside under a roof and there is no reasonable potential for wind blown rain, snow, or runoff coming into contact with the materials or product, then there may not be exposure at that area. However, if materials are stored under a structure without sides and storm water comes into contact with material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products or industrial machinery, the discharge from that area must be permitted. The permitting authority should be contacted for specific issues related to exposure.

III. Individual Permits

42. **Will individual permits include requirements for storm water pollution prevention plans and monitoring?**

A. EPA anticipates that many individual permits will include storm water pollution prevention plans as a means of satisfying Best Available Technology (BAT)/Best Conventional Technology (BCT) requirements established in the Clean Water Act (CWA). With regard to monitoring requirements under individual permits, such requirements will be determined by the permit writer on a case-by-case basis. At a minimum, all facilities with storm water discharges associated with industrial activity must conduct an annual site inspection as prescribed at 40 CFR 122.44(i)(4).

43. **Do permitting authorities have the option of subjecting facilities that have submitted individual storm water permit applications to general permits?**

A. Yes, permitting authorities may subject facilities that have submitted individual permit applications to general permits. Facilities that are covered by a general permit may petition the permitting authority to be covered under an individual permit by submitting an individual permit application with reasons supporting the request to the permitting authority, pursuant to 40 CFR 122.28(b)(2)(iii).

44. **What are the benefits/drawbacks of pursuing an individual storm water permit over a general permit?**

A. An individual storm water permit may be advantageous, as it is designed to reflect a facility's site-specific conditions, whereas general permits are much broader in scope, particularly in terms of monitoring requirements. However, the individual permit application is generally more difficult to prepare than submitting EPA's notice of intent (NOI) to be covered under a general permit (in part because the individual permit application requires sampling and EPA's NOI does not). General permits may be advantageous because regulated facilities know, in advance of submitting their NOI, the requirements of the permit. In addition, coverage under a general permit may be automatic (depending on how the permit is written), whereas the individual permitting process takes longer.

45. **When does EPA anticipate that individual permits will be issued?**

A. Issuance of individual permits may vary on a State by State basis, as permitting priorities and resources allow. The December 18, 1992, Federal Register (57 FR 60447) established October 1, 1993, as the deadline by which individual permits are to be issued. Many authorized States are already issuing individual permits.

46. **Can a facility that has submitted an individual permit application obtain general permit coverage upon issuance of a general permit in its State?**

A. Yes, an eligible facility may opt for coverage under a general permit (by submitting an NOI) up until the time that the permitting authority issues such facility its individual permit. Authorized States may require a written request for withdrawal from the individual permit application process. EPA recommends submitting such requests to the appropriate Regional office.

IV. EPA General Permits (issued on 9/9/92 and 9/25/92)

47. **What is the difference between EPA's construction and industrial general permits?**

A. Because the nature of construction activity varies considerably from other industrial activities, EPA developed two separate general permits: one covering storm water discharges from construction activity and one for other storm water industrial discharges. Whereas the pollution prevention plan for the construction permit focuses on sediment and erosion controls and storm water management, the pollution prevention plan for industry emphasizes general site management. Note that some authorized States have industrial general permits that authorize storm water discharges from construction activity.

EPA's general permits for storm water discharges associated with industrial activity, issued on 9/9/92 (57 FR 41236) and 9/25/92 (57 FR 44438), authorize storm water discharges from all new and existing point source discharges of storm water associated with industrial activity, as defined at 40 CFR 122.26(b)(14), to waters of the U.S., except for ineligible storm water discharges that are listed at I.B.3. (9/9/92 Federal Register page 41305) and
(9/25/92 Federal Register page 44444) in EPA's general permits.

EPA's general permits for storm water discharges associated with construction activity, which were issued on 9/9/92 (57 FR 41176) and 9/25/92 (57 FR 44412), authorize storm water discharges associated with construction activity, as defined at 40 CFR 122.26(b)(14)(x), except for ineligible discharges that are listed at I.B.3 (9/9/92 Federal Register page 41217) and (9/25/92 Federal Register page 44418) in EPA's general permits.

48. **What is the procedure for applying for coverage under EPA's Industrial or construction general permits?**

A. Dischargers of storm water associated with industrial activity located in non-NPDES States must submit a Notice of Intent (NOI) to be authorized to discharge under the general permit. The NOI form is a one-page document requesting basic information about the nature of the facility and the particular storm water discharge under consideration. Under EPA's general permits, monitoring is not required for submittal of the NOI. States with NPDES authority may have different requirements for their NOI and should be contacted directly.

49. **Will a facility automatically be covered by an EPA general permit upon submittal of an NOI or will it have to cease operations until the Agency provides notification of acceptance?**

A. Permit coverage begins two days after the postmark date on the NOI, provided the storm water discharges from the facility are eligible for coverage as established by the permit conditions (see 9/9/92 Federal Register page 41305 for limitations on coverage). The permitting authority can require the submittal of an individual application at any time. However, the facility may continue to discharge under the general permit until an individual permit is issued or denied.

50. **What are the deadlines for compliance with EPA's general permits?**

A. Individuals who intend to obtain coverage for a storm water discharge associated with industrial activity that commenced on or before October 1, 1992, were required to submit an NOI by October 1, 1992; however, EPA is accepting late NOIs. Regulated facilities wishing to obtain coverage under the general permit that have not yet submitted an NOI should do so immediately. EPA's storm water general permits require permittees to develop and implement a storm water pollution prevention plan. Deadlines for NOI submittal and development and implementation of plans are listed in the table below.

Facilities with salt storage or facilities that were not required to report under Emergency Planning Community Right to Know (EPCRA) Section 313 prior to July 1, 1992, (but must report after that date) must comply with the special requirements for section 313 facilities and salt storage (if applicable) within 3 years of the date on which the facility is required to first report under section 313. All other conditions in the permit must be met within the deadlines listed above. Plans do not have to be submitted to the Agency but must be kept on site and made available upon request.

Type of Discharge	NOI Deadline	Pollution Prevention Plan Development Deadline	Pollution Prevention Plan Implementation Deadline
Existing industrial activities (other than construction)	October 1, 1992	April 1, 1993	October 1, 1993

Type of Discharge	NOI Deadline	Pollution Prevention Plan Development Deadline	Pollution Prevention Plan Implementation Deadline
Industrial activities (other than construction) that begin between October 1, 1992 and January 1, 1993	2 days prior to the start of industrial activity	Within 60 days of commencement of operations	Within 60 days of commencement of operations
Industrial activities (other than construction) that begin on or after January 1, 1993	2 days prior to the start of industrial activity	Within 60 days of commencement of operations	Upon commencement of operations
Oil and gas facilities previously not required to be permitted that have an RQ after October 1, 1992	Within 14 days of first knowledge of the release	Within 60 days of first knowledge of the release	Within 60 days of first knowledge of the release
Municipally-owned or operated industrial activities that were rejected or denied from a group application	Within 180 days of the date of rejection or denial	Within 365 days of the date of rejection or denial	Within 545 days of the date of rejection or denial
Construction sites in operation on October 1, 1992	October 1, 1992	October 1, 1992	October 1, 1992
Construction sites that begin operation after October 1, 1992	2 days prior to the start of construction	Prior to the submittal of the NOI	With the initiation of construction activities

51. **Is there a fee for NOI applications?**

A. EPA's general permits do not require fees at this time. However, authorized NPDES States may levy fees and should be contacted directly.

52. **Where should NOIs be submitted?**

A. Facilities in States and Territories where EPA is the permitting authority submit NOIs to the central processing center at the following address:

Storm Water Notice of Intent
P.O. Box 1215
Newington, VA 22122.

All permittees in States with NPDES authority submit the NOI to their State permitting authority except those in New York, who submit to the processing center at the above address. Note that authorized NPDES States may develop NOI forms that are different from EPA's NOI form. Under EPA's general permits, the operator of any industrial activity that discharges storm water through a municipal separate storm sewer system in a medium or large municipality must also submit a copy of the NOI to that municipality. In addition, operators of construction activities must provide a copy of all applicable NOIs for a site to the local agency approving sediment and erosion plans or storm water management plans.

53. **Is an operating regulated industrial facility required to submit a separate NOI for each outfall that discharges storm water associated with industrial activity at the site?**

A. Under EPA's general permits, one NOI is generally sufficient for the entire site, provided there is one operator. In this case, the pollution prevention plan must address all discharges of storm water associated with industrial activity from the site. If there are multiple operators at the site, each operator must submit an NOI. In addition, if a facility that is covered under EPA's industrial storm water general permit undertakes a construction activity disturbing more than five acres of land, then the facility must submit an NOI for those construction-related storm water discharges for coverage under EPA's construction general permit (or submit an individual permit application).

54. **Will a facility receive any notification from EPA after submitting an NOI under EPA's general permit?**

A. Yes, EPA confirms the receipt of NOIs and will provide the applicant with a permit number and explains how to get a summary of the guidance on preparing storm water pollution prevention plans.

55. **Is an entire facility excluded from coverage under EPA's general permits if a single discharge at the site is excluded from coverage?**

A. No. Eligibility under EPA's general permits should be applied on a discharge-specific basis. Thus, a site with multiple discharges can be covered under two different permits: a general permit for some discharges and a separate NPDES permit for any discharges excluded from coverage under the general permit. NPDES States should be contacted for additional guidance on this issue.

56. **Does an industrial facility operating under an EPA industrial general permit have to apply for a separate permit for all on site construction activities that disturb more than five acres of land?**

A. Storm water discharges from construction activities that disturb five or more acres of land must be covered under a separate NPDES permit that specifically addresses storm water discharges from construction activity. EPA's industrial storm water general permits do not provide coverage for storm water discharges from regulated construction activities. Construction activities that disturb less than five acres of land do not require a storm water permit at this time. The pollution prevention plan for the industrial facility must be modified to address site changes due to that amount of construction activity.

57. **Can a facility submit one NOI for similar but separately located industrial facilities which are owned by the same corporation?**

A. No. One NOI must be submitted by the operator of each individual facility that intends to obtain coverage under a general permit, regardless of common ownership.

58. **Does an asphalt/concrete batch plant have to submit a new NOI each time it changes location?**

A. Under EPA's general permits, an NOI must be submitted each time the plant moves to a new site of operation. However, some authorized States may have different requirements with respect to asphalt/concrete batch plants and, therefore, facilities in such States should contact their permitting authorities.

59. **Who is required to monitor under the conditions of EPA's storm water general permits?**

A. EPA established tiered monitoring requirements in its final industrial storm water general permits based on the potential to contribute pollutants to storm water (4/2/92 Federal Register page 11394). Six classes of facilities are required to monitor semiannually and report annually, ten classes of facilities are required to monitor annually and keep the data on site, and all other classes of facilities are not required to monitor. All facilities authorized by general permits (including those facilities not otherwise required to monitor) must still conduct an annual site inspection, except for inactive mining sites where this may be impractical due to remote location and inaccessibility of sites (inspection no less than once in three years). The sixteen classes of facilities that are required to monitor are specified in EPA's industrial general permits (9/9/92 Federal Register page 41248), which are available from the Storm Water Hotline. EPA's construction storm water general permits require periodic inspections in lieu of monitoring.

60. **If an industrial facility that is required to monitor under EPA's industrial storm water general permits does not have any exposure of materials or activities to storm water, does it still have to conduct sampling?**

A. Under EPA's industrial storm water general permits, industrial facilities can provide a certification in lieu of monitoring results for a given outfall, that materials and activities are not presently exposed to storm water and will not be exposed during the certification period (see 9/9/92 Federal Register page 41314 for a more detailed description). This determination should be applied on outfall-by-outfall basis (e.g., permittees may elect to monitor certain outfalls while providing certification for others). The certification must be updated on an annual basis and retained in the pollution prevention plan. The six classes of facilities that are required to report monitoring results annually must submit this certification to the permitting authority in lieu of the Discharge Monitoring Report (DMR).

61. **Within one drainage area leading to a single outfall, if a facility conducts two separate industrial activities that are subject to both semiannual and annual monitoring requirements, which set of monitoring requirements will apply?**

A. If the discharges cannot be segregated, the combined discharge would be subject to both sets of monitoring requirements. In effect, a combined discharge could be subject to annual monitoring requirements for certain parameters and semi-annual monitoring for others. If a facility can segregate the discharges from the different activities, separate monitoring requirements would apply to each discharge.

62. **Is it possible to sample only one of several identical outfalls under the provisions of EPA's general permits?**

Yes. To reduce the monitoring burden on the facility, the permit allows an operator to sample one outfall where it is substantially identical to the other outfalls. Permittees that intend to use this provision must justify and document in writing why one outfall is substantially identical to the others. Criteria for making this determination are presented in the NPDES Storm Water Sampling Guidance Document. Facilities using this provision must include the written justification in their storm water pollution prevention plan. Facilities that are subject to semiannual monitoring requirements must submit the justification of why an outfall is substantially identical to the others with the Discharge Monitoring Report. Other facilities required to monitor under the permit are not required to submit the justification unless it is requested by the permitting authority.

63. **If a facility had to report under section 313 of the Emergency Planning and Community Right to Know Act (EPCRA) when its NOI was submitted but no longer uses the quantity of water priority chemicals that makes such reporting necessary, is that facility still subject to special requirements in EPA's industrial storm water general permits for facilities that handle EPCRA section 313 water priority chemicals?**

A. No. Such facilities are no longer subject to the special EPCRA requirements contained in EPA's industrial storm water general permit and should accordingly modify their pollution prevention plan to indicate the changes in industrial activity at the facility.

64. **Under EPA's general permits, when and where must Discharge Monitoring Reports (DMR) be submitted for semi-annual monitoring facilities?**

A. DMRs must be submitted to the permitting authority according to the following schedule: a) certain EPCRA section 313 facilities and wood treatment facilities monitor from January to June and July to December and report no later than January 28 following the second monitoring period; b) Primary metal facilities, facilities with coal pile runoff, and battery reclaimers monitor from March to August and September to February and report no later than April 28; and c) land disposal facilities monitor from October to March and from April to September and report no later than October 28. For facilities in non-NPDES States, DMRs must be submitted to the EPA Regional office (Section XI of this document includes storm water list of contacts for addresses). In States with approved NPDES permit programs, DMRs must be sent to the location specified in the State's general permit. The general permits in such States may also have different schedules for submitting DMRs than the one specified above.

65. **Under the industrial general permit, coal-fired steam electric facilities have annual monitoring requirements for storm water discharges from coal handling sites (other than from coal pile runoff). Are access roads considered coal handling sites?**

A. Coal handling sites include those areas of the facility where coal is either loaded or unloaded. Therefore, those portions of access roads where loading/unloading operations do not occur are not considered to be coal handling sites and, therefore, are not subject to annual monitoring requirements under EPA's general permits.

66. **Are there specific numeric effluent limits in EPA's storm water general permits?**

A. EPA's general permits establish pollutant discharge limits for total suspended solids (TSS) and pH in coal pile runoff. In most other situations, EPA's industrial storm water general permits focus on storm water management and the implementation of facility-specific pollution prevention plans; however, EPA's industrial general permits also include State-specific conditions that may include additional numeric effluent limits.

67. **What is a storm water "best management practice" (BMP)?**

A. A BMP (defined at 9/9/92 Federal Register page 41319) is a technique, process, activity or structure used to reduce the pollutant content of a storm water discharge. BMPs include simple, nonstructural methods such as good housekeeping and preventive maintenance. Additionally, BMPs may include sophisticated, structural modifications such as the installation of sediment basins. The focus of EPA's general permits is on preventative BMPs which limit the release of pollutants into storm water discharges. EPA has published guidance materials to assist in the selection of appropriate BMPs in the preparation of storm water pollution prevention plans, including: *Storm Water Management for Industrial Activities: Developing Pollution Prevention Plans and Best Management Practices (PB-92-235969)* and *Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices (PB-*

92-235951). These Manuals are available from NTIS at (703) 487-1650 and the Office of Water Resource Center at (202)260-7786.

68. **What should a facility do when the nature of its activities changes?**

A. When the nature of a facility's activities changes, the facility must modify the pollution prevention plan accordingly. If the facility is subject to new monitoring requirements as a result of the changes, sampling must begin at the start of the next monitoring period.

69. **Is there a procedure for notifying EPA when a storm water discharge associated with industrial activity covered by EPA's general permit has been eliminated?**

A. Yes. EPA's general permits include procedures for filing a Notice of Termination (NOT) form when there is no longer a potential for storm water discharges associated with industrial activity to occur. Operators of construction activities can submit an NOT once they have finally stabilized all areas that were disturbed. For construction activity, final stabilization means that all soil disturbing activities at the site have been completed, and that a uniform perennial vegetative cover has been established or equivalent permanent stabilization measures (such as the use of riprap, gabions, or geotextiles) have been employed with a density of 70% of the previously existing/background cover for unpaved areas and areas not covered by permanent structures. A copy of the NOT can be found in Federal Register notices dated September 9, 1992 (57 FR 41232 and 41341), and September 25, 1992 (57 FR 44434 and 44469).

70. **If a NPDES authorized State has general permitting authority but has not yet finalized an applicable general permit, can a facility still submit an NOI and assume general permit coverage?**

A. No, a facility cannot submit an NOI to obtain coverage under a general permit until that permit has been finalized. Furthermore, a facility located in an NPDES State cannot seek coverage under one of EPA's general permits.

71. **Will State general permit requirements vary and to what extent?**

A. General permit requirements for authorized NPDES States may vary considerably because these States develop and issue permits independently from EPA. However, all NPDES permits must meet minimum technical and water quality-based requirements of the Clean Water Act. Permittees in NPDES authorized States should consult with their permitting authorities regarding particular State conditions. Under EPA's storm water general permits, State-specific requirements vary because of different water quality concerns in different States. Each of the 12 non-authorized States and Territories provided certification that EPA's general permits comply with State water quality standards, and added permit requirements where necessary to achieve compliance with those standards in the final general permits.

72. **Can discharges from industrial areas at a construction site such as portable asphalt plants and/or concrete batch plants be covered under EPA's construction general permits?**

A. No. EPA's construction general permits only authorize discharges from the construction area; these permits do not authorize storm water discharges from industrial activities other than construction that are located on the construction site. Portable asphalt plants and/or concrete batch plants are considered to be "industrial activity," as defined 40 CFR 122.26(b)(14)(ii). Therefore, storm water discharges from such industrial activities must be in compliance with a general or individual storm water permit for industrial storm water discharges other than construction. At a construction site which disturbs less than 5 acres of land (and which is, therefore, not subject to storm water permit application requirements for the construction activity), the operator of the mobile asphalt or concrete plant still would be required to obtain storm water permit coverage for discharges from the plant. Please note that States with approved NPDES permit programs may allow portable asphalt plants and/or cement batch plants to be covered under the State's construction general permit.

V. Group Applications

73. **How will group applicants be permitted?**

A. EPA is currently developing a model permit using information from Part I and Part II group applications, and other sources. This model permit will have sections which address a particular type of industrial activity. When the model permit is completed, the permitting authority (EPA or NPDES States) then has the option to propose and issue final permits to cover group members within their state based upon the model permit.

VI. Sampling

74. **For what parameters does a facility have to sample under the individual or group application?**

A. Applicants are required to obtain quantitative data from samples collected during storm events from all outfalls that discharge storm water associated with industrial activity for the following parameters: (1) any pollutant limited in an effluent guideline to which the facility is subject; (2) Any pollutant listed in the facility's permit for its process wastewater [if the facility is operating under an existing NPDES permit]; (3) Oil and grease, pH, BOD5, COD, TSS, total phosphorous, total Kjeldahl nitrogen, and nitrate plus nitrite nitrogen; (4) certain toxic pollutants listed in Tables II and III of the Appendix D to 40 CFR Part 122 (also listed as Tables 2F-2 and 2F-3 in the instructions for Form 2F) that are expected to be present in the storm water.

75. **For an individual or group application, how many aliquots (portions) of storm water are needed to obtain a flow-weighted composite?**

A. A flow-weighted composite may be taken as a combination of a minimum of 3 sample aliquots taken in each hour of discharge for the entire event or for the first three hours of the event, with each aliquot collection being separated by a minimum of 15 minutes. If the storm event lasts less than three hours, aliquots should be collected for as long as there is sufficient flow. Large and medium municipalities may use a different protocol with respect to time duration between collection of aliquots with approval of the permitting authority. EPA's *NPDES Storm Water Sampling Guidance Document* discusses several ways to estimate flows. [This manual is available from the Storm Water Hotline (703) 821-4823) and the Office of Water Resource Center (202)260-7786].

76. **How does a facility measure flow if there are numerous small outfalls?**

A. Applicants may provide either measurements or estimates of storm water flows. One possible method for estimating flow is to create a conveyance that would combine flows from many of the outfalls. Alternatively, where flows are similar, the flow at one outfall may be measured to calculate flows at the other outfalls, provided that the method of measurement is indicated to the permitting authority. EPA's *NPDES Storm Water Sampling Guidance Document* discusses several ways to estimate flows. [This manual is available from the Storm Water Hotline (703) 821-4823) and the Office of Water Resource Center (202)260-7786.]

77. **For what parameters is only a grab sample appropriate?**

A. When collecting storm water samples, grab samples are required for the following parameters: pH, temperature, cyanide, total phenols, residual chlorine, oil and grease, fecal coliform and fecal streptococcus. Both grab and composite samples are required for all other pollutants.

78. **Do both a grab and a composite sample have to be taken from a 24-hour holding pond?**

A. No. Only a minimum of one grab sample is required to be taken for effluent from holding ponds or other impoundments with a retention period of greater than 24 hours for the representative event.

79. **Can composite and grab samples be taken from separate events?**

A. Grab and composite samples for a given outfall should be taken from the same storm event to provide a basis for comparing the data. If this is impossible, information describing each storm event used for sample collection should be recorded and submitted with sampling results. However, applicants are advised that the permitting authority may request data to be collected from only one storm event.

80. **Is a facility required to sample all of its outfalls during a single storm event?**

A. No. Unless otherwise specified by the permitting authority, a facility may sample outfalls during different events provided that the storms meet the criteria established in the application regulations or in the applicable permit language. Information describing each storm event used for sample collection should be recorded and submitted with sampling results.

81. **If a facility has two conveyances that join and leave the site as one combined discharge, where should a sample be collected?**

A. If the discharge is composed entirely of storm water, the sampling point should be at the outfall as it leaves the property. If the discharge is a combination of process wastewater and storm water, the storm water component of the discharge should be sampled before it commingles with the process waste water discharges. If sampling at an outfall at the property boundaries is impossible because of safety reasons, inaccessibility, or a poor conveyance, sampling may be done closer to the discharge source.

82. **How long of a 'dry' period does a facility need before sampling?**

A. A 'dry' period needs to be at least 72 hours. More specifically, all samples must be collected from the discharge resulting from a storm event that occurs at least 72 hours from the previously measurable (greater than 0.1 inches) storm event.

83. **If two or more outfalls at a facility have identical discharges, does each outfall have to be sampled?**

A. Where a facility has outfalls that discharge "substantially identical effluent," the permitting authority may allow the applicant to test only one outfall and report that the quantitative data are representative of the substantially identical outfalls. EPA's *NPDES Storm Water Sampling Guidance Document* (available from the Storm Water Hotline (703-821-4823)) provides information on how to prepare this petition, or the applicant should contact their permitting authority to determine what information is required.

84. **Do analyses for storm water need to be done by a certified lab?**

A. There is no Federal requirement to use a certified lab. However, certain States may require that a certified lab be used. Please note, analyses must comply with the analytical procedures set out in 40 CFR Part 136, as discussed below.

85. **What analytical methods must be used for the pollutants for which sampling is required?**

A. EPA-approved methods must be used where a method for a pollutant has been promulgated. 40 CFR Part 136 discusses required methods. If there is no approved method, the applicant may use any suitable method, but must provide a description of the method in its application. Additional information on general sampling issues can be obtained through the EPA's *NPDES Storm Water Sampling Guidance Document.* The manual is available from the Storm Water Hotline (703-821-4823).

VII. Municipal Permit Applications

86. **Once a municipal separate storm sewer system (MS4) has submitted Part 2 of its storm water permit application, when does the term of the permit actually begin?**

A. The term of the permit begins when a permit is issued by the permitting authority. Pursuant to 40 CFR 122.26(e)(7), storm water permits for discharges from MS4s are to be issued with in one year after submission of a complete application. Since applications for medium and large municipal separate storm sewer systems were due on May 17, 1993 and November 16, 1992, respectively, this results in permit issuance by November 16, 1993 for large municipalities and by May 17, 1994 for medium municipalities.

87. **How is EPA incorporating 1990 census data into the storm water program?**

A. Most of the municipalities that meet the definition of either a large or medium MS4 based on the results of the 1990 Census have already begun to seek an NPDES permit. Headquarters is working with the Regions and States to determine the best way to incorporate the remaining municipal entities into the program.

88. **How does EPA envision the relationship between large and medium MS4 operators and NPDES permitting authorities in terms of addressing industrial storm water discharges to MS4s?**

A. EPA envisions a partnership between NPDES permitting authorities and operators of large and medium municipal separate storm sewer systems in controlling pollutants in storm water discharges associated with industrial activity through MS4s. In addition, NPDES storm water permits provide a basis for enforcement actions directly against the owner or operator of the storm water discharge associated with industrial activity.

A second NPDES permit will be issued to the operator of the large and medium MS4. This permit will establish the responsibilities of the municipal operators in controlling pollutants from storm water associated with industrial activity which discharges through their municipal system. Under this approach, municipal operators will be able to:

- Assist EPA in identifying priority storm water discharges associated with industrial activity through their system;
- Assist EPA in reviewing and evaluating storm water pollution prevention plans that industrial facilities are required to develop; and
- Assist EPA in compliance efforts regarding storm water discharges associated with industrial activity to their municipal system.

A more complete description of this policy is provided in the August 16, 1991 Federal Register (56 FR 40973).

VIII. The Intermodal Surface Transportation Efficiency Act of 1991 (Transportation Act)

89. **How did the Transportation Act affect permitting requirements for municipalities under 100,000?**

A. Storm water discharges from certain industrial activities owned or operated by municipalities with a population of less than 100,000 people were granted a moratorium from the October 1, 1992 deadline for storm water permit applications. Exceptions to this moratorium include discharges from powerplants, airports and uncontrolled sanitary landfills.

90. **How does the Transportation Act impact privately owned or operated industrial activities located in municipalities under 100,000?**

A. The provisions of the Transportation Act specifically address publicly owned or operated industrial activities. Privately owned facilities that have storm water discharges associated with industrial activity, as defined at 40 CFR 122.26(b)(14), must submit a permit application regardless of the size of the population of the municipality in which they are located.

91. **What is an "uncontrolled sanitary landfill?"**

A. An uncontrolled sanitary landfill (discussed in the 4/2/92 Federal Register, page 11410) is a landfill or open dump, whether in operation or closed, that does not satisfy the runon/runoff requirements established pursuant to subtitle D of the Solid Waste Disposal Act. However, landfills closed prior to October 9, 1991 are not subject to RCRA runon/runoff requirements, and therefore need not submit storm water permit applications if they are located in municipalities of less than 100,000 population. Landfills closed after October 9, 1991 and others that meet the above definition would be subject to the storm water permit application requirements.

92. **If a municipally-owned sewage treatment plant is located in a municipality with a population of less than 100,000 people, but the service population is greater than 100,000 people, is the facility subject to the permitting requirements?**

A. Yes, because service populations are used in determining population for publicly-owned treatment works [POTWs] (April 2, 1992 Federal Register page 11394). Additionally, where one sewer district operates a number of POTWs, the entire service population of the district will be used to determine the applicable population classification of all the POTWs operated by the district. For example, if a district with a cumulative service population of 160,000 operates two sewage treatment plants, one of which serves 120,000 and the other which serves 40,000, both plants will be considered to be owned or operated by a municipality with a population of 100,000 or more.

93. **If a construction operation disturbing five or more acres is owned by a small municipality (a population of less than 100,000 people)but operated by a private contractor, is the activity regulated?**

A. No. If the construction activity is either owned or operated by a municipality with a population of less than 100,000 it would not be required to obtain a storm water permit during Phase I of the storm water program. Some States, however, may require that an application be submitted.

IX. 9th Circuit U.S. Court of Appeals Decision

94. **What is the current status of light manufacturing facilities without exposure and construction activities under five acres, pursuant to the 9th Circuit Court decision?**

A. The 9th Circuit Court decision remanded two "exemptions" provided in the NPDES storm water permit application regulations for light manufacturing facilities without exposure and construction activities under five acres (11/16/90 Federal Register page 48066). Both exemptions were remanded for further proceedings. In response to these two remands, the Agency intends to conduct further rulemakings on both the light manufacturing and construction activities under five acres. In the December 18, 1992, Federal Register, the Agency stated that it is not requiring permit applications from construction activity under five acres or light industry without exposure until this further rulemaking is completed.

X. Phase II of the Storm Water Program

95. **What is the difference between Phase I and Phase II of the NPDES storm water program?**

A. In the Water Quality Act of 1987, Congress mandated that EPA establish storm water control programs in two phases. While the first Phase I was defined on November 16, 1990, Phase II regulations were to be promulgated by October 1, 1992. However, the Water Resources Development Act (WRDA) of 1992 extended deadlines for Phase II of the storm water program as follows: 1) EPA must issue Phase II regulations by October 1, 1993; and 2) permits for Phase II sources may not be required by EPA or the State prior to October 1, 1994. EPA is currently developing regulations that will implement Phase II of the storm water program. (See Question #1 for more information on Phase I).

96. **Will all storm water discharges that are not regulated under Phase I be regulated under Phase II of the storm water program (e.g., service stations, retail and wholesale businesses, parking lots, municipalities with populations of less than 100,000)?**

A. Not necessarily. Statutory provisions require that EPA, in consultation with State and local officials, issue regulations that designate additional Phase II sources for regulation to protect water quality. EPA is currently developing approaches to identify and control high risk Phase II sources. EPA requested initial public comments on a variety of Phase II issues on September 9, 1992 (57 FR 41344). As part of this process, EPA is considering all sources of storm water not regulated under Phase I for potential coverage under Phase II.

APPENDIX E

GROUP APPLICATION PART 2 SAMPLING DATA AND INDUSTRY DESCRIPTIONS ORGANIZED BY INDUSTRY SECTOR

APPENDIX E

GROUP APPLICATION PART 2 SAMPLING DATA AND INDUSTRY DESCRIPTIONS ORGANIZED BY INDUSTRY SECTOR

This appendix contains summary descriptions for the 31 industrial sectors that were identified in the group application portion of the Phase I permitting process (four of the sectors were consolidated into two sectors for permit development purposes). The summaries describe the industrial activities, significant materials, and pollutants of concern that were listed in the applications submitted by the industry groups. The descriptions also contain tables which summarize the sampling data submitted by the groups. The tables list the mean values, median values, 95th percentile values, for the grab and composite samples and the mean, median and 90th percentile values for NURP data for a portion of the pollutants sampled within each sector.

INDUSTRIAL SECTORS/GROUP APPLICATIONS	
SECTOR	ACTIVITIES REPRESENTED
1	Lumber and Wood Products
2	Paper and Allied Products
3	Chemicals and Allied Products
4	Asphalt and Lubricant Manufacturers
5	Stone, Clay, Glass and Concrete Products
6	Primary Metal Industries
7	Metal Mining
8	Coal and Lignite Mining
9	Oil and Gas Extraction
10	Mining and Quarrying of Nonmetallic Minerals
11	Hazardous Waste Treatment Storage or Disposal Facilities
12	Industrial Landfills, Land Application Sites and Open Dumps
13	Used Motor Vehicle Parts
14	Scrap and Waste Materials
15	Steam Electric Power Generating Facilities
16	Railroad Transportation
17	Local and Suburban Transit and Interurban Highway Passenger Transportation Motor Freight Transportation United States Postal Service Petroleum Bulk Stations
18	Water Transportation
19	Ship Building and Repairing Boat Building and Repairing
20	Transportation By Air
22	Domestic Wastewater Treatment Plants
23	Food and Kindred Products Tobacco Products
24	Textile Mill Products Apparel and Other Finished Products Made From Fabrics and Similar Materials
25	Furniture and Fixtures Manufacturing
26	Printing Publishing and Allied Industries
27	Rubber and Misc. Plastic Products
28	Leather and Leather Products
29	Fabricated Metal Products, Except Machinery and Transportation Equipment Jewelry, Silverware, and Plated Ware
30	Industrial and Commercial Machinery (Except Computer and Office Equipment) Transportation Equipment
31	Electronic and other Electrical Equipment and Components Measuring, Analyzing, and Controlling Instruments; Photographic and Optical Goods; Watches and Clocks

Sector 1: Timber Products Facilities

The definition of storm water discharges associated with industrial activity includes point source discharges of storm water from eleven major categories of facilities, including: "... category (ii) facilities classified as Standard Industrial Classification (SIC) code 24 (except 2434)." Storm water discharges covered include those from establishments that cut timber and pulpwood, merchant sawmills, lath mills, shingle mills, cooperage stock mills, planing mills, and plywood and veneer mills that produce lumber and wood basic materials; and establishments that manufacture finished articles made entirely of wood or related materials. These facilities use wood as their primary raw material. Industrial activities include the following:

Log Storage and Handling activities include loading and unloading of logs onto trucks or railroad cars for transport to other facilities, log sorting, and storage of logs. In addition, some cutting may be performed, such as chopping off tree branches and sectioning of tree trunks for easier handling during transport. Chipping may be performed at facilities serving pulp industries. Residues generated at these sites may include bark, coarse sawdust, and wood chunks.

Untreated Wood Lumber and Residue Generation Activities occur at the following: saw and planing mills (SIC group 242); millwork, veneer, plywood and structural wood member manufacturing facilities (SIC group 243); wood container manufacturing facilities (SIC group 244); wood building and mobile home manufacturing facilities (SIC group 245); and miscellaneous wood product manufacturers (SIC group 249). These facilities may engage in one or more activities such as log washing, bark removal, milling, sawing, resawing edging, trimming, planing, machining, air drying, and kiln drying. Some facilities generate residue as a product, while other facilities may generate residues as a waste product. A summary of the residues generated include: bark, wood chips, planer shavings, and sawdust.

Wood Surface Protection Activities are accomplished by one of the following three methods: spraying, dipping, and green chain operations. Industrial activities at saw mills with the potential to contaminate storm water include spills from surface protection areas, storage and mixing tank areas, treated wood drippage, transport or storage areas, maintenance and shop areas, and areas used for treatment/disposal of wastes. Fugitive emissions from negative pressure spraying activities and hand spraying surface protection formulations may also result in the contamination of storm water.

Wood Preservation Activities are accomplished by two steps. First, the moisture content of wood is reduced to increase its permeability (this is referred to as conditioning). After conditioning, wood is impregnated with a preservative for fire retardency, insecticidal resistance, and/or fungicidal resistance. Then, the wood stock is often subject to cleaning in order to remove excess preservative prior to stacking treated lumber products outside.

Wood Assembly/Fabrication Activities such as the fabrication of fiberboard, insulation board, and hardboard may involve the use of wax emulsions, paraffin, aluminum sulfate, melamine formaldehyde, and miscellaneous thermosetting resins. These chemicals may be introduced as part of the board formation process or as a coating to maintain the board's integrity. In the formation of fiberboard/insulation board/hardboards, the digestion of pulp and fiber by mechanical, thermal, and sometimes chemical means takes place. Another operation which involves resinous agents is the formation of veneer. In this process, veneer is placed in hot ponds or vats to soften the wood. Veneer strips are removed and often bound by glue or a resinous agent. Glues are also used in the assembly of wood components. Other types of activities include the finishing of wood products. Stains, paints, lacquers, varnish, water repellents and sealants, etc. may be applied to some of the wood products.

Significant materials at timber products facilities which can contribute pollutants to storm water include: uncut logs, wood bark, wood chips wood shavings, sawdust, green lumber, rough and finished lumber, other waste wood material, non-hazardous wood ash, above and below ground fuel storage tanks, finishing chemicals, solvents and cleaners, petroleum, herbicides, pesticides, fertilizers, sawmill equipment, material handling equipment, boiler water treatment chemicals, scrap metals, scrap equipment and plastics, boiler blowdown water, and leachate from decaying organic matter.

Pollutants from timber products facilities generally include biological oxygen demand (BOD^5), total suspended solids (TSS), chemical oxygen demand (COD), leachate, wood wastes, chemicals, heavy metals, and pH.

Table E-1
Summary Statistics From (Part 2) Sampling Results by Industrial Sector
Industrial Sector 1

	Grab Samples (mg/l)				Composite Samples (mg/l)				NURP Results (mg/l)		
Pollutant	No.	Mean	Median	95%	No.	Mean	Median	95%	Mean	Median	90%
BOD5	198	39.63	13.00	193.00	200	45.37	17.00	135.50	12.00	9.00	15.00
COD	19	297.64	131.00	1500.00	198	242.50	122.50	1080.00	82.00	65.00	140.00
Copper	32	0.05	0.03	0.16	29	0.04	0.03	0.12	0.04	0.04	0.09
Lead									0.18	0.14	0.35
NO_2+NO_3-N	189	0.95	0.32	2.20	188	0.75	0.34	1.79	0.86	0.68	1.75
Oil & Grease	107	15.21	2.20	55.00					NR	NR	NR
P, Total	198	23.91	0.29	2.66	199	6.29	0.30	1.72	0.42	0.33	0.70
pH	211	7.17	7.30	8.56					NR	NR	NR
TKN	188	2.57	1.62	9.26	188	2.32	1.50	7.50	1.90	1.50	3.30
TSS	198	1108.42	242.00	4800.00	198	575.27	230.00	2288.00	180.00	100.00	300.00
Zinc	16	0.47	0.37	1.70	15	0.36	0.30	1.20	0.20	0.16	0.50

Sector 2: Paper And Allied Products Manufacturing Facilities

The definition of storm water discharges associated with industrial activity includes point source discharges of storm water from eleven major categories of facilities, including: "...category (ii) facilities classified as Standard Industrial Classification (SIC) code 26 (except 265 and 267)." Storm water discharges covered include those from establishments primarily engaged in the manufacture of pulps from wood and other cellulose fibers, and from rags; manufacture paper and paperboard; and the manufacture of paper and paperboard into converted products, such as paper coated off the paper machine, paper bags, paper boxes, and envelopes. This major group also includes facilities which manufacture bags of plastics film and sheet.

Significant materials include fuels (diesel and gasoline), lumber, paper, and paperboard.

Pollutants of concern include total suspended solids (TSS), biochemical oxygen demand (BOD), and chemical oxygen demand (COD).

Table E-2
Summary Statistics From (Part 2) Sampling Results by Industrial Sector
Industrial Sector 2

Pollutant	Grab Samples (mg/l)				Composite Samples (mg/l)				NURP Results (mg/l)		
	No.	Mean	Median	95%	No.	Mean	Median	95%	Mean	Median	90%
BOD5	121	34.72	8.00	115.00	111	24.25	8.00	93.00	12.00	9.00	15.00
COD	121	191.69	61.00	740.00	113	133.90	51.00	530.00	82.00	65.00	140.00
Copper	2	0.03	0.03	0.05	2	0.03	0.03	0.07	0.04	0.04	0.09
Lead	2	0.05	0.05	0.09	2	0.03	0.03	0.05	0.18	0.14	0.35
NO_2+NO_3-N	121	.095	0.50	3.93	111	0.76	0.47	2.44	0.86	0.68	1.75
Oil & Grease	122	3.69	1.00	15.00					NR	NR	NR
P, Total	120	0.39	0.18	1.06	111	0.36	0.16	0.91	0.42	0.33	0.70
pH	121		6.97	8.22					NR	NR	NR
TKN	121	3.83	1.76	10.20	112	3.17	1.77	10.10	1.90	1.50	3.30
TSS	121	152.98	41.00	520.00	111	44.04	13.00	198.00	180.00	100.00	300.00
Zinc	1	0.62	0.62	0.62	1	0.78	0.78	0.78	0.20	0.16	0.50

Sector 3: Chemical and Allied Products Manufacturing Facilities

The definition of storm water discharges associated with industrial activity includes point source discharges of storm water from eleven major categories of facilities, including: "... category (ii) facilities classified as Standard Industrial Classification (SIC) 28 (except 283 and 285)." Storm water discharges covered include those from establishments primarily engaged in manufacturing: industrial inorganic chemicals; plastic and synthetic materials; cleaning agents; paint products and varnishes; industrial organic chemicals; fertilizers; adhesives; explosives; and printing ink. Also covered are storm water discharges from facilities which manufacture inks and paints under SIC 3952. Storm water discharges from drug manufacturing facilities (SIC 283) are not covered.

Pollutants at chemical and allied product facilities include Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Copper, Manganese, and Zinc.

Table E-3
Summary Statistics From (Part 2) Sampling Results by Industrial Sector
Industrial Sector 3

Pollutant	Grab Samples (mg/l)				Composite Samples (mg/l)				NURP Results (mg/l)		
	No.	Mean	Median	95%	No.	Mean	Median	95%	Mean	Median	90%
BOD5	165	36.42	7.00	67.00	156	11.74	6.00	45.00	12.00	9.00	15.00
COD	168	96.14	57.50	290.00	159	77.24	41.00	320.00	82.00	65.00	140.00
Copper	51	0.19	0.01	0.21	46	0.12	0.00	0.19	0.04	0.04	0.09
Lead	47	0.07	0.01	0.17	42	0.02	0.01	0.07	0.18	0.14	0.35
NO_2+NO_3-N	164	5.83	0.80	16.00	154	4.29	0.82	17.00	0.86	0.68	1.75
Oil & Grease	169	3.75	0.50	16.30					NR	NR	NR
P, Total	170	2.82	0.24	12.10	158	9.51	0.23	16.40	0.42	0.33	0.70
pH	166	6.94	7.10	8.50					NR	NR	NR
TKN	171	15.50	1.90	27.00	159	18.30	1.70	23.70	1.90	1.50	3.30
TSS	169	200.33	40.00	793.00	159	93.67	25.00	453.00	180.00	100.00	300.00
Zinc	75	2.11	0.24	7.70	70	1.74	0.24	4.20	0.20	0.16	0.50

Sector 4: Asphalt Paving and Roofing Materials Manufacturers and Lubricant Manufacturers

The definition of storm water discharges associated with an industrial activity includes point source discharges of storm water from eleven major categories of facilities, including: "... category (ii) which identifies facilities classified as Standard Industrial Classification (SIC) code 29." This covers storm water discharges associated with industrial activities at facilities with a primary SIC code of 2951 (Asphalt Paving Mixtures and Blocks), 2952 (Asphalt Felts and Coatings), and 2992 (Lubricating Oils and Greases) including portable plants. Hereinafter, facilities with primary SIC codes 2951 or 2952 will be referred to as 'Asphalt Facilities,' and facilities with primary SIC code 2992 as 'Lubricant Manufacturers.'

Facilities manufacturing asphalt concrete, paving materials, or block, are classified as SIC code 2951. Facilities primarily engaged in manufacturing asphalt roofing products, such as asphalt felts, shingles, and other products including tars, pitch, and roofing cements, are identified as SIC 2952. Facilities primarily engaged in manufacturing oils and lubricants are identified as SIC 2992.

Manufacturers of Asphalt Paving Mixtures and Blocks: These facilities stockpile a variety of raw materials such as sand, gravel, crushed limestone, and recycled asphalt products (RAP). These facilities produce asphalt concrete, and may also mold and cure asphalt concrete products such as asphalt blocks. There are two types of facilities associated with these activities, batch plants and drum plants.

Manufacturers of Roofing Materials: Manufacturers classified in standard industrial code 2952 typically produce roofing felts, and impregnated roofing felts (shingles) and other products, such as tar papers, impregnated asphalt siding, expansion joints, roofing cements, tars and pitches. Many of the roofing products consist of materials coated with asphalt purchased from a vendor and then cured and stored out of doors until shipped.

Manufacturers of Lubricating Oils and Greases: Facilities primarily engaged in blending, compounding, and re-refining lubricating oils and greases from purchased mineral, animal, and vegetable materials are identified as SIC code 2992. SIC code 2992 includes manufacturers of metalworking fluids, cutting oils, gear oils, hydraulic brake fluid, transmission fluid, and other automotive and industrial oil and greases.

Significant materials at these facilities include additives, asphalt, asphalt cement, asphalt concrete, asphalt felt, asphalt release agents, asphalt shingles, crushed stone, fuel, granite, gravel, limestone, lubricants, mineral spirits, oil, quartzite rock, reclaimed asphalt pavement, sand, sandstone, and slag. The pollutants of concern at facilities which manufacture asphalt and lubricant include total, suspended solids (TSS), oil and grease, chemical oxygen demand (COD), and fuel wastes.

Table E-4
Summary Statistics From (Part 2) Sampling Results by Industrial Sector
Industrial Sector 4

	Grab Samples (mg/l)				Composite Samples (mg/l)				NURP Results (mg/l)		
Pollutant	No.	Mean	Median	95%	No.	Mean	Median	95%	Mean	Median	90%
BOD5	61	39.99	7.00	47.00	51	10.87	4.00	22.00	12.00	9.00	15.00
COD	64	151.55	48.00	485.00	53	86.93	50.00	375.00	82.00	65.00	140.00
Copper									0.04	0.04	0.09
Lead									0.18	0.14	0.35
NO_2+NO_3-N	62	0.97	0.31	2.63	52	0.82	0.03	2.43	0.86	0.68	1.75
Oil & Grease	64	5.89	1.25	28.00					NR	NR	NR
P, Total	63	0.37	0.13	1.65	54	0.28	0.15	1.28	0.42	0.33	0.70
pH	59	7.1	7.1	8.80					NR	NR	NR
TKN	63	2.13	1.13	7.16	51	1.63	0.99	6.28	1.90	1.50	3.30
TSS	63	286.67	93.00	1330.00	54	165.03	46.00	860.00	180.00	100.00	300.00
Zinc									0.20	0.16	0.50

Sector 5: Glass, Clay, Cement, Concrete, and Gypsum Product Manufacturing Facilities

The definition of storm water discharges associated with industrial activity includes point source discharges of storm water from eleven major categories of facilities, including: "...category (ii) which identifies facilities classified as Standard Industrial Classification (SIC) code 32."

Glass Product Manufacturing - Facilities primarily engaged in the manufacturing of glass and glassware, or manufacturing glass products from purchased glass are classified under standard industrial groups 321-323. Manufacturing processes include the storage of raw materials, weighing the materials, charging, melting and forming. Significant materials may include silica sand, limestones, feldspars, borates, soda ash, boric acid, potash and barium carbonate.

Cement Manufacturing - Facilities primarily engaged in manufacturing hydraulic cement (e.g., portland, natural, masonry, and pozzolana cements) are identified as SIC code 3241. The three basic steps in cement manufacturing are: 1) proportioning, grinding and blending raw materials; 2) heating raw materials to produce a hard, stony substance known as "clinker"; and 3) combining the clinker with other materials and grinding the mixture into a fine powdery form.

Clay Product Manufacturing - Facilities primarily engaged in manufacturing clay products, including brick, tile (clay or ceramic), or pottery products are classified as standard industrial groups 325 and 326. Although clay product manufacturing facilities produce a wide variety of final products, there are several similar processing steps shared by most facilities in this industry: 1) storage and preparation of raw materials; 2) forming; 3) drying; 4) firing; and 5) cooling. Manufacturers classified as standard industrial groups 325 and 326 typically use clay (common, silt, kaolin and/or phyllite) and shale (mud, red, blue and/or common) as their primary raw materials. Raw materials are generally stored outside.

Concrete Products - Facilities primarily engaged in manufacturing concrete products, including ready-mixed concrete, are identified as SIC group 327. Although concrete product facilities in SIC group 327 produce a variety of final products, they all have common raw materials and activities.

Concrete products manufacturers combine cement, aggregate, and water to form concrete. Aggregate generally consists of: sand, gravel, crushed stone, cinder, shale, slag, clay, slate, pumice, vermiculite, scoria, perlite, diatomite, barite, limonite, magnetite, or ilmenite. Admixtures including fly ash, calcium chloride, triethanolamine, calcium salt, lignosulfunic acid, vinosol, saponin, keratin, sulfonated hydrocarbon, fatty acid glyceride, vinyl acetate, and styrene copolymer of vinyl acetate may be added to obtain desired characteristics, such as slower or more rapid curing times.

Gypsum Products Manufacturing - Facilities primarily engaged in manufacturing plaster, wallboard, and other products composed wholly or partially of gypsum (except plaster of paris and papier-mâché) are classified as SIC code 3275. The gypsum product manufacturing process begins with calcining the gypsum: finely ground raw gypsum (referred to as "land plaster") is fed into imp mills or calcining kettles where extreme heat removes 75 percent of the gypsum's molecular moisture. The result is a dry powder called stucco, which is cooled and conveyed to storage bins. To produce wallboard, stucco is fed into pin mixers where it is blended with water and other additives to produce a slurry. The slurry is then applied to continuous sheets of paper to form wallboard. In addition to producing wallboard, some facilities may combine stucco with additives (excluding water) to produce plaster.

As a result of the industrial activities such as materials handling and storage and other industry specific activities, pollutants of concern include: total suspended solids (TSS), chemical oxygen demand (COD), oil and grease, lead, aluminum, zinc, potassium and sulfate.

Table E-5
Summary Statistics From (Part 2) Sampling Results by Industrial Sector
Industrial Sector 5

Pollutant	Grab Samples (mg/l)				Composite Samples (mg/l)				NURP Results (mg/l)		
	No.	Mean	Median	95%	No.	Mean	Median	95%	Mean	Median	90%
BOD5	310	14.30	5.00	32.00	300	7.32	4.20	26.00	12.00	9.00	15.00
COD	313	107.47	51.30	317.00	302	77.53	43.15	240.00	82.00	65.00	140.00
Copper	6	0.13	0.02	0.40	5	0.16	0.04	0.40	0.04	0.04	0.09
Lead	15	0.24	0.01	3.30	15	0.25	0.01	3.40	0.18	0.14	0.35
NO_2+NO_3-N	303	1.99	0.60	3.03	292	1.40	0.55	3.03	0.86	0.68	1.75
Oil & Grease	315	4.67	1.40	17.10					NR	NR	NR
P, Total	313	1.21	0.28	4.96	300	0.87	0.25	3.24	0.42	0.33	0.70
pH	297	8.59	8.50	11.30					NR	NR	NR
TKN	304	3.82	1.16	7.00	292	2.37	1.00	5.00	1.90	1.50	3.30
TSS	311	1066.79	200.00	2620.00	302	385.51	149.00	1440.00	180.00	100.00	300.00
Zinc	8	0.35	0.14	1.17	7	0.39	0.18	1.12	0.20	0.16	0.50

Sector 6: Primary Metals Facilities

The definition of storm water discharges associated with industrial activity includes point source discharges from eleven major categories of facilities, including: "(ii) facilities classified as Standard Industrial Classification (SIC) 33 [primary metals facilities]." Storm water discharges covered include those from the following types of activities: Steel works, blast furnaces, and rolling and finishing mills (SIC 331); Iron and steel foundries (SIC 332) Primary smelting and refining of nonferrous metals (SIC 333); Secondary smelting and refining of nonferrous metals (SIC 334); Rolling, drawing, and extruding of nonferrous metals (SIC 335); Nonferrous foundries (SIC 336); and Miscellaneous primary metal products, not elsewhere classified (SIC 339).

Facilities in the primary metals industry are typically involved in one or more of the following general operations: raw material storage and handling; furnace and oven related processes; preparation of molds, casts, or dies; metal cleaning, treating and finishing; and waste handling and disposal.

Pollutants at primary metals facilities include Aluminum, Copper, Iron, Manganese, Total Suspended Solids (TSS), and Zinc.

Table E-6
Summary Statistics From (Part 2) Sampling Results by Industrial Sector
Industrial Sector 6

	Grab Samples (mg/l)				Composite Samples (mg/l)				NURP Results (mg/l)		
Pollutant	No.	Mean	Median	95%	No.	Mean	Median	95%	Mean	Median	90%
BOD5	163	32.15	11.00	83.00	140	34.08	8.30	61.50	12.00	9.00	15.00
COD	162	221.34	70.50	870.00	151	109.84	60.00	420.00	82.00	65.00	140.00
Copper	143	3.46	0.10	3.40	131	2.25	0.07	3.10	0.04	0.04	0.09
Lead	136	0.78	0.02	1.41	123	0.19	0.02	1.00	0.18	0.14	0.35
NO_2+NO_3-N	148	1.17	0.68	3.60	135	1.38	0.77	4.30	0.86	0.68	1.75
Oil & Grease	163	8.88	1.00	47.00					NR	NR	NR
P, Total	163	1.25	0.17	1.80	149	0.52	0.14	0.96	0.42	0.33	0.70
pH	163	7.07	7.30	8.90					NR	NR	NR
TKN	160	3.56	1.98	13.00	149	3.05	1.60	9.70	1.90	1.50	3.30
TSS	162	368.45	71.75	1700.00	149	162.28	69.00	717.00	180.00	100.00	300.00
Zinc	144	8.85	0.46	11.80	132	6.55	0.43	9.67	0.20	0.16	0.50

Sector 7: Metal Mining (Ore Mining and Dressing)

The definition of storm water discharges associated with industrial activity includes point source discharges of storm water from eleven major categories of facilities, including: "...category (iii) facilities classified by Standard Industrial Classification (SIC) codes 10 through 14 including active or inactive mining operations (except for areas coal mining operations no longer meeting the definition of reclamation area under 40 CFR 434.11(l) because the performance bond issued to the facility by the appropriate SMCRA authority has been released, or except for areas of non-coal mining operations which have been released from applicable State or Federal reclamation requirements after December 17, 1990) and oil and gas exploration production, processing or treatment operations, or transmission facilities that discharge storm water contaminated by contact with or that has come into contact with any overburden, raw material, intermediate products, finished products, byproducts or waste products located on the site of such operations." The following is a listing of the types of mining/milling facilities that are covered under SIC code 10:

- Iron Ores (SIC 1011)
- Copper Ores (SIC 1021)
- Lead and Zinc Ores (SIC 1031)
- Gold Ores (SIC 1041)
- Silver Ores (SIC 1044)
- Ferroalloy Ores, Except Vanadium (SIC 1061)
- Metal Mining Services (SIC 1081)
- Uranium-Radium-Vanadium Ores (SIC 1094)
- Miscellaneous Metal Ores, Not Elsewhere Classified (SIC 1099)

The term "metal mining" includes all ore mining and/or dressing and beneficiating operations, whether performed at mills operated in conjunction with the mines served or at mills, such as custom mills, operated separately. The above establishments are primarily engaged in mining, developing mines, or exploring for metallic minerals (ores). This group also includes all ore dressing and beneficiating operations, whether performed at mills operated in conjunction with the mines served or at mills, such as custom mills, operated separately. These include mills which crush, grind, wash, dry, sinter, calcine, or leach ore, or perform gravity separation or flotation operations.

Pollutants of concern include total suspended solids (TSS), total dissolved solids (TDS), heavy metals, oil and grease, dust, and turbidity.

Table E-7
Summary Statistics From (Part 2) Sampling Results by Industrial Sector
Industrial Sector 7

Pollutant	Grab Samples (mg/l)				Composite Samples (mg/l)				NURP Results (mg/l)		
	No.	Mean	Median	95%	No.	Mean	Median	95%	Mean	Median	90%
BOD5	18	10.02	9.00	27.00	12	10.63	6.00	44.00	12.00	9.00	15.00
COD	18	144.54	71.10	630.00	15	195.07	160.00	740.00	82.00	65.00	140.00
Copper	19	3.88	0.14	46.80	13	0.59	0.09	3.40	0.04	0.04	0.09
Lead	23	0.89	0.00	1.20	13	6.07	0.05	65.00	0.18	0.14	0.35
NO_2+NO_3-N	16	1.10	0.75	5.30	13	0.90	0.86	2.10	0.86	0.68	1.75
Oil & Grease	16	2.36	0.00	22.00					NR	NR	NR
P, Total	21	1.83	0.30	11.00	16	1.06	0.38	7.00	0.42	0.33	0.70
pH	24	7.23	7.45	8.00					NR	NR	NR
TKN	15	3.27	2.60	9.40	13	3.39	3.20	11.80	1.90	1.50	3.30
TSS	17	6995.78	403.00	100000.00	15	623.09	330.00	3049.00	180.00	100.00	300.00
Zinc	14	3.04	0.59	16.30	8	3.87	0.66	20.90	0.20	0.16	0.50

Sector 8: Coal Mines and Coal Mining-Related Facilities

The definition of storm water discharges associated with industrial activity includes point source discharges of storm water from eleven major categories of facilities, including: "...category (iii) facilities classified by Standard Industrial Classification (SIC) codes 10 through 14 including active or inactive mining operations (except for areas coal mining operations no longer meeting the definition of reclamation area under 40 CFR 434.11(l) because the performance bond issued to the facility by the appropriate SMCRA authority has been released, or except for areas of non-coal mining operations which have been released from applicable State or Federal reclamation requirements after December 17, 1990) and oil and gas exploration production, processing or treatment operations, or transmission facilities that discharge storm water contaminated by contact with or that has come into contact with any overburden, raw material, intermediate products, finished products, byproducts or waste products located on the site of such operations." Coal mining activities are classified as Standard Industrial Classification (SIC) code 12, and includes the following operations:

- Bituminous Coal and Lignite Surface Mining (SIC 1221)
- Bituminous Coal Underground Mining (SIC 1222)
- Anthracite Mining (SIC 1231)
- Coal Mining Services (SIC 1241)

Storm water discharges are covered at all inactive facilities and only from haul roads and rail lines at active facilities. Haul roads are non-public roads on which coal or coal refuse is conveyed. Access roads are non-public roads providing light vehicular traffic within the facility property and to public roadways. Railroad spurs, sidings, and internal haulage lines are rail lines used for hauling coal within the facility property and to off-site commercial railroad lines or loading areas. Inactive coal mines and related areas are abandoned and other inactive mines, refuse disposal sites and other mining-related areas.

Significant materials include coal, refuse coal, used equipment, and other equipment used to haul coal.

Pollutants of concern include total suspended solids (TSS), total dissolved solids (TDS), turbidity, oil and grease, dust, heavy metals, and acid/alkaline wastes.

Table E-8
Summary Statistics From (Part 2) Sampling Results by Industrial Sector
Industrial Sector 8

Pollutant	Grab Samples (mg/l)				Composite Samples (mg/l)				NURP Results (mg/l)		
	No.	Mean	Median	95%	No.	Mean	Median	95%	Mean	Median	90%
BOD5	7	3.63	1.80	9.00	4	6.55	3.90	17.40	12.00	9.00	15.00
COD	13	16.45	6.00	83.90	8	26.86	13.50	115.00	82.00	65.00	140.00
Copper	1	0.00	0.00	0.00	2	0.00	0.00	0.00	0.04	0.04	0.09
Lead	2	0.02	0.02	0.04	2	0.00	0.00	0.00	0.18	0.14	0.35
NO_2+NO_3-N	8	0.77	0.40	3.12	6	1.00	0.61	3.12	0.86	0.68	1.75
Oil & Grease	19	2.17	1.20	13.90					NR	NR	NR
P, Total	8	0.12	0.04	0.66	5	0.12	0.00	0.58	0.42	0.33	0.70
pH	21	7.40	7.58	8.45					NR	NR	NR
TKN	9	2.56	2.60	5.20	8	2.65	1.46	7.40	1.90	1.50	3.30
TSS	10	5607.60	150.00	33240.00	8	689.75	251.00	3880.00	180.00	100.00	300.00
Zinc	2	0.17	0.17	0.30	2	0.06	0.06	0.09	0.20	0.16	0.50

Sector 9: Oil and Gas Extraction Facilities

The definition of storm water discharges associated with industrial activity includes point source discharges of storm water from eleven major categories of facilities, including: "...category (iii)...oil and gas exploration production, processing or treatment operations, or transmission facilities that discharge storm water contaminated by contact with or that has come into contact with any overburden, raw material, intermediate products, finished products, byproducts or waste products located on the site of such operations." Oil and gas extraction facilities are classified as Standard Industrial Classification (SIC) code 13. The activities subject to storm water regulations include the following types of operations:

- Crude Petroleum and Natural Gas (SIC 1311)
- Natural Gas Liquids (SIC 1321)
- Drilling Oil and Gas Wells (SIC 1321)
- Oil and Gas Field Exploration Services (SIC 1382)
- Oil and Gas Field Services, Not Elsewhere Classified (SIC 1389)

Table E-9
Summary Statistics From (Part 2) Sampling Results by Industrial Sector
Industrial Sector 9

	Grab Samples (mg/l)				Composite Samples (mg/l)				NURP Results (mg/l)		
Pollutant	No.	Mean	Median	95%	No.	Mean	Median	95%	Mean	Median	90%
BOD5	35	13.79	9.71	44.00	33	10.59	7.00	21.80	12.00	9.00	15.00
COD	36	140.12	82.00	352.00	31	115.94	92.00	445.00	82.00	65.00	140.00
Copper									0.04	0.04	0.09
Lead									0.18	0.14	0.35
NO_2+NO_3-N	35	0.52	0.15	4.10	31	0.60	0.12	3.30	0.86	0.68	1.75
Oil & Grease	36	10.18	3.00	49.00					NR	NR	NR
P, Total	36	15.82	0.18	144.90	33	3.41	0.07	19.46	0.42	0.33	0.70
pH	36	7.45	7.14	9.41					NR	NR	NR
TKN	36	1.39	0.76	5.20	30	1.69	0.93	5.67	1.90	1.50	3.30
TSS	37	353.00	75.00	1520.00	30	413.00	48.00	2056.00	180.00	100.00	300.00
Zinc									0.20	0.16	0.50

Sector 10: Mineral Mining and Processing Facilities

The definition of storm water discharges associated with industrial activity includes point source discharges of storm water from eleven major categories of facilities, including: "...(iii) facilities classified as Standard Industrial Classifications 10 through 14 (mineral industry) including active or inactive mining operations (except for areas of coal mining operations no longer meeting the definition of a reclamation area under 40 CFR 434.11(l) because the performance bond issued to the facility by the appropriate SMCRA authority has been released, or except for areas of non-coal mining operations which have been released from applicable State or Federal reclamation requirements after December 17, 1990) and oil and gas exploration, production, processing, or treatment operations, or storm water contaminated by contact with, any overburden, raw material, intermediate products, finished products, by-products or waste products located on the site of such operations."

Mineral mining and processing facilities subject to storm water regulations include the following types of operations:

- Dimension Stone, (SIC Code 1411);
- Crushed and Broken Limestone, (SIC Code 1422);
- Crushed and Broken Granite, (SIC Code 1423);
- Crushed and Broken Stone, (SIC Code 1429);
- Construction Sand and Gravel, (SIC Code 1442);
- Industrial Sand and Gravel, (SIC Code 1446);
- Kaolin and Ball Clay, (SIC Code 1455);
- Clay, Ceramic, and Refractory Minerals, (SIC Code 1459);
- Potash, Soda, and Borate Minerals, (SIC Code 1474);
- Phosphate Rock, (SIC Code 1475);
- Chemical and Fertilizer Mineral Mining, (SIC Code 1479); and
- Miscellaneous Nonmetallic Minerals, Except Fuels, (SIC Code 1499).

There are typically three phases to a mining operation: the exploration and construction phase; the active phase; and the reclamation phase. The exploration and construction phase entails exploration and a certain amount of land disturbance to determine the financial viability of a site. Construction includes building of site access roads, and removal of overburden and waste rock to expose minable ore. These land-disturbing activities are significant potential sources of storm water contaminants. The active phase includes each step from extraction through production of a saleable product. The active phase may include periods of inactivity due to the seasonal nature of these mineral mining activities. The final phase of reclamation is intended to return the land to its pre-mining state. Non-metallic minerals are recovered using four basic forms of extraction techniques: open pit, open face or quarry mining; dredging; solution mining; and underground mining. Each type of extraction method may be followed by varying methods of beneficiation and processing.

Storm water discharges covered include all discharges where precipitation and run-on come into contact with significant materials commonly found at mining facilities which include:

overburden; waste rock; sub-ore piles; tailings; petroleum-based products; solvents and detergents; manufactured products; and other waste materials. This includes storm water discharges from haul roads, access roads, and rail lines used or traveled by carriers of raw materials, manufactured products, waste materials, or by-products created by the facility. In addition, overflows from facilities governed by effluent limitation guidelines with impoundments such as settling or sedimentation ponds, tailings ponds or piles, or other impoundments designed to contain a 10-year, 24-hour storm event are also covered.

Because of the land-disturbing nature of the mineral mining and processing industry, contaminants of concern generated by industrial activities in this industry include total suspended solids (TSS), total dissolved solids (TDS), turbidity, pH, dust, heavy metals, solvents, and oils.

Table E-10
Summary Statistics From (Part 2) Sampling Results by Industrial Sector
Industrial Sector 10

	Grab Samples (mg/l)				Composite Samples (mg/l)				NURP Results (mg/l)		
Pollutant	No.	Mean	Median	95%	No.	Mean	Median	95%	Mean	Median	90%
BOD5	55	7.09	5.00	24.00	51	6.89	5.00	17.00	12.00	9.00	15.00
COD	56	58.79	33.00	247.00	51	66.20	37.00	185.00	82.00	65.00	140.00
Copper	6	0.05	0.01	0.15	4	0.01	0.01	0.01	0.04	0.04	0.09
Lead	6	0.00	0.00	0.00	4	0.00	0.00	0.00	0.18	0.14	0.35
NO_2+NO_3-N	50	0.98	0.65	3.00	45	1.27	0.76	4.17	0.86	0.68	1.75
Oil & Grease	60	1.08	0.00	5.45					NR	NR	NR
P, Total	55	0.84	0.20	4.69	51	1.13	0.24	2.61	0.42	0.33	0.70
pH	58	7.60	7.55	9.10					NR	NR	NR
TKN	55	1.81	1.05	8.00	50	2.41	0.84	6.89	1.90	1.50	3.30
TSS	55	1848.14	181.00	11120.00	51	1576.24	296.00	10080.00	180.00	100.00	300.00
Zinc	5	0.18	0.18	0.34	3	0.29	0.30	0.30	0.20	0.16	0.50

Sector 11: Hazardous Waste, Treatment, Storage, or Disposal Facilities

The definition of storm water discharges associated with industrial activity includes point source discharges of storm water from eleven major categories of facilities, including: "...(iv) hazardous waste treatment, storage, or disposal facilities, including those that are operating under Subtitle C of RCRA [Resource Conservation and Recovery Act] ...." Industrial activities at treatment, storage, or disposal facilities (TSDF) can be described as follows:

At TSDFs, some wastes are disposed without any intervening storage or treatment, while other wastes are held in storage prior to treatment or disposal. Hazardous wastes are generally stored in containers and tanks, which are enclosed by a bermed area to prevent any releases to the environment from the storage units.

The processes for treating hazardous wastes can be divided into two major categories based on whether the waste is organic or inorganic in nature. Organic wastes are treated by destructive technologies, such as incineration, whereas inorganic wastes are treated using fixation technologies, such as stabilization, in which the hazardous constituents are immobilized in the residual matrix. Residuals from fixation processes are usually land-disposed.

Hazardous waste disposal units include landfills, surface impoundments, waste piles, and land treatment units. Wastes are also disposed of in incinerators. Some liquid hazardous wastes are underground-injected into deep wells regulated under the Underground Injection Control (UIC) program.

Hazardous wastes are also recycled at TSDFs. Recycling is considered a form of treatment, however, the recycling process itself is not generally regulated under RCRA. Recycling activities include reclamation, regeneration, reuse, burning for energy or materials recovery, and use in a manner constituting disposal (i.e., land application of hazardous waste or products containing hazardous waste).

Table E-11
Summary Statistics From (Part 2) Sampling Results by Industrial Sector
Industrial Sector 11

Pollutant	Grab Samples (mg/l)				Composite Samples (mg/l)				NURP Results (mg/l)		
	No.	Mean	Median	95%	No.	Mean	Median	95%	Mean	Median	90%
BOD5	8	17.75	11.50	45.00	9	9.44	7.00	45.00	12.00	9.00	15.00
COD	8	177.40	41.00	500.00	9	48.90	34.00	131.00	82.00	65.00	140.00
Copper									0.04	0.04	0.09
Lead									0.18	0.14	0.35
NO_2+NO_3-N	9	0.46	0.47	0.79	9	0.39	0.34	0.67	0.86	0.68	1.75
Oil & Grease	9	9.33	0.00	74.00					NR	NR	NR
P, Total	9	0.24	0.07	1.60	9	0.11	0.09	0.32	0.42	0.33	0.70
pH	7	6.93	7.29	7.79					NR	NR	NR
TKN	9	1.43	1.30	3.00	9	1.07	0.92	3.92	1.90	1.50	3.30
TSS	8	337.63	127.50	1100.00	9	82.67	32.00	304.00	180.00	100.00	300.00
Zinc									0.20	0.16	0.50

Sector 12: Landfills/Land Application Sites

The definition of storm water discharge associated with industrial activity includes point source discharges of storm water from eleven major categories of facilities, including: "...category (v) landfills, land application sites and open dumps that receive industrial wastes." Special conditions apply to land disposal sites which meet the definition of a landfill under RCRA Subtitle D. Landfills are defined as areas of land or excavation in which wastes are placed for permanent disposal, and that are not land application units, surface impoundments, injection wells, or waste piles. Included in this definition are municipal solid waste landfills (MSWLFs) and industrial solid non-hazardous waste landfills. Land application sites are defined as facilities at which wastes are applied onto or incorporated into the soil surface for the purpose of beneficial use or waste treatment and disposal. Open dumps are defined as solid waste disposal units not in compliance with State/Federal criteria established under RCRA Subtitle D.

Municipal Solid Waste Landfills are constructed according to one of two generic designs, the trench method, area method, or a combination of both. The trench method requires the excavation of a trench into which wastes will be placed. In the area method, wastes are placed directly on the ground surface and disposal follows the natural contours of the land. Some landfills use combinations of the two methods at different times depending on the location of the active unit.

Most modern landfills contain one or more separate "units," which are final waste containment areas. Active units continue to receive wastes until they have reached disposal capacity. When capacity is reached, a unit is capped with a final cover, and additional wastes are placed in other active units. Within each unit, wastes are added in layers referred to as lifts. Received wastes are spread across the working face of the landfill to a depth of six to twenty feet and then compacted. At the end of each working day a thin layer of soil (daily cover) is spread on top of the added wastes and compacted. A large unit may consist of multiple lifts, depending on the planned final depth. When a landfill (or landfill unit) has reached disposal capacity, a final cover is applied. Final covers generally provide a relatively impermeable cap over which topsoil is placed and vegetation is established.

Industrial Landfills are similar to MSWLFs, but only receive wastes from industrial facilities such as factories, processing plants, and manufacturing sites. These facilities may also receive hazardous wastes from very small quantity hazardous waste generators (less than one hundred kilograms per month), as defined in RCRA Subtitle C.

Land Application Sites receive wastes (primarily wastewaters and sludges) from facilities in virtually every major industrial category. Typically, individual land application sites will only dispose of wastes with specific characteristics. However, the criteria for selection are site-specific, depending on type of process used and the soil characteristics.

The significant materials at land disposal sites consist of the wastes and the equipment used to handle the wastes. Examples of wastes disposed at these sites include household waste (including household hazardous waste which is excluded from RCRA hazardous waste regulation), non-hazardous incinerator ashes, commercial wastes, yard wastes, tires, white goods, construction wastes, municipal and industrial sludges, asbestos, and other industrial wastes from various industrial facilities.

Pollutants of concern at land disposal sites include total suspended solids (TSS), oil and grease, heavy metals, leachate, organics, and chemical oxygen demand (COD) and other toxic pollutants.

Table E-12
Summary Statistics From (Part 2) Sampling Results by Industrial Sector
Industrial Sector 12

	Grab Samples (mg/l)				Composite Samples (mg/l)				NURP Results (mg/l)		
Pollutant	No.	Mean	Median	95%	No.	Mean	Median	95%	Mean	Median	90%
BOD5	51	13.66	7.00	59.00	48	9.04	4.40	34.00	12.00	9.00	15.00
COD	51	114.46	31.00	825.00	48	102.02	27.50	548.00	82.00	65.00	140.00
Copper									0.04	0.04	0.09
Lead	9	9.62	0.08	83.70	7	20.64	0.18	143.00	0.18	0.14	0.35
NO_2+NO_3-N	50	1.57	0.55	4.10	47	1.38	0.50	6.02	0.86	0.68	1.75
Oil & Grease	53	2.97	0.00	14.00					NR	NR	NR
P, Total	50	0.91	0.50	3.35	47	0.95	0.38	4.08	0.42	0.33	0.70
pH	54	7.41	7.32	8.40					NR	NR	NR
TKN	51	3.36	1.10	12.00	48	3.03	1.04	14.20	1.90	1.50	3.30
TSS	51	2978.97	633.00	19370.00	47	1850.17	370.00	9140.00	180.00	100.00	300.00
Zinc									0.20	0.16	0.50

Sector 13: Automobile Salvage Yards

The definition of storm water discharges associated with industrial activity includes point source discharges of storm water from eleven categories of facilities, including: "... category (vi) facilities classified as Standard Industrial Classification (SIC) code 5015." That SIC code includes battery reclaimers, salvage yards, and automobile junkyards.

Storm water discharges include discharges where precipitation and storm water runon come into contact with significant materials including, but are not limited to parts storage and cleaning, storage of junked vehicles, waste products, by-products, stored materials, fuels, and areas used for dismantling operations. Dismantlers are a major source for replacement parts for motor vehicles in service. The primary activity involves the dismantling or wrecking of used motor vehicles. Some facilities, however, perform vehicle maintenance and may rebuild vehicles for resale.

Typically, automobile dismantling facilities receive vehicles that are either uneconomical to run or wrecks that are uneconomical to repair. The nature of operations generally depends on the size and location of the facility. In urban areas where land is more valuable, vehicles are typically dismantled upon arrival, parts are segregated, cleaned, and stored. Remaining hulks are generally sold to scrap dealers rather than stored on site due to limited space. In more rural areas, discarded vehicles are typically stored on the lot and parts removed as necessary. Remaining hulks are sold to scrap dealers less frequently.

Once a used vehicle is brought to the site, fluids may be drained and the tires, gas tank, radiator, engine and seats may be removed. The dismantler may separate and clean parts. Such cleaning may include steam cleaning of the engine and transmission as well as the use of solvents to remove oil and grease and other residues. Usable parts are then inventoried and stored for resale. The remaining car and/or truck bodies are stored on site for future sale of the sheet metal and glass. Stripped vehicles and parts that have no resale value are typically crushed and sold to a steel scrapper. Some operations may, however, convert used vehicles and parts into steel scrap as a secondary operation. This is accomplished by incineration, shearing (bale shearer), shredding, or baling.

Significant materials include automobile parts (e.g., engine blocks, mufflers, batteries), solvents, oils, cleaning agents (e.g., detergents), used equipment, and junked automobiles. Due to the nature of the industrial activities at these facilities, pollutants of concern include: oil and grease, ethylene glycol, heavy metals, petroleum hydrocarbons, solvents, suspended solids, acid/alkaline wastes, detergents, phosphorus and salts.

Table E-13
Summary Statistics From (Part 2) Sampling Results by Industrial Sector
Industrial Sector 13

Pollutant	Grab Samples (mg/l)				Composite Samples (mg/l)				NURP Results (mg/l)		
	No.	Mean	Median	95%	No.	Mean	Median	95%	Mean	Median	90%
BOD5	13	7.15	6.00	16.00	30	12.61	6.50	48.00	12.00	9.00	15.00
COD	30	135.00	61.00	250.00	13	66.23	60.00	155.00	82.00	65.00	140.00
Copper									0.04	0.04	0.09
Lead									0.18	0.14	0.35
NO_2+NO_3-N	13	1.70	0.83	5.65	30	1.62	1.32	4.87	0.86	0.68	1.75
Oil & Grease	30	5.35	3.00	32.00					NR	NR	NR
P, Total	13	0.19	0.05	1.08	30	3.05	0.26	15.70	0.42	0.33	0.70
pH	29	7.38	7.41	8.20					NR	NR	NR
TKN	13	2.17	1.90	4.87	30	2.27	1.77	6.63	1.90	1.50	3.30
TSS	13	474.39	183.00	2300.00	30	839.07	226.00	5100.00	180.00	100.00	300.00
Zinc									0.20	0.16	0.50

Sector 14: Scrap and Waste Material Processing and Recycling Facilities

The definition of storm water discharge associated with industrial activity includes point source discharges from eleven major categories of facilities, including: ". . . category (vi) facilities involved in the recycling of materials, including metal scrapyards, battery reclaimers, salvage yards and automobile junk yards, including but limited to those classified as Standard Industrial Classification (SIC) 5093 and 5015." Automobile junk yards (SIC 5015) are addressed under Sector 13.

SIC 5093 includes establishments engaged in assembling, breaking up, sorting and the wholesale distribution of scrap and recyclable waste materials including bag, bottle and box wastes, fur cuttings, iron and steel scrap, metal and non-ferrous metal scrap, oil, plastics, rags, rubber, textiles, waste paper and rag wastes.

Table E-14.1
Materials and Sources of Pollutants of Concern

Significant Materials: White Goods (Appliances) <u>Potential Sources</u>: Leaking oil-filled capacitors, ballasts, leaking compressors, pumps, leaking pressure vessels, reservoirs, sealed electrical components and chipped or deteriorated painted surfaces <u>Pollutants of Concern</u>: PCBs, oil, lubricants, paint pigments or additives such as lead, and other heavy metals
<u>Significant Materials</u>: Ferrous and Non-ferrous turnings and cuttings <u>Potential Sources</u>: Cutting oil residue, metallic fines <u>Pollutants of Concern</u>: Oil, heavy metals
<u>Significant Materials</u>: Materials from Demolition projects <u>Potential Source</u>: Deteriorated/damaged insulation, chipped painted surfaces, lead, copper, and steel pipes <u>Pollutants of Concern</u>: asbestos fibers, lead, copper, zinc, cadmium, other metals

Table E-14.1
Materials and Sources of Pollutants of Concern (continued)

Significant Materials: Electrical Components, transformers, switch gear, mercury float switches, sensors Potential Sources: Leaking oil-filled transformer casings, oil-filled switch, float switches, radioactive materials in gauges, sensors Pollutants of Concern: PCBs, oils, mercury, ionizing radioactive isotopes
Significant Materials: Fluorescent lights, light fixtures Potential Sources: Leaking ballasts Pollutants of Concern: PCBs, oil
Significant Materials: Food/Beverage Dispensing Equipment Potential Sources: Leaking fluorescent light ballasts, chipped painted surfaces Pollutants of Concern: PCBs, oil, heavy metals from paint pigments and additives
Significant Materials: Hospital and Dental Waste & Equipment Potential Sources: Drums/containers of hospital waste, shielding from diagnostic and other medical equipment, radioactive materials from gauges, sensors and diagnostic equipment Pollutants of Concern: Infectious/bacterial contamination, lead, ionizing radioactive isotopes
Significant Materials: Instruments Potential Sources: Radioactive material from thickness gages Pollutants of Concern: Ionizing radioactive isotopes
Significant Materials: Insulated wire Potential Sources: Insulation and other coatings, wire Pollutants of Concern: Lead, zinc, copper

Table E-14.1
Materials and Sources of Pollutants of Concern (continued)

Significant Materials: Lawnmowers, snowmobiles, motorcycles Potential Sources: Leaking engines, transmissions, fuel, oil reservoirs,leaking batteries Pollutants of Concern: Oils, transmission and brake fluids, fuel, grease, battery acid, lead acid
Significant Materials: Light gage materials Potential Sources: Deteriorating insulation, painted surfaces and other coatings Pollutants of Concern: Asbestos, lead, chromium
Significant Materials: Locomotives, rail cars Potential Sources: Leaking fuel reservoirs, fittings, hydraulic components, engines, bearings, compressors, oil reservoirs, worn brake pads, damaged insulation Pollutants of Concern: PCBs, diesel fuel, hydraulic oil, oil, brake fluid, grease from fittings, asbestos,
Significant Materials: Motor Vehicle Bodies, Engines, Transmissions, Exhaust systems Potential Sources: Leaking fuel tanks, oil reservoirs, transmission housings, brake fluid reservoir and lines, brake cylinders, shock absorber casing, engine coolant, wheel weights, leaking battery casings/housings and corroded terminals, painted surfaces and corrosion inhibitors, exhaust system, catalytic converters Pollutants of Concern: Fuel, benzene, oil, hydraulic oil, transmission fluids, brake fluids, ethylene glycol (antifreeze), lead, lead acid, lead oxides, cadmium, zinc, other heavy metals
Significant Materials: Misc. Machinery and obsolete equipment Potential Sources: Leaking reservoirs, damaged or chipped painted surfaces/coatings Pollutants of Concern: Fuel, oil, lubricants, lead, cadmium, zinc

Table E-14.1
Materials and Sources of Pollutants of Concern (continued)

Significant Materials: Pipes/Materials from Chemical and Industrial Plants Potential Sources: Chemical residue, insulation, lead piping, chipped or damaged painted surfaces and protective coatings Pollutants of Concern: Chemical residue, oil, lubricants, damaged insulation (asbestos), lead, cadmium, zinc, copper
Significant Materials: Sealed containers, hydraulic cylinders Potential Sources: Leaking liquid reservoirs, containers, cylinders, misc. chemicals Pollutants of Concern: Oil, PCBs, solvents, chemical residue
Significant Materials: Salvaged Construction Materials Potential Sources: Chemical residues, oils, solvents, lubricants, damaged insulation, chipped painted surfaces and protective coatings Pollutants of Concern: Chemical residue, oily wastes, asbestos, lead, cadmium, zinc
Significant Materials: Tanks, containers, vessels, cans, drums Potential Sources: Leaking or damaged containers Pollutants of Concern: Chemical residue, oily wastes, petroleum products, heating oil
Significant Materials: Transformers (oil filled) Potential Sources: Leaking transformer housings Pollutants of Concern: PCBs, oil

[1] Institute of Scrap Recycling Industries, Inc.'s Environmental Operating Guidelines, (April 1992)

(2) **Material Processing**. The type of processes employed at a particular facility depends on the type of recyclable and waste material. Typical processes include; torch cutting, shredding, baling, briquetting, wire stripping and chopping, and compacting. Processes such as shredding and shearing reduce the bulk size of recyclable scrap and waste into a size that is more easily transportable and which allows separation into uniform grades based on

manufacturer specifications. Processes such as shredding of automotive bodies include a means of segregating materials into their ferrous and non-ferrous fractions.

(3) Segregation of Processed Materials into Uniform Grades. Processing, e.g., shearing, shredding, baling, etc, of recyclable materials is followed by its segregation into uniform grades to meet a particular manufacturer's specifications. If segregated recyclable material remains exposed to precipitation, the potential still exists for storm water contamination.

(4) Disposal of Non-recyclable Waste Materials. During recycling of scrap and waste materials, a significant fraction is non-recyclable waste materials and must be disposed. The volume or quantity of material that remains un-recyclable may be too large to permit covered storage prior to shipment. Consequently, un-recyclable waste materials may be left exposed to both precipitation and runoff and, therefore, they are a likely source of storm water pollutants.

(5) Other Operations of Concern. There are a number of activities that frequently occur at scrap and waste recycling facilities including, heavy vehicle traffic over unstabilized areas, vehicle maintenance and fueling, and material handling operations. Operations associated with the receipt, handling, and processing of scrap and waste material frequently occur over areas that are not stabilized to prevent erosion. Erosion of unstabilized soils is potentially a significant source of suspended solids in storm water runoff. For example, sampling results for total suspended solids (TSS) concentrations provided in sampling data indicated a mean concentration of 466 mg/l. Unless specific measures or controls are provided to either prevent erosion or trap the sediment, this material will be carried away in storm water runoff and eventually exit the site. Suspended solids are of significant concern given the potential amount of unstabilized area and the significant amount of particulate matter that is often produced at these facilities. Both organic and inorganic pollutants can become bound up or absorbed to suspended solids in runoff.

Some scrap and waste recycling facilities may also conduct vehicle maintenance on-site. Although many of these activities frequently occur indoors, there are specific activities which could contribute pollutants to storm water. This includes washdown of vehicle maintenance areas, leaks or spills of fuel, hydraulic fluids and oil and outdoor storage of lubricants, fluids, oils and oily rags. Fueling stations are also frequently conducted outdoors without any roof cover. Activities such as topping off fuel tanks, or overfilling storage tanks (without high-level alarms) are also activities that can cause contamination of runoff. One last activity of concern is vehicle washing which can result in accumulated residue material being discharged to a storm sewer system.

The following table highlights activities associated with vehicle maintenance and material handling that are potential sources of storm water contamination.

Table E-14.2
Other Potential Pollutant Source Activities

Activity: Material Handling Systems (forklifts, cranes, conveyors) Potential Sources: Spills and/or leaks from fueling tanks, spills/leaks from oil/hydraulic fuel reservoirs, faulty/leaking hose connections/fittings, leaking gaskets Pollutants of Concern: Accumulated particulate matter (ferrous and non-ferrous metals, plastics, rubber, other), oil/lubricants, PCBs (electrical equipment), mercury (electrical controls), lead/battery acids
Activity: Vehicle Maintenance Potential Sources: Parts cleaning, waste disposal of rags, oil filters, air filters, batteries, hydraulic fluids, transmission fluids, brake fluids, coolants, lubricants, degreasers, spent solvents Pollutants of Concern: Fuel (gas/diesel), fuel additives, oil/lubricants, heavy metals, brake fluids, transmission fluids, chlorinated solvents, arsenic
Activity: Fueling stations Potential Sources: spills and leaks during fuel transfer, spills due to "topping off" tanks, runoff from fueling areas, washdown of fueling areas, leaking storage tanks,spills of oils, brake fluids, transmission fluids, engine coolants, Pollutants of Concern: gas/diesel fuel, fuel additives, oil, lubricants, heavy metals
Activity: Vehicle & Equipment cleaning & washing Potential Sources: Washing and steam cleaning Pollutants of Concern: solvent cleaners, oil/lubricants/additives, antifreeze (ethylene glycol)

b. Waste Recycling Facilities (SIC 5093) - (Liquid Recyclable Wastes)

This sub-section applies to those facilities engaged in the reclaiming and recycling of liquid wastes such as "spent solvents", "used oil", and "used ethylene glycol" typically identified under SIC 5093. This sub-section is particularly applicable to those facilities that participated in EPA group application number 195. EPA received a single group application in this category of waste recycling facilities. The following is a profile of industrial activities and the types of significant materials associated with facilities participating in this group activity.

Group application number 195 included 220 facilities of which 214 were classified as service centers. Service centers accumulate spent solvent, used oil and antifreeze, filter cartridges and still bottoms contaminated with dry cleaning solvents (typically perchloroethylene), and used lacquer thinner from paint gun cleaning machines. The typical service center has a total storage capacity limited to approximately 10,000 gallons in individual containers and tanks with a maximum storage capacity of 20,000 gallons each. Service centers are typically limited to a maximum of 6 tanks (a total of 120,000 gallons). Twenty (20) of the service centers also function as accumulation centers where they have a maximum storage capacity of 70,000 gallons of liquid materials in containers. None of the containers are opened except under conditions where a container begins to leak or is damaged.

The group application also included four (4) facilities that operated only as container transfer stations and do not operate storage tanks. These facilities are largely enclosed warehouses that provide secondarily-contained storage areas. Three (3) facilities were identified as used oil depots where only oily water and/or used oil are accumulated in storage tanks. Storage tanks are limited to a maximum capacity of 20,000 gallons each. Used oil is transported to the facility in tanker trucks (3,500 gallons) and shipped out in tanker trucks (7,500 gallons). The used oil is ultimately transported to a processing or re-refining facility (not covered under this permit). The following table summarizes the percentage of facilities with significant materials stored.

Table E-14.3
Significant Materials Reported in Group Application Number 195

Significant Materials	Percent of Facilities
Mineral Spirits	98%
Immersion Cleaner	98%
Dry Cleaner Solvents	98%
Paint Solvents	83%
Industrial Solvents	81%
Spent Antifreeze	59%
Used Oil	57%
Allied Products	98%

The types of materials identified in Table E-14.3 are potential sources of storm water runoff contamination. Since these materials are stored and transported in individual drums and bulk storage tanks, the potential exists for spills and/or leaks during all phases of waste transport, waste transfer, container/drum handling and shipping.

There are a number of operations at these facilities that have significant potential to release pollutants to the environment if recyclable waste materials are not managed properly. However, in response to other Federal and State environmental regulations, such as RCRA and 40 CFR 112 (Oil Pollution Prevention), facilities in this group application currently employ a range of the best management practices and structural controls that also benefit storm water quality.

(1) Pollutants Found in Storm Water Discharges. Based on data provided in the group application number 195, pollutants that were most frequently reported included total suspended solids (TSS), BOD, COD, nitrite plus nitrate, oil & grease. The following table provides a statistical summary of data provided in group application number 195.

Table E-14.4
Summary Statistics for Waste Recycling Facilities in Group Application Number 195 (SIC 5093) - (Recyclable Liquid Wastes). All values in mg/l.

Paragraph	# of Samples		Mean		Min		Max		Median		99th Percentile	
Sample Type	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD5	22	17	18	9	2	2	94	48	5	5	79	38
COD	22	17	133	83	12	5	660	400	45	45	449	320
TSS	21	16	51	28	5	5	500	84	28	20	68	59
Nitrite + Nitrate	22	17	0.90	0.78	0.05	0.05	3.70	3.50	0.61	0.38	3.45	3.29
TKN	22	17	3.1	2.0	1.0	1.0	11.0	6.0	1.5	1.0	9.9	5.7
Oil & Grease	22	17	1.8	1.5	1.0	1.0	5.0	3.0	1.5	1.0	4.0	3.0

Table E-14.4 indicates that, with the exception of BOD and COD, average concentrations in grab and composite samples were comparable with average values reported in the NURP study (NURP did not measure oil & grease). The data also indicates that pollutants such as industrial solvents were all below detection limits (without values). In the case of oil & grease, all concentration values were below the reportable concentration of 10 mg/l (see 40 CFR 110.10 and 117.21).

(2) Waste Material Handling and Storage. Given the nature and type of materials stored and handled at these facilities, the potential exists for accidental spills and leaks. Consequently, the types of activities that occur at these facilities which could potentially result in contamination of storm water runoff is also of concern to EPA. The following table is a list of activities which may result in a release of pollutants.

Table E-14.5
Types of Potential Pollutant-Causing Activities at Waste Recycling Facilities that Handle Liquid Recyclable Wastes

Activity: Drum/Individual Container Storage and Handling Potential Sources of Pollutants: Leaks or spills due to faulty container/drum integrity, e.g., leaking seals or ports. Container materials incompatible with waste material. Improper stacking and storage of containers. Pollutants of Concern: Mineral spirits, industrial solvents, immersion cleaners, dry cleaner solvents, paint solvents, spent antifreeze.
Activity: Return and Fill Stations Potential Sources of Pollutants: Leaks, spills, or overflows from tanker truck transfer of wastes and hose drainage. Leaking pipes, valves, pumps, worn or deteriorated gaskets or seals Pollutants of Concern: Mineral spirits, industrial solvents, immersion cleaners, dry cleaner solvents, paint solvents, spent antifreeze.
Activity: Individual Container/Drum Storage Potential Sources of Pollutants: Leaks or spills due to faulty container/drum integrity, e.g., leaking seals or ports. Improper stacking and storage of containers. Pollutants of Concern: Mineral spirits, industrial solvents, immersion cleaners, dry cleaner solvents, paint solvents, spent antifreeze.

Table E-14.5
Types of Potential Pollutant-Causing Activities at Waste Recycling Facilities that Handle Liquid Recyclable Wastes (continued)

Activity: Storage Tank Operations Potential Sources of Pollutants: Overfill of storage tanks, leaking pipes, valves, worn or deteriorated pumps seals. Leaking underground storage tanks Pollutants of Concern: Mineral spirits, industrial solvents, immersion cleaners, dry cleaner solvents, paint solvents, spent antifreeze.
Activity: Material Handling Equipment Potential Sources of Pollutants: Leaking fuel lines, worn gaskets, leaking hydraulic lines and connections. Pollutants of Concern: Fuel, hydraulic fluid, oil and grease.

3. Other Activities of Concern:

The following table highlights other types of activities that are potential sources of storm water contamination.

Table E-14.6
Other Potential Sources of Storm Water Contamination

Activity: Vehicle and Equipment Maintenance (if applicable) Potential Sources of Pollutants: Replacement of fluids such as transmission and brake fluids, antifreeze, oil and other lubricants, washdown of maintenance areas, dumping fluids down floor drains connected to storm sewer system, outside storage of fluids and oily rags and waste material. Pollutants of Concern: Oil and grease, fuel, accumulated particulate matter, antifreeze.
Activity: Vehicle or Equipment Washing (if applicable) Potential Sources of Pollutants: Wash water or steam cleaning Pollutants of Concern: Oil, detergents, chlorinated solvents, suspended solids and accumulated particulate matter.

Table E-14.7
Summary Statistics From (Part 2) Sampling Results by Industrial Sector
Industrial Sector 14

Pollutant	Grab Samples (mg/l)				Composite Samples (mg/l)				NURP Results (mg/l)		
	No.	Mean	Median	95%	No.	Mean	Median	95%	Mean	Median	90%
BOD5	130	23.49	9.00	89.00	120	24.00	9.00	88.00	12.00	9.00	15.00
COD	130	253.33	120.00	1100.00	117	203.71	110.00	700.00	82.00	65.00	140.00
Copper	102	0.77	0.26	3.00	95	0.63	0.22	2.50	0.04	0.04	0.09
Lead	103	0.85	0.21	4.00	96	0.88	0.22	3.40	0.18	0.14	0.35
NO_2+NO_3-N	129	1.78	0.62	3.30	117	5.88	0.80	12.00	0.86	0.68	1.75
Oil & Grease	135	8.95	5.00	32.00					NR	NR	NR
P, Total	127	0.81	0.30	2.20	114	0.77	0.29	1.80	0.42	0.33	0.70
pH	136	7.52	7.47	9.10					NR	NR	NR
TKN	127	3.44	2.05	11.10	114	3.38	2.20	9.20	1.90	1.50	3.30
TSS	130	437.11	148.00	2096.00	116	375.84	84.50	1700.00	180.00	100.00	300.00
Zinc	97	3.16	1.40	12.00	90	3.20	1.40	10.00	0.20	0.16	0.50

Sector 15: Steam Electric Power Generating Facilities, Including Coal Handling Areas.

The definition of storm water discharges associated with industrial activity includes point source discharges of storm water from eleven major categories of facilities, including: "...category (vii) steam electric power generating facilities." The steam electric power generating category includes facilities which are coal, oil, gas, or nuclear fired. Heat captured co-generation facilities are not covered under the definition of storm water discharge associated with industrial activity, however, dual fuel co-generation facilities are included in the definition. Ancillary facilities such as fleet centers, gas turbine stations, and substations that are not contiguous to a steam electric power generation facility are not included in this classification.

Pollutants of concern include fuel, oil, heavy metals, ammonia, chlorine, sulfuric acid, sodium hydroxide, ethylene glycol, arsenic, and solvents.

Table E-15
Summary Statistics From (Part 2) Sampling Results by Industrial Sector
Industrial Sector 15

	Grab Samples (mg/l)				Composite Samples (mg/l)				NURP Results (mg/l)		
Pollutant	No.	Mean	Median	95%	No.	Mean	Median	95%	Mean	Median	90%
BOD5	76	5.71	4.25	20.00	78	5.69	4.00	20.00	12.00	9.00	15.00
COD	76	104.02	32.50	360.00	77	69.47	39.50	280.00	82.00	65.00	140.00
Copper	70	0.08	0.00	0.21	75	0.03	0.02	0.13	0.04	0.04	0.09
Lead	28	0.02	0.00	0.08	23	0.02	0.01	0.07	0.18	0.14	0.35
NO_2+NO_3-N	76	5.62	0.36	3.70	77	0.75	0.45	3.20	0.86	0.68	1.75
Oil & Grease	88	1.38	0.00	6.00					NR	NR	NR
P, Total	75	0.79	0.29	3.09	78	0.63	0.27	3.10	0.42	0.33	0.70
pH	70	7.32	7.42	8.28					NR	NR	NR
TKN	76	2.41	1.25	8.55	78	1.95	1.00	10.00	1.90	1.50	3.30
TSS	76	516.25	44.00	1200.00	77	212.35	40.00	810.00	180.00	100.00	300.00
Zinc	35	0.32	0.05	0.66	39	0.27	0.06	0.92	0.20	0.16	0.50

Sector 16: Motor Freight Transportation Facilities, Passenger Transportation Facilities, Rail Transportation Facilities, and United States Postal Service Transportation Facilities

The definition of storm water discharges associated with industrial activity includes point source discharges of storm water from eleven major categories of facilities, including: "...category (viii) facilities classified as Standard Industrial Classification (SIC) codes 40, 41, 42 (except 4221-25), 43, 44, and 5171 that have vehicle and equipment maintenance shops, or equipment cleaning operations." The category further states that only those portions of the facility that are either involved in vehicle and equipment maintenance (including vehicle and equipment rehabilitation, mechanical repairs, painting, fueling, and lubrication) or equipment cleaning operations are associated with industrial activity.

Vehicle and equipment maintenance is a broad term used to include the following activities: vehicle and equipment fluid changes, mechanical repairs, parts cleaning, sanding, refinishing, painting, fueling, locomotive sanding (loading sand for traction), storage of vehicles and equipment waiting for repair or maintenance, and storage of the related materials and waste materials, such as oil, fuel, batteries, tires, or oil filters. Equipment cleaning operations include areas where the following types of activities take place: vehicle exterior wash down, interior trailer washouts, tank washouts, and rinsing of transfer equipment.

SIC code 40 includes facilities primarily engaged in furnishing transportation by line-haul railroad, and switching and terminal establishments. The following types of facilities are examples of those covered under SIC code 40: electric railroad line-haul operation, railroad line-haul operation, interurban railways, beltline railroads, logging railroads, railroad terminals, and stations operated by railroad terminal companies.

SIC code 41 includes facilities primarily engaged in furnishing local and suburban transportation, such as those providing transportation in and around a municipality by bus, rail, or subway. The following types of facilities are examples of those covered under SIC code 41: bus line operations, airport transportation services (road or rail), cable car operations, subway operations, ambulance services, sightseeing buses, van pool operations, limousine rental with drivers, taxicab operations, and school buses not operated by the educational institution.

SIC code 42 includes facilities providing local or long-distance trucking, transfer, and/or storage services. The following types of facilities are examples of those covered under SIC code 42: hauling by dump truck, trucking timber, contract mail carriers, furniture moving, garbage collection without disposal, over-the-road trucking, long distance trucking, and freight trucking terminal.

SIC code 43 includes all establishments of the United States Postal Service.

SIC code 5171 includes establishments engaged in the wholesale distribution of crude petroleum and petroleum products from bulk liquid storage facilities.

Significant materials include oily rags, air filters, batteries, hydraulic fluids, paints, and vehicles awaiting service.

Pollutants include fuel, oil, heavy metals, chlorinated solvents, acid/alkaline wastes, ethylene glycol, arsenic, heavy metals, organics, hydraulic fluids, dust, paint solids, sediment, detergents, phosphorus, salts, suspended solids, and biochemical oxygen demand (BOD).

Table E-16
Summary Statistics From (Part 2) Sampling Results by Industrial Sector
Industrial Sector 16

	Grab Samples (mg/l)				Composite Samples (mg/l)				NURP Results (mg/l)		
Pollutant	No.	Mean	Median	95%	No.	Mean	Median	95%	Mean	Median	90%
BOD5	116	11.29	6.00	34.00	105	9.27	6.00	28.00	12.00	9.00	15.00
COD	117	318.10	118.00	781.00	102	189.46	89.00	489.00	82.00	65.00	140.00
Copper									0.04	0.04	0.09
Lead									0.18	0.14	0.35
NO_2+NO_3-N	118	1.59	0.92	6.07	102	1.41	0.78	4.26	0.86	0.68	1.75
Oil & Grease	118	9.56	0.00	27.00					NR	NR	NR
P, Total	118	1.47	0.54	8.10	102	0.92	0.45	3.05	0.42	0.33	0.70
pH	114	7.30	7.40	8.80					NR	NR	NR
TKN	118	3.75	1.50	13.40	102	2.48	1.40	8.80	1.90	1.50	3.30
TSS	118	517.01	171.50	2800.00	102	248.51	89.50	917.00	180.00	100.00	300.00
Zinc	1	0.14	0.14	0.14	1	0.28	0.28	0.28	0.20	0.16	0.50

Sector 17: Vehicle and Equipment Maintenance and Cleaning Operations

The definition of storm water discharge associated with industrial activity includes point source discharges of storm water from eleven major categories of facilities, including: "...category (viii) transportation facilities classified as Standard Industrial Classification (SIC) codes 40, 41, 42 (except 4221-25), 43, 44, 45, and 5171 that have vehicle and equipment maintenance shops, equipment cleaning operations, or airport deicing operations."

SIC code 41 includes facilities primarily engaged in furnishing local and suburban transportation, such as those providing transportation in and around a municipality by bus, rail, or subway. The following types of facilities are examples of those covered under SIC code 41: bus line operation, airport transportation service (road or rail), cable car operation, subway operation, ambulance service, sightseeing buses, van pool operation, limousine rental with drivers, taxicab operation, and school buses not operated by the educational institution.

SIC code 42 includes facilities providing local or long-distance trucking, transfer, and/or storage services. The following types of facilities are examples of those covered under SIC code 42: hauling by dump truck, trucking timber, contract mail carriers, furniture moving, garbage collection without disposal, over-the-road trucking, long distance trucking, and freight trucking terminal.

SIC code 43 includes all establishments of the United States Postal Service.

SIC code 5171 includes establishments engaged in the wholesale distribution of crude petroleum and petroleum products from bulk liquid storage facilities.

Vehicle and equipment maintenance is a broad term used to include the following activities: vehicle and equipment fluid changes, mechanical repairs, parts cleaning, sanding, refinishing, painting, fueling, storage of vehicles and equipment waiting for repair or maintenance, and storage of the related materials and waste materials, such as oil, fuel, batteries, or oil filters. Equipment cleaning operations include areas where the following types of activities take place: vehicle exterior wash down, interior trailer washouts, tank washouts, and rinsing of transfer equipment.

Significant materials include oils, washing equipment, used equipment, vehicle parts, vehicles, fuels, paint, waste rags, oil filters, storage tanks, and detergents. Pollutants from these facilities include fuel, oil, heavy metals, organics, solvents, suspended solids, phosphorus, salts, acid/alkaline wastes and arsenic.

Table E-17
Summary Statistics From (Part 2) Sampling Results by Industrial Sector
Industrial Sector 17

Pollutant	Grab Samples (mg/l)				Composite Samples (mg/l)				NURP Results (mg/l)		
	No.	Mean	Median	95%	No.	Mean	Median	95%	Mean	Median	90%
BOD5	400	17.11	8.00	60.50	376	11.07	6.00	41.00	12.00	9.00	15.00
COD	408	135.16	63.95	498.00	374	85.64	48.00	250.00	82.00	65.00	140.00
Copper	19	0.02	0.01	0.06	20	0.02	0.01	0.08	0.04	0.04	0.09
Lead	32	0.03	0.01	0.11	31	0.01	0.00	0.06	0.18	0.14	0.35
NO_2+NO_3-N	399	2.99	0.61	9.00	372	1.99	0.52	5.10	0.86	0.68	1.75
Oil & Grease	418	16.38	2.80	41.00					NR	NR	NR
P, Total	405	1.12	0.33	3.90	373	0.73	0.29	2.91	0.42	0.33	0.70
pH	380	7.13	7.26	8.89					NR	NR	NR
TKN	405	2.69	1.40	7.70	373	2.04	1.13	6.30	1.90	1.50	3.30
TSS	406	503.15	104.00	1890.00	375	454.20	67.00	1100.00	180.00	100.00	300.00
Zinc	30	0.23	0.13	1.10	28	1.34	0.11	0.66	0.20	0.16	0.50

Sector 18: Water Transportation Facilities, Vehicle Maintenance/Equipment Cleaning Operations

The definition of storm water discharges associated with industrial activity includes point source discharges of storm water from eleven major categories of facilities, including: ...category (viii) water transportation facilities classified as Standard Industrial Classification (SIC) code 44 that have vehicle maintenance shops and/or equipment cleaning operations. The category further states that only those portions of the facility that are either involved in vehicle and equipment maintenance (including vehicle and equipment rehabilitation, mechanical repairs, painting, fueling, and lubrication), or equipment cleaning operations are associated with industrial activity. Vehicle and equipment maintenance is a broad term used to include the following activities: vessel and equipment fluid changes, mechanical repairs, parts cleaning, sanding, blasting, welding, refinishing, painting, fueling, storage of the related materials and waste materials, such as oil, fuel, batteries, or oil filters. Equipment cleaning operations include areas where vessel and vehicle exterior washdown occurs.

SIC code 44 includes facilities primarily engaged in furnishing water transportation services. The following types of facilities are examples of those covered under SIC code 44:

- Deep Sea Foreign Transportation of Freight (SIC 4412)
- Deep Sea Domestic Transportation of Freight (SIC 4424)
- Freight Transportation on the Great Lakes - St. Lawrence Seaway (SIC 4432)
- Water Transportation of Freight, Not Elsewhere Classified (SIC 4449)
- Deep Sea Transportation of Passengers, Except by Ferry (SIC 4481)
- Ferries (SIC 4482)
- Marine Cargo Handling (SIC 4491)
- Towing and Tugboat Services (SIC 4492)
- Marinas (SIC 4493)
- Water Transportation Services, Not Elsewhere Classified (SIC 4499)

Pollutants of concern include paint solids, heavy metals, suspended solids, spent abrasives, solvents, dust, paint, paint thinner, spent solvents, dust, oil, ethylene glycol, acid/alkaline wastes, detergents, fuel, trash, petroleum products, sanitary waste bilge & ballast water, biochemical oxygen demand (BOD), and bacteria.

Table E-18
Summary Statistics From (Part 2) Sampling Results by Industrial Sector
Industrial Sector 18

Pollutant	Grab Samples (mg/l)				Composite Samples (mg/l)				NURP Results (mg/l)		
	No.	Mean	Median	95%	No.	Mean	Median	95%	Mean	Median	90%
BOD5	15	8.60	7.00	39.00	14	6.00	6.00	11.00	12.00	9.00	15.00
COD	15	130.93	93.00	500.00	14	75.79	50.50	203.00	82.00	65.00	140.00
Copper									0.04	0.04	0.09
Lead	4	0.20	0.05	0.70	3	0.10	0.10	0.10	0.18	0.14	0.35
NO_2+NO_3-N	15	4.23	0.60	54.00	14	0.66	0.65	1.61	0.86	0.68	1.75
Oil & Grease	15	11.93	2.00	96.00					NR	NR	NR
P, Total	15	0.27	0.10	1.20	14	0.15	0.17	0.32	0.42	0.33	0.70
pH	15	7.14	7.00	8.80					NR	NR	NR
TKN	15	2.64	1.60	16.00	14	9.41	0.75	118.00	1.90	1.50	3.30
TSS	15	633.80	135.00	4330.00	14	224.14	67.50	944.00	180.00	100.00	300.00
Zinc	4	0.68	0.22	2.20	3	0.42	0.21	0.87	0.20	0.16	0.50

Sector 19: Ship Building & Repairing and Boat Building & Repairing Facilities

The definition of storm water discharges associated with industrial activity includes point source discharges of storm water from eleven major categories of facilities, including: "...category (ii) facilities classified as Standard Industrial Classification (SIC) code 373." SIC code 373 includes facilities primarily engaged in ship and boat building and repairing services, and include the following:

- **Ship Building and Repairing (SIC code 3731).** These are establishments primarily engaged in building and repairing ships, barges, and lighters, whether self-propelled or towed by other crafts. The industry also includes the conversion and alteration of ships and the manufacture of off-shore oil and gas well drilling and production platforms (whether of not self-propelled). Examples include building and repairing of barges, cargo vessels, combat ships, crew boats, dredges, ferryboats, fishing vessels, lighthouse tenders, naval ships, offshore supply boats, passenger-cargo vessels, patrol boats, sailing vessels, towboats, trawlers, and tugboats.

- **Boat Building and Repairing (SIC code 3732).** These facilities are primary engaged in building and repairing boats. Examples include building and repairing of fiberglass boats, motor-boats, sailboats, rowboats, canoes, dinghies, dories, small fishing boats, houseboats, kayaks, lifeboats, pontoons, and skiffs.

Pollutants of concern include spent abrasives, solvents, dust, oil, ethylene glycol, acid/alkaline wastes, detergents, paint solids, heavy metals, spent solvents, biochemical oxygen demand (BOD), bacteria, suspended solids.

Table E-19
Summary Statistics From (Part 2) Sampling Results by Industrial Sector
Industrial Sector 19

	Grab Samples (mg/l)				Composite Samples (mg/l)				NURP Results (mg/l)		
Pollutant	No.	Mean	Median	95%	No.	Mean	Median	95%	Mean	Median	90%
BOD5	44	5.00	2.80	15.00	37	7.40	0.90	23.00	12.00	9.00	15.00
COD	51	73.22	53.00	260.00	43	68.80	28.00	240.00	82.00	65.00	140.00
Copper	5	0.16	0.15	0.32	5	0.08	0.09	0.13	0.04	0.04	0.09
Lead	6	0.75	0.04	4.24	5	11.00	0.06	0.33	0.18	0.14	0.35
NO_2+NO_3-N	51	0.79	0.72	1.60	45	0.85	0.72	1.80	0.86	0.68	1.75
Oil & Grease	52	0.98	0.00	5.00					NR	NR	NR
P, Total	51	0.21	0.00	0.91	45	0.88	0.00	0.76	0.42	0.33	0.70
pH	43	7.20	7.30	8.11					NR	NR	NR
TKN	51	1.19	1.00	2.40	43	2.20	0.97	3.90	1.90	1.50	3.30
TSS	51	92.33	17.00	505.00	45	2.36	8.00	200.00	180.00	100.00	300.00
Zinc	2	0.31	0.31	0.36	1	39.00	0.33	0.33	0.20	0.16	0.50

Sector 20: Vehicle Maintenance Areas, Equipment Cleaning Areas, or Deicing Areas Located at Air Transportation Facilities

The definition of storm water discharges associated with industrial activity includes point source discharges of storm water from eleven major categories of facilities, including: "... category (viii) facilities classified as Standard Industrial Classification (SIC) 45 that have vehicle and equipment maintenance shops, equipment cleaning operations, or airport deicing operations." Only those portions of the facility that are either involved in vehicle and equipment maintenance (including vehicle and equipment rehabilitation, mechanical repairs, painting, fueling, and lubrication), equipment cleaning operations, or airport deicing operations are considered associated with industrial activity. SIC code 45 generally applies to airports, airport terminals and flying fields. Industrial activities include the following:

Aircraft Deicing includes both deicing to remove frost, snow or ice, and anti-icing which prevents the accumulation of frost, snow or ice. Deicing of an airplane is accomplished through the application of a freezing point depressant fluid, commonly ethylene glycol or propylene glycol, to the exterior surface of an airplane. Both ethylene and propylene glycol have high biochemical oxygen demands (BOD) when discharged to receiving waters. Environmental impacts on surface waters due to glycol discharges includes glycol odors and glycol contaminated surface water and ground water systems, diminished dissolved oxygen levels and fish kills.

Runway Deicing/Anti-icing activities include deicing/anti-icing operations conducted on runways, taxiways and ramps. Runway deicing/anti-icing commonly involves either the application of chemical fluids such as ethylene glycol or propylene glycol, or solid constituents such as pelletized urea. Urea has a high nitrogen content, therefore degradation of urea in a receiving water causes an increase in nutrient loadings resulting in an accelerated growth of algae and eutrophic conditions. Under certain ambient conditions, the degradation of urea in receiving waters can also result in ammonia concentrations toxic to aquatic life.

Aircraft, Ground Vehicle and Equipment Maintenance and Washing. Maintenance activities included in this section include both minor and major operations conducted either on the apron adjacent to the passenger terminal, or at dedicated maintenance facilities. Potential pollutant sources from all types of maintenance activities includes spills and leaks of engine oils, hydraulic fluids, transmission oil, radiator fluids, and chemical solvents used for parts cleaning. In addition, the disposal of waste parts, batteries, oil and fuel filters, and oily rags also have a potential for contaminating storm water runoff from maintenance areas unless proper management practices and operating procedures are implemented. The spent wash water from aircraft and ground vehicle washing activities could potentially be contaminated with surface dirt, metals, and fluids (fuel, hydraulic fluid, oil, lavatory waste).

Runway Maintenance. Over time, materials such as tire rubber, oil and grease, paint chips, and jet fuel can buildup on the surface of a runway causing a reduction in the friction of the pavement surface. When the friction level of the runway falls below a specific level, then maintenance on the runway must be performed. The Federal Aviation Administration (FAA) recommends several methods for removing rubber deposits and other contaminants from a runway surface including high pressure water, chemical solvents, high velocity particle impact, and mechanical grinding. If not properly managed, the materials removed from the runway surface could be discharged into nearby surface waters. Similarly, if chemical solvents are used in the maintenance operation, improper management practices could result in discharges of the chemical solvents in the storm water runoff from runway areas to nearby surface waters.

Table E-20
Summary Statistics From (Part 2) Sampling Results by Industrial Sector
Industrial Sector 20

Pollutant	Grab Samples (mg/l)				Composite Samples (mg/l)				NURP Results (mg/l)		
	No.	Mean	Median	95%	No.	Mean	Median	95%	Mean	Median	90%
BOD5	96	23.95	7.50	42.00	89	21.34	5.30	41.40	12.00	9.00	15.00
COD	95	81.49	44.00	286.00	88	75.63	36.00	182.00	82.00	65.00	140.00
Copper	2	0.03	0.03	0.04	3	0.01	0.01	0.02	0.04	0.04	0.09
Lead	2	0.02	0.02	0.03	3	0.00	0.00	0.00	0.18	0.14	0.35
NO_2+NO_3-N	75	1.27	0.41	7.90	65	1.29	0.43	7.70	0.86	0.68	1.75
Oil & Grease	98	4.66	1.85	20.00					NR	NR	NR
P, Total	86	0.44	0.20	1.84	79	0.29	0.20	0.88	0.42	0.33	0.70
pH	94	7.23	7.60	8.30					NR	NR	NR
TKN	95	19.79	1.58	27.00	88	16.00	1.40	18.80	1.90	1.50	3.30
TSS	96	184.73	29.00	1080.00	87	79.59	22.00	258.00	180.00	100.00	300.00
Zinc	8	0.14	0.08	0.58	3	0.35	0.04	1.00	0.20	0.16	0.50

Sector 22: Domestic Wastewater Treatment Plants

The definition of storm water discharge associated with industrial activity includes point source discharges from eleven major categories of facilities, including: "...category (ix) treatment works treating domestic sewage or any other sewage sludge or wastewater treatment device or system, used in the storage treatment, recycling, and reclamation of municipal or domestic sewage, including land dedicated to the disposal of sewage sludge that are located within the confines of the facility, with a design flow of 1.0 mgd or more or required to have an approved pretreatment program under 40 CFR part 403." This category does not includes farm lands, domestic gardens or lands used for sludge management where beneficially reused which are not physically located in the confines of the facility, or areas that are in compliance with section 405 of the CWA.

Pollutants of concern include diesel, gasoline, petroleum products other than fuels: numerous grades of motor oils, gear and chassis lubricants, turbine oils, grease and hydraulic fluids, acid/alkaline wastes, arsenic, organics, chlorinated ethylene glycol, acids and bases for pH adjustments, disinfectants, polymers and coagulants, alum, ferric chloride, soda ash, lime, methanol, sodium aluminate, sodium hypochlorite, sodium hydrochloride mineral spirits, acetone, paint thinner, and lacquer thinner, toluene, TCE, isopropandlamine, and methyl-ethyl-ketone, dust, paint solids, paint, spent chlorinated solvents, commercial brands of balance fertilizers (6-6-6, 8-8-8 or 12-12-12), commercial sludge based products, fuel, process chemicals, diazanon, malathion, amdro, dimethylphthalate, diethyl phthalate, dichlorvos, carbaryl, skeetal, batex, liquid copper, bacteria, biochemical oxygen demand (BOD), suspended solids, oil, heavy metals, chlorinated solvents, ethylene glycol, detergents, metals, phosphorous.

Table E-22
Summary Statistics From (Part 2) Sampling Results by Industrial Sector
Industrial Sector 22

Pollutant	Grab Samples (mg/l)				Composite Samples (mg/l)				NURP Results (mg/l)		
	No.	Mean	Median	95%	No.	Mean	Median	95%	Mean	Median	90%
BOD5	90	33.26	11.50	53.40	89	46.11	8.00	200.00	12.00	9.00	15.00
COD	84	133.03	68.65	410.00	84	157.95	61.59	880.00	82.00	65.00	140.00
Copper	28	0.07	0.01	0.22	27	0.05	0.02	0.11	0.04	0.04	0.09
Lead	27	0.03	0.00	0.15	26	0.01	0.00	0.09	0.18	0.14	0.35
NO_2+NO_3-N	84	20.86	1.09	136.00	83	20.50	0.87	131.27	0.86	0.68	1.75
Oil & Grease	89	24.24	0.90	26.00					NR	NR	NR
P, Total	86	0.95	0.50	3.17	84	0.68	0.45	1.89	0.42	0.33	0.70
pH	82	6.80	6.98	7.83					NR	NR	NR
TKN	79	8.10	1.52	18.00	78	4.74	1.33	11.00	1.90	1.50	3.30
TSS	90	160.17	68.10	575.00	88	114.44	55.50	414.00	180.00	100.00	300.00
Zinc	23	0.23	0.06	0.75	22	0.12	0.06	0.43	0.20	0.16	0.50

Sector 23: Food and Kindred Products Manufacturing Facilities

The definition of storm water discharges associated with industrial activity includes point source discharges of storm water from eleven major categories of facilities, including: "...category (xi) facilities under Standard Industrial Classification (SIC) codes 20, 21 ..."

- Meat Products (SIC Codes 2011, 2013, and 2015)
- Dairy Products (SIC Codes 2021, 2022, 2023, 2024, and 2026)
- Canned, Frozen, and Preserved Fruits, Vegetables, and Food Specialties (SIC Codes 2032, 2033, 2034, 2035, 2037, and 2038)
- Grain Mill Products (SIC Codes 2041, 2043, 2044, 2045, 2046, 2047, and 2048)
- Bakery Products (SIC Codes 2051, 2052, and 2053)
- Sugar and Confectionery Products (SIC Codes 2061, 2062, 2063, 2064, 2066, 2067, and 2068)
- Fats and Oils (SIC Codes 2074, 2075, 2076, 2077, and 2079)
- Beverages (SIC Codes 2082, 2083, 2084, 2085, 2086, and 2087)
- Miscellaneous Food Preparations and Kindred Products (SIC Codes 2091, 2092, 2095, 2096, 2097, 2098, and 2099)
- Tobacco Products (SIC Codes 2111, 2121, 2131, and 2141).

Meat Products (SIC Code 201X) - Production related activities include stockyards, slaughtering (killing, blood processing, viscera handling, and hide processing), cutting and deboning, meat processing, rendering, and materials recovery.

Dairy Products (SIC Code 202X) - Typical operations may include: culturing, churning, pressing, curing, blending, condensing, sweetening, drying, milling, and packaging.

Canned, Frozen, and Preserved Fruits, Vegetables, and Frozen Specialties (SIC Code 203X) -Fruits and vegetables are washed, cut, blanched, and cooked prior to being classified as finished product. Additional operations may include drying, dehydrating, and freezing.

Grain Mills (SIC Code 204X) - Process operations performed in the grain mill subsector include: washing, milling, debranning, heat treatment (i.e., steeping, parboiling, drying and cooking), screening, shaping (i.e., extruding, grinding, molding, and flaking), and vitamin and mineral supplementing.

Bakery Products (SIC Code 205X) - Process operations in this subsector include mixing, shaping of dough, cooling, and decorating.

Sugar and Confectionery (SIC Code 206X) - Typical processes include mixing, cooking, and then forming using various techniques. The manufacture of chocolate products requires shelling, roasting, and grinding of the cocoa beans followed by the typical processing operations.

Fats and Oils (SIC Code 207X) Typical process operations at an animal and marine fats and oils facility include cooking of inedible fats and oils. Operations at an edible oils manufacturer include refining, bleaching, hydrogenation, fractionation, emulsification, deodorization, filtration, and blending of the crude oils into edible products.

Beverages (SIC Code 208X) - Process operations may include brewing, distilling, fermentation, blending, and packaging (i.e., bottling, canning, or bulk packaging).

Miscellaneous Food Preparation and Kindred Products (SIC Code 209X) - Process operations may include shelling, washing, drying, shaping, baking, frying, and seasoning.

Tobacco Products (SIC Code 21XX) - Typical process operations may include drying, blending, shaping, cutting and rolling.

Significant materials exposed to storm water at food and kindred products manufacturing facilities consist mostly of food products or byproducts and include acids (phosphoric, sulfuric), activated carbon, ammonia, animal cages, bleach, blood, bone meal, brewing residuals, calcium oxide, carbon dioxide, caustic soda, chlorine, cheese, coke oven tar, detergent, eggs, ethyl alcohol, fats (greases, shortening, oils), feathers, feed, ferric chloride, fruits, vegetables, coffee beans, gel bone, grain (flour, oats, wheat), hides, lard, manure, milk, salts (brine), skim powder, starch, sugar (sweetener, honey, fructose, syrup), tallow, wastes (off-spec product, sludge), whey, and yeast.

The pollutants of concern are biological oxygen demand (BOD_5), total suspended solids (TSS), oil and grease, pH, and chemicals from applications of pesticides.

Table E-23
Summary Statistics From (Part 2) Sampling Results by Industrial Sector
Industrial Sector 23

Pollutant	Grab Samples (mg/l)				Composite Samples (mg/l)				NURP Results (mg/l)		
	No.	Mean	Median	95%	No.	Mean	Median	95%	Mean	Median	90%
BOD5	298	51.15	13.90	206.00	287	42.54	11.00	180.00	12.00	9.00	15.00
COD	296	192.46	77.00	745.00	286	141.65	63.00	463.00	82.00	65.00	140.00
Copper	17	0.08	0.04	0.27	17	0.05	0.03	0.24	0.04	0.04	0.09
Lead	12	0.01	0.01	0.03	10	0.01	0.01	0.04	0.18	0.14	0.35
NO_2+NO_3-N	301	1.17	0.56	3.70	289	0.98	0.55	3.60	0.86	0.68	1.75
Oil & Grease	300	5.35	1.05	20.95					NR	NR	NR
P. Total	298	5.13	0.56	9.06	287	1.32	0.48	5.96	0.42	0.33	0.70
pH	286	7.06	7.10	8.40					NR	NR	NR
TKN	300	4.95	2.35	18.00	290	4.07	2.00	17.00	1.90	1.50	3.30
TSS	298	252.39	72.50	1320.00	286	200.06	53.50	900.00	180.00	100.00	300.00
Zinc	33	0.78	0.21	2.10	31	0.79	0.24	5.83	0.20	0.16	0.50

Sector 24: Textile Mills, Apparel and other Fabric Product Manufacturing Facilities

The definition of storm water discharges associated with industrial activity includes point source discharges of storm water from eleven major categories of facilities, including: "...category (xi) facilities under Standard Industrial Classification (SIC) code 22." Storm water discharges from the following activities are covered: Textile Mill Products, of and regarding facilities and establishments engaged in the preparation of fiber and subsequent manufacturing of yarn, thread, braids, twine, and cordage, the manufacturing of broadwoven fabrics, narrow woven fabrics, knit fabrics, and carpets and rugs from yarn; processes involved in the dyeing and finishing of fibers, yarn fabrics, and knit apparel; the integrated manufacturing of knit apparel and other finished articles of yarn; the manufacturing of felt goods (wool), lace goods, nonwoven fabrics, and miscellaneous textiles.

Pollutants of concern include biochemical oxygen demand (BOD5), total suspended solids (TSS), pH, total chromium, total aluminum, total copper, total lead, total zinc, COD, phenols, sulfides, oil and grease, and benzene.

Table E-24
Summary Statistics From (Part 2) Sampling Results by Industrial Sector
Industrial Sector 24

Pollutant	Grab Samples (mg/l)				Composite Samples (mg/l)				NURP Results (mg/l)		
	No.	Mean	Median	95%	No.	Mean	Median	95%	Mean	Median	90%
BOD5	110	11.41	7.75	38.00	107	9.82	7.00	29.00	12.00	9.00	15.00
COD	110	69.19	44.00	228.00	107	48.05	37.00	111.00	82.00	65.00	140.00
Copper	16	0.03	0.01	0.15	14	0.07	0.01	0.61	0.04	0.04	0.09
Lead	8	0.07	0.02	0.28	7	0.04	0.03	0.11	0.18	0.14	0.35
NO_2+NO_3-N	110	1.33	0.39	2.50	107	1.14	0.39	1.87	0.86	0.68	1.75
Oil & Grease	111	2.94	0.00	14.00					NR	NR	NR
P, Total	110	0.35	0.14	0.66	107	0.31	0.11	0.60	0.42	0.33	0.70
pH	105	6.72	6.85	8.60					NR	NR	NR
TKN	110	2.72	1.70	6.50	107	1.92	1.50	5.40	1.90	1.50	3.30
TSS	110	126.22	35.50	410.00	107	80.04	22.00	380.00	180.00	100.00	300.00
Zinc	6	0.33	0.19	1.06	14	0.30	0.21	0.88	0.20	0.16	0.50

Sector 25: Wood and Metal Furniture and Fixture Manufacturing Facilities

The definition of storm water discharges associated with an industrial activity includes point source discharges of storm water from eleven major categories of facilities, including: "...category (xi) facilities classified as Standard Industrial Classification (SIC) codes 2434 and 25." Furniture and fixture manufacturing facilities eligible for coverage include facilities identified by the following SIC codes:

- Wood Kitchen Cabinets (SIC Code 2434)
- Household Furniture (SIC Code 251)
- Office Furniture (SIC Code 252)
- Public Buildings and Related Furniture (SIC Code 253)
- Partitions, Shelving, Lockers, and Office and Store Fixtures (SIC Code 254)
- Miscellaneous Furniture and Fixtures (SIC Code 259).

The process of manufacturing wood furniture begins with the delivery and storage of wood. There are three different raw wood materials, lumber, veneer, and particle board. Once delivered, raw lumber is allowed to air dry up to one year. After the lumber is sufficiently air dried it is then transported to a dry kiln for further drying. Once the lumber has been dried to a desired moisture content, the dried lumber is taken to the processing area. The remaining furniture manufacturing processes are all completed indoors, including cutting, planing, sanding, finishing, and lathing.

Veneer is another raw material used in the production of furniture. In this process logs are placed in a steam vat to increase moisture content. The logs are turned on a lathe to peel off the veneer. The resulting veneer sheets are layered into stacks or "hacks." Moisture is removed from the hacks by kiln drying. After a desired moisture content has been achieved the hacks are disassembled.

Particle board is the third raw material incorporated into the manufacturing of wood furniture. The board is received, cut to size, and banded on all four edges with solid wood. The banding is accomplished in continuous, steam heated units utilizing adhesives. The panels are allowed to cool and then they are sanded.

The significant materials identified as exposed to storm water at wood furniture and fixture manufacturing facilities include raw wood, sawdust, coal, kiln ash, solvent-based finishing materials and waste products, used rags, raw glue and waste materials, and petroleum-based products.

Metal furniture manufacturing facilities may purchase wood pieces ready for assembly or they may have all the industrial activities of wood manufacturing facilities in addition to the metal manufacturing facilities. Facilities that manufacture metal household furniture maintain all operations including: machining and assembly, finishing, and temporary storage of finished products within an enclosed building. Cold roll steel is initially received and temporarily stored within the manufacturing building. However, steel may be stored outside prior to use. The steel is cut to size, bent, and welded to design specifications to fabricate raw metal household furniture. Final grinding, sanding, finishing, spot welding, and painting are then completed.

The significant materials identified as exposed to storm water at metal furniture and fixture facilities include metals, sawdust, solvent-based finishing materials and waste products, electroplating solutions and sludges, used rags, raw glue and waste materials, and petroleum-based products.

Pollutants at wood and metal furniture manufacturing facilities include TSS, pH, cadmium, arsenic, COD, BOD_5, lead, solvents, oil & grease, diesel fuel, and gasoline.

Table E-25
Summary Statistics From (Part 2) Sampling Results by Industrial Sector
Industrial Sector 25

Pollutant	Grab Samples (mg/l)				Composite Samples (mg/l)				NURP Results (mg/l)		
	No.	Mean	Median	95%	No.	Mean	Median	95%	Mean	Median	90%
BOD5	25	12.22	9.00	44.00	24	8.80	5.95	26.00	12.00	9.00	15.00
COD	25	95.96	83.00	230.00	24	76.33	72.50	180.00	82.00	65.00	140.00
Copper	4	0.04	0.04	0.07	4	0.00	0.00	0.02	0.04	0.04	0.09
Lead	3	0.08	0.06	0.16	3	0.01	0.01	0.02	0.18	0.14	0.35
NO_2+NO_3-N	25	1.73	0.90	6.20	24	1.51	0.68	5.60	0.86	0.68	1.75
Oil & Grease	25	3.84	0.00	14.00					NR	NR	NR
P, Total	25	0.27	0.20	0.89	24	0.26	0.19	0.71	0.42	0.33	0.70
pH	23	7.54	7.50	8.90					NR	NR	NR
TKN	25	4.37	1.70	15.00	24	4.40	1.35	13.00	1.90	1.50	3.30
TSS	25	187.83	130.00	440.00	24	142.88	90.50	550.00	180.00	100.00	300.00
Zinc	4	2.97	0.78	10.00	4	0.59	0.40	1.50	0.20	0.16	0.50

Sector 26: Printing and Publishing Facilities

The definition of storm water discharges associated with industrial activity includes point source discharges of storm water from eleven major categories of facilities, including: "...category (xi) facilities classified as Standard Industrial Classification (SIC) Code 27 which includes facilities primarily engaged in printing and publishing services. The following facilities are covered under SIC code 27:

- **Book Printing (SIC Code 2732)**: Establishments primarily engaged in printing, or in printing and binding, books and pamphlets, but not engaged in publishing.

- **Commercial Printing, Lithographic (SIC Code 2752)**: Establishments primarily engaged in printing by the lithographic process. Offset printing, photo-offset printing, and photolithographing are also included in this industry.

- **Commercial Printing, Gravure (SIC Code 2754)**: Establishments primarily engaged in gravure printing.

- **Commercial Printing, Not Elsewhere Classified (SIC Code 2759)**: Establishments primarily engaged in commercial or job printing. This industry includes general printing shops, as well as shops specializing in printing newspapers and periodicals for others.

- **Platemaking and Related Services (SIC Code 2796)**: Establishments primarily engaged in making plates for printing purposes and in related services. Also included are establishments primarily engaged in making positive or negatives from which offset lithographic plates are made.

Pollutants of concern include toxic waste ink with solvents chromium, lead, dust, sludge, ink - sludges with chromium or lead, solvents, photographic processing wastes, fuel, oil, heavy metals, trash, and petroleum products.

Table E-26
Summary Statistics From (Part 2) Sampling Results by Industrial Sector
Industrial Sector 26

Pollutant	Grab Samples (mg/l)				Composite Samples (mg/l)				NURP Results (mg/l)		
	No.	Mean	Median	95%	No.	Mean	Median	95%	Mean	Median	90%
BOD5	27	10.99	9.00	49.00	27	6.95	6.40	22.20	12.00	9.00	15.00
COD	27	57.19	49.00	176.00	27	42.37	39.00	119.00	82.00	65.00	140.00
Copper	7	0.03	0.03	0.08	6	0.02	0.03	0.04	0.04	0.04	0.09
Lead	1	0.03	0.03	0.03	0				0.18	0.14	0.35
NO_2+NO_3-N	20	1.27	0.82	4.00	20	1.35	1.05	4.49	0.86	0.68	1.75
Oil & Grease	27	12.58	2.50	56.00					NR	NR	NR
P, Total	27	0.37	0.14	1.50	27	0.35	0.13	1.30	0.42	0.33	0.70
pH	20	7.07	7.03	8.46					NR	NR	NR
TKN	27	3.13	1.50	10.00	27	1.57	0.84	4.60	1.90	1.50	3.30
TSS	27	91.52	30.00	433.00	27	30.83	28.00	82.00	180.00	100.00	300.00
Zinc	4	0.48	0.37	1.00	3	0.47	0.52	0.65	0.20	0.16	0.50

Sector 27: Rubber, Miscellaneous Plastic Products, and Miscellaneous Manufacturing Industries

The definition of storm water discharges associated with industrial activity includes point source discharges of storm water from eleven major categories of facilities, including: "... (xi) facilities classified as Standard Industrial Classification (SIC) major groups 30 and 39." Storm water discharges from category (xi) facilities are only regulated where precipitation and storm water runon come into contact with areas associated with industrial activities and significant materials. Sector 27 covers all storm water discharges from facilities classified as SIC 30 and 39, except for those facilities classified as SIC code 391 - Jeweler, Silverware, and Plated ware. Facilities classified as SIC code 391 are subject to Sector 29 permitting requirements.

Major SIC group 30 includes rubber and miscellaneous plastic products. Specifically, this SIC group includes manufacturers of tires and inner tubes, rubber and plastic footwear, rubber and plastic hose and belting, gaskets, packing and sealing devices, and miscellaneous fabricated rubber products. This SIC group also includes miscellaneous plastic products such as unsupported plastic film, sheet, rods and tubes, laminated plastic plate, sheet and profile shapes, plastic pipe and bottles, plastic foam products such as cups, ice chests and packaging materials, plastic plumbing fixtures, and miscellaneous plastic products.

Major SIC group 39 (except 391) includes miscellaneous manufacturing industries. Specifically, this group includes manufacturers of musical instruments, games, toys and athletic goods, pens, pencils and artists' supplies, buttons, and pins and needles.

Pollutants found in storm water discharges from rubber and miscellaneous plastic products manufacturers may include total suspended solids (TSS), oil and grease, zinc, and acids.

Table E-27
Summary Statistics From (Part 2) Sampling Results by Industrial Sector
Industrial Sector 27

Pollutant	Grab Samples (mg/l)				Composite Samples (mg/l)				NURP Results (mg/l)		
	No.	Mean	Median	95%	No.	Mean	Median	95%	Mean	Median	90%
BOD5	90	13.92	7.15	51.00	89	11.21	7.00	34.00	12.00	9.00	15.00
COD	90	100.00	53.00	330.00	87	72.08	43.00	240.00	82.00	65.00	140.00
Copper	5	0.00	0.00	0.01	5	0.03	0.05	0.05	0.04	0.04	0.09
Lead	1	0.00	0.00	0.00	1	0.01	0.01	0.01	0.18	0.14	0.35
NO_2+NO_3-N	89	0.86	0.58	2.93	86	1.26	0.67	3.56	0.86	0.68	1.75
Oil & Grease	94	4.26	0.50	18.00					NR	NR	NR
P, Total	89	0.41	0.19	1.61	85	0.34	0.16	0.83	0.42	0.33	0.70
pH	86	7.17	7.10	8.40					NR	NR	NR
TKN	89	2.34	1.36	6.00	86	1.63	1.25	4.70	1.90	1.50	3.30
TSS	90	188.55	44.00	893.00	87	119.32	30.00	476.00	180.00	100.00	300.00
Zinc	34	0.98	0.19	4.90	34	0.80	0.25	2.86	0.20	0.16	0.50

Sector 28: Leather Tanning and Finishing Facilities

The definition of storm water discharges associated with industrial activity includes point source discharges of storm water from eleven major categories of facilities, including: "...category (ii) facilities classified as Standard Industrial Classification (SIC) code 3111." Storm water discharges covered include those from leather tanning facilities and facilities which make fertilizer solely from leather scraps and leather dust where precipitation and storm water runon come into contact with significant materials including, but not limited to, raw materials, waste products, by-products, stored materials, and fuels.

Leather tanning or finishing is the conversion of animal hides or skins into leather. Leather is made from the inner layer of the animal skin, which consists primarily of the protein collagen. Tanning is the reaction of the collagen fibers with tannins, chromium, alum or other tanning agents. Tanning processes use sodium dichromate, sulfuric acid and detergents and a variety of raw and intermediate materials.

There are three major processes required to make finished leather. These are beamhouse operations, tanyard processes and retanning and finishing processes.

- Beamhouse Operations—These consist of four activities: side and trim; soak and wash; fleshing and unhairing. Side and trim is the cutting of the hide into two sides and trimming of areas which do not produce good leather. In soak and wash processes, the hides are soaked in water to restore moisture lost during curing. Washing removes dirt, salt, blood, manure, and nonfibrous proteins. Fleshing is a mechanical operation which removes excess flesh. The removed matter is normally recovered and sold for conversion to glue. Unhairing involves using calcium hydroxide, sodium sulfhydrate, and sodium sulfide to destroy the hair (hair pulp process) or remove hair roots.

- Tanyard Processes—These consist of bating, pickling, tanning, wringing, splitting, and shaving. Bating involves the addition of salts of ammonium sulfate or ammonium chloride used to convert the residual alkaline chemicals present from the unhairing process into soluble compounds which can be washed from the hides or skins. "Pickling" the hide with sulfuric acid provides the acid environment necessary for chromium tanning. In the tanning process, tanning agents such as trivalent chromium and vegetable tannins convert the hide into a stable product which resists decomposition. Wringing of the "blue hides" (hides tanned with chromium) removes excess moisture with a machine similar to a clothes wringer. Splitting adjusts the thickness of the tanned hide to the requirements of the finished product and produces a "split" from the flesh side of the hide. The hide is then shaved to remove any remaining fleshy matter.

- Retanning and Wet Finishing Processes—These include retanning, bleaching, coloring, fatliquoring, and finishing. The most common retanning agents are chromium, vegetable extracts and syntans (based upon naphthalene and phenol). Sodium bicarbonate and sulfuric acid are sometimes used to bleach leather. Coloring involves the use of dyes (usually aniline based) on the tanned skin. Animal or vegetable fatliquors are added to replace the natural oils lost in the beamhouse and tanyard processes. Finishing includes all operations performed on the hide after fatliquoring, and includes finishing to enhance color and resistance to stains and abrasions, smoothing and stretching of the skin, drying, conditioning, staking, dry milling, buffing and plating.

Significant materials include raw materials, brine or salt cured hides and skins, fuels, materials such as solvents, detergents, finished materials, fertilizers, pesticides, waste products, leather shavings and dust, leather scrap, blue hides and splits, empty chemical containers, spent solvents, and emissions from spray booths.

Pollutants include aluminum, manganese, Total Kjeldahl Nitrogen (TKN), nitrate + nitrite as N, and Biochemical Oxygen Demand (BOD_5).

Table E-28
Summary Statistics From (Part 2) Sampling Results by Industrial Sector
Industrial Sector 28

Pollutant	Grab Samples (mg/l)				Composite Samples (mg/l)				NURP Results (mg/l)		
	No.	Mean	Median	95%	No.	Mean	Median	95%	Mean	Median	90%
BOD5	31	33.07	11.00	140.00	31	22.32	10.00	77.00	12.00	9.00	15.00
COD	31	205.45	82.00	900.00	31	91.94	50.00	340.00	82.00	65.00	140.00
Copper									0.04	0.04	0.09
Lead	2	0.02	0.02	0.04	2	0.02	0.02	0.04	0.18	0.14	0.35
NO_2+NO_3-N	31	1.86	1.20	4.70	31	1.88	0.90	9.10	0.86	0.68	1.75
Oil & Grease	31	13.87	0.00	120.00					NR	NR	NR
P, Total	31	0.36	0.16	1.60	31	0.83	0.18	1.30	0.42	0.33	0.70
pH	31	7.21	7.40	8.60					NR	NR	NR
TKN	31	7.70	4.30	22.00	31	6.22	3.50	15.00	1.90	1.50	3.30
TSS	31	309.84	49.00	1300.00	31	114.81	86.00	460.00	180.00	100.00	300.00
Zinc									0.20	0.16	0.50

Sector 29: Fabricated Metal Products Facilities

The definition of storm water discharges associated with industrial activity includes point source discharges of storm water from eleven major categories of facilities, including: "...category (xi) facilities classified as Standard Industrial Classification (SIC) codes 34 and 391." Storm water discharges from fabricated metal and processing facilities eligible for coverage include the following types of operations:

- Fabricated Metal Products, Except Machinery and Transportation Equipment, SIC code 34 (3429, 3441, 3442, 3443, 3444, 3451, 3452, 3462, 3465, 3471, 3479, 3494, 3496, 3499)

- Jewelry, Silverware, and Plated Ware, SIC code 391.

This section covers establishments engaged in fabricating ferrous and nonferrous metal products, such as metal cans, tinware, general hardware, automotive parts, tanks, road mesh, structural metal products, nonelectrical equipment, and a variety of metal and wire products made from purchased iron or steel rods, bars, or wire materials.

These facilities are engaged in the manufacturing of a variety of products that are constructed primarily by using metals. The operations performed usually begin with materials in the form of raw rods, bars, sheet, castings, forgings, and other related materials and can progress to the most sophisticated surface finishing operations. There are typically several operations that take place at a fabrication facility: machining operations, grinding, cleaning and stripping, surface treatment and plating, painting, and assembly. The machining operation involves turning, drilling, milling, reaming threading, broaching, grinding, polishing, cutting and shaping, and planing. Grinding is the process using abrasive grains such as aluminum oxide, silicon carbide, and diamond to remove stock from a workpiece. Cleaning and stripping is a preparatory process involving solvents for the removal of oil, grease and dirt. Both alkaline and acid cleaning are employed. Surface treatment and plating is a major component that involves batch operations to increase corrosion or abrasion resistance. This is generally in the form of galvanizing. Painting is generally practiced at most facilities to provide decoration and protection to the product. Assembly is the fitting together of previously manufactured parts into a complete unit or structure.

Areas with significant materials include those with waste storage, outside product storage, used for pickling acids, storage of cutoff scrap metal, aluminum scraps, hazardous materials, galvanized steel components, solvent storage, waste paper storage, and machinery storage.

Pollutants at these facilities include aluminum, copper, manganese, nitrate + nitrite as N, iron, and zinc.

Table E-29
Summary Statistics From (Part 2) Sampling Results by Industrial Sector
Industrial Sector 29

Pollutant	Grab Samples (mg/l)				Composite Samples (mg/l)				NURP Results (mg/l)		
	No.	Mean	Median	95%	No.	Mean	Median	95%	Mean	Median	90%
BOD5	115	28.31	7.60	81.00	111	10.04	7.00	40.00	12.00	9.00	15.00
COD	115	118.16	56.00	440.00	114	86.17	47.50	249.00	82.00	65.00	140.00
Copper	36	0.63	0.03	4.30	33	0.46	0.02	0.64	0.04	0.04	0.09
Lead	32	0.11	0.00	0.89	30	0.06	0.00	0.22	0.18	0.14	0.35
NO_2+NO_3-N	115	1.48	0.74	7.00	114	1.27	0.77	3.50	0.86	0.68	1.75
Oil & Grease	114	6.11	2.00	21.00					NR	NR	NR
P, Total	113	1.03	0.22	9.80	114	0.84	0.21	4.80	0.42	0.33	0.70
pH	103	7.06	7.05	8.70					NR	NR	NR
TKN	115	2.61	1.37	7.20	114	1.78	1.20	5.75	1.90	1.50	3.30
TSS	115	186.58	76.00	758.00	114	125.39	32.00	423.00	180.00	100.00	300.00
Zinc	60	4.20	0.36	9.77	58	2.17	0.21	10.50	0.20	0.16	0.50

Sector 30: Transportation Equipment, Industrial or Commercial Machinery Manufacturing Facilities

The definition of storm water discharge associated with industrial activity includes point source discharges of storm water from eleven categories of facilities, including: "...category (xi) facilities classified as Standard Industrial Classification (SIC) codes ... 34 (except 3441), 35, 37 (except 373),..." Under these SIC codes, the facilities subject to storm water regulations include:

- Fabricated Structural Metal Products, (SIC Code 344)
- Metal Forgings and Stampings, (SIC Code 346)
- Miscellaneous Fabricated Metal Products (SIC Code 349)
- Engines and Turbines (SIC Code 351)
- Farm and Garden Machinery and Equipment (SIC Code 352)
- Construction, Mining, and Materials Handling Machinery and Equipment (SIC Code 353)
- Metalworking Machinery and Equipment (SIC Code 354)
- Special Industry Machinery, Except Metalworking Machinery (SIC Code 355)
- General Industrial Machinery and Equipment (SIC Code 356)
- Refrigeration and Service Industry Machinery (SIC Code 358)
- Miscellaneous Industrial and Commercial Machinery and Equipment (SIC Code 359)
- Motor Vehicles and Motor Vehicle Equipment (SIC Code 371)
- Aircraft and Parts (SIC Code 372)
- Motorcycles, Bicycles, and Parts (SIC Code 375)
- Guided Missiles and Space Vehicles and Parts (SIC Code 376)
- Miscellaneous Transportation Equipment (SIC Code 379)

The general manufacturing process is conducted indoors, and includes activities such as cutting, shaping, grinding, cleaning, coating, forming, and finishing. Specific processes are referred to as "unit operations." These operations occur predominately indoors, so contamination of storm water discharges from manufacturing processes is unlikely.

Significant materials include ferrous and nonferrous metals, such as aluminum, copper, iron, steel and alloys of these metals; either in raw form or as intermediate products, paints, solvents (e.g., paint thinners, degreasers), chemicals (e.g., acids, bases, liquid gases), fuels (e.g., gasoline and diesel fuel), lubricating and cutting oils, and plastics.

Pollutants of concern at these facilities include total suspended solids (TSS), turbidity, fugitive dust, oil and grease, organics, heavy metals, and chemical oxygen demand (COD).

Table E-30
Summary Statistics From (Part 2) Sampling Results by Industrial Sector
Industrial Sector 30

Pollutant	Grab Samples (mg/l)				Composite Samples (mg/l)				NURP Results (mg/l)		
	No.	Mean	Median	95%	No.	Mean	Median	95%	Mean	Median	90%
BOD5	182	13.01	6.00	32.00	179	7.34	5.00	19.00	12.00	9.00	15.00
COD	174	66.89	36.00	310.00	169	46.55	29.00	149.20	82.00	65.00	140.00
Copper	79	0.20	0.01	0.84	74	0.06	0.01	0.36	0.04	0.04	0.09
Lead	76	0.22	0.00	0.97	75	0.18	0.00	0.94	0.18	0.14	0.35
NO_2+NO_3-N	184	1.20	0.58	5.00	174	1.28	0.45	4.50	0.86	0.68	1.75
Oil & Grease	189	7.84	0.00	34.00					NR	NR	NR
P, Total	176	0.29	0.14	1.00	179	0.40	0.13	1.12	0.42	0.33	0.70
pH	179	6.93	7.09	8.34					NR	NR	NR
TKN	170	2.47	1.30	5.80	165	1.81	1.10	4.75	1.90	1.50	3.30
TSS	173	162.81	30.00	576.00	169	100.41	17.00	319.00	180.00	100.00	300.00
Zinc	88	0.58	0.20	2.55	85	0.39	0.14	1.40	0.20	0.16	0.50

Sector 31: Electronic and Electrical Equipment and Components, Photographic and Optical Goods

The definition of storm water discharges associated with industrial activity includes point source discharges of storm water from eleven major categories of facilities, including: "... category (xi) facilities classified as Standard Industrial Classification (SIC) codes 36, 38, and 357."

Major SIC group 36 includes manufacturers of a broad range of electronic and electrical equipment and components, not including computer equipment. Specifically, this group includes manufacturers of electricity distribution equipment such as transformers and switch-gear, electrical industrial equipment such as motors and generators, household appliances, electric lighting and wiring equipment such as light bulbs and lighting fixtures, and audio and video equipment including phonograph records and audio tapes and disks. Also included are manufacturers of communication equipment including telephone and telegraph equipment, radio and television equipment, electronic components such as printed circuit boards and semiconductors and related devices, and miscellaneous electrical items such as batteries and electrical equipment for automobiles. Storm water discharges from facilities in this category are only regulated where precipitation and storm water runon come into contact with areas associated with industrial activities and significant materials.

Major SIC group 38 includes manufacturers of measuring, analyzing, and controlling instruments, photographic, medical and optical goods, and watches and clocks. Specifically, this group includes facilities which manufacture search, detection, navigation, or guidance systems such as radar and sonar equipment, measurement and control instruments and laboratory apparatus, surgical, medical and dental instruments and supplies, photographic equipment and supplies, and watches and clocks.

Computer and office equipment is included in industrial SIC group 357. This group includes manufacturers of computers, computer storage devices, and peripheral equipment for computers such as printers and plotters. Manufacturers of miscellaneous office machines are also included in this group.

Pollutants found in storm water discharges from Electronic and Electrical Equipment and Components, Photographic and Optical Goods manufacturers may include total suspended solids (TSS), heavy metals, organics, oil and grease, and acids.

Table E-31
Summary Statistics From (Part 2) Sampling Results by Industrial Sector
Industrial Sector 31

Pollutant	Grab Samples (mg/l)				Composite Samples (mg/l)				NURP Results (mg/l)		
	No.	Mean	Median	95%	No.	Mean	Median	95%	Mean	Median	90%
BOD5	64	8.81	5.50	32.00	56	7.48	5.10	14.00	12.00	9.00	15.00
COD	65	59.19	46.00	170.00	56	36.32	24.00	200.00	82.00	65.00	140.00
Copper	54	0.04	0.00	0.11	50	0.01	0.00	0.05	0.04	0.04	0.09
Lead	60	0.02	0.00	0.08	56	0.01	0.00	0.04	0.18	0.14	0.35
NO_2+NO_3-N	64	0.83	0.51	2.80	57	0.66	0.51	1.43	0.86	0.68	1.75
Oil & Grease	69	0.58	0.00	4.10					NR	NR	NR
P, Total	64	1.50	0.13	1.10	57	1.02	0.16	1.20	0.42	0.33	0.70
pH	69	7.43	7.54	8.60					NR	NR	NR
TKN	62	1.46	1.05	4.09	56	1.36	1.01	3.70	1.90	1.50	3.30
TSS	63	89.21	29.00	348.00	56	67.12	14.00	370.00	180.00	100.00	300.00
Zinc	51	0.16	0.09	0.53	48	0.15	0.09	0.47	0.20	0.16	0.50

APPENDIX F

GROUP APPLICATION PART 2 SAMPLING DATA

ORGANIZED BY POLLUTANT

APPENDIX F

GROUP APPLICATION PART 2 SAMPLING DATA

ORGANIZED BY POLLUTANT

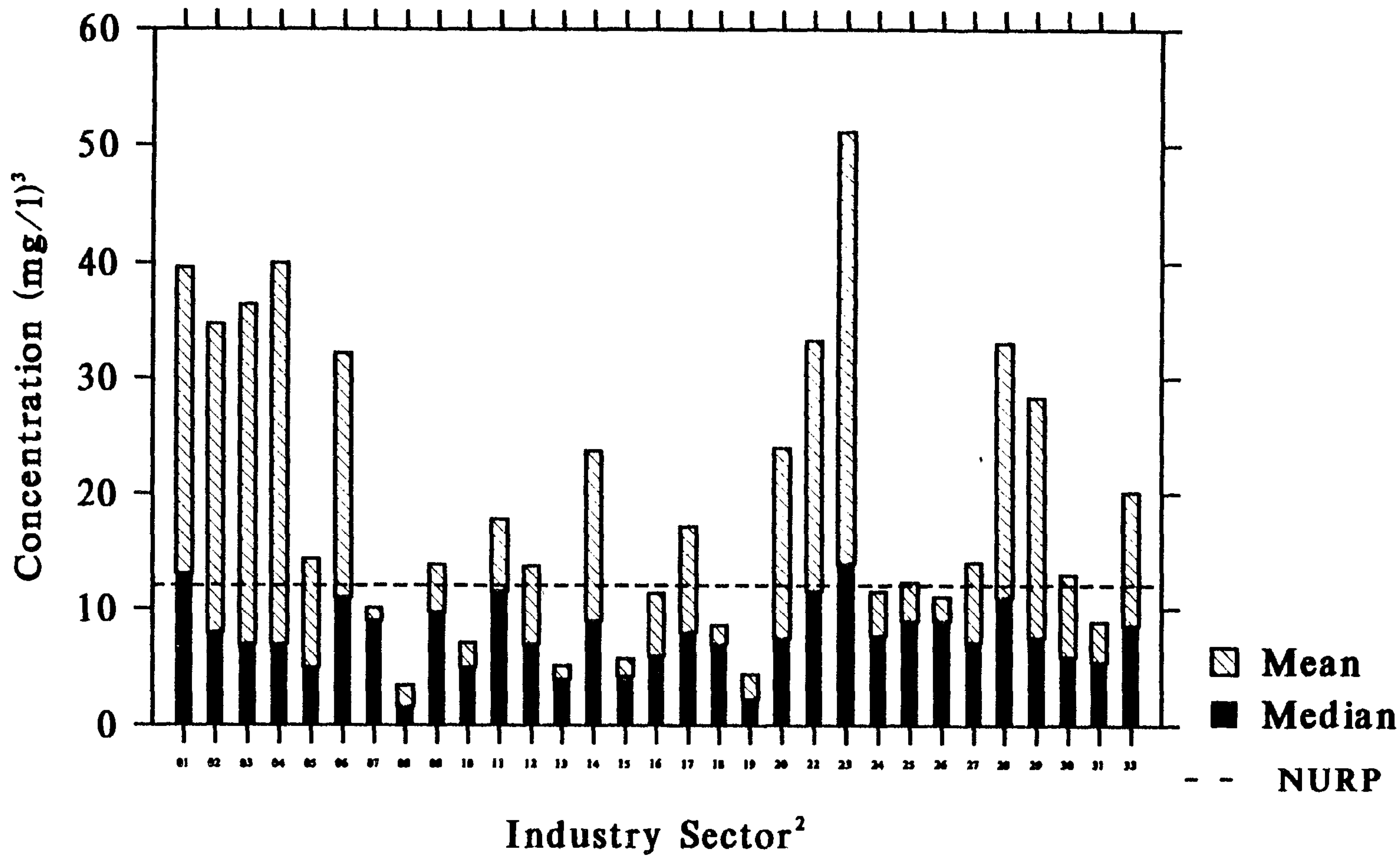
This appendix contains tabular and graphical descriptions of the sampling data for the 31 industrial sectors that were identified in the group application portion of the Phase I permitting process (four of the sectors were consolidated into two sectors for permit development purposes, only tablular data is presented for copper, lead, and zinc). This appendix summarizes the sampling data on a pollutant by pollutant basis. The tables and figures display the mean values, median values, 95th percentile values, for the grab and composite samples and the mean, median and 90th percentile values for NURP data for a portion of the pollutants sampled within each sector.

INDUSTRIAL SECTORS/GROUP APPLICATIONS (TABLE 1)	
SECTOR	**ACTIVITIES REPRESENTED**
1	Lumber and Wood Products
2	Paper and Allied Products
3	Chemicals and Allied Products
4	Asphalt and Lubricant Manufacturers
5	Stone, Clay, Glass and Concrete Products
6	Primary Metal Industries
7	Metal Mining
8	Coal and Lignite Mining
9	Oil and Gas Extraction
10	Mining and Quarrying of Nonmetallic Minerals
11	Hazardous Waste Treatment Storage or Disposal Facilities
12	Industrial Landfills, Land Application Sites and Open Dumps
13	Used Motor Vehicle Parts
14	Scrap and Waste Materials
15	Steam Electric Power Generating Facilities
16	Railroad Transportation
17	Local and Suburban Transit and Interurban Highway Passenger Transportation Motor Freight Transportation United States Postal Service Petroleum Bulk Stations
18	Water Transportation
19	Ship Building and Repairing Boat Building and Repairing
20	Transportation By Air
22	Domestic Wastewater Treatment Plants
23	Food and Kindred Products Tobacco Products
24	Textile Mill Products Apparel and Other Finished Products Made From Fabrics and Similar Materials
25	Furniture and Fixtures Manufacturing
26	Printing Publishing and Allied Industries
27	Rubber and Misc. Plastic Products
28	Leather and Leather Products
29	Fabricated Metal Products, Except Machinery and Transportation Equipment Jewelry, Silverware, and Plated Ware
30	Industrial and Commercial Machinery (Except Computer and Office Equipment) Transportation Equipment
31	Electronic and other Electrical Equipment and Components Measuring, Analyzing, and Controlling Instruments; Photographic and Optical Goods; Watches and Clocks

Table F-1
Summary of Sampling Data From Phase I Part II Permit Applications (With Comparison to NURP and USGS Data) for BOD_5 (mg/l)

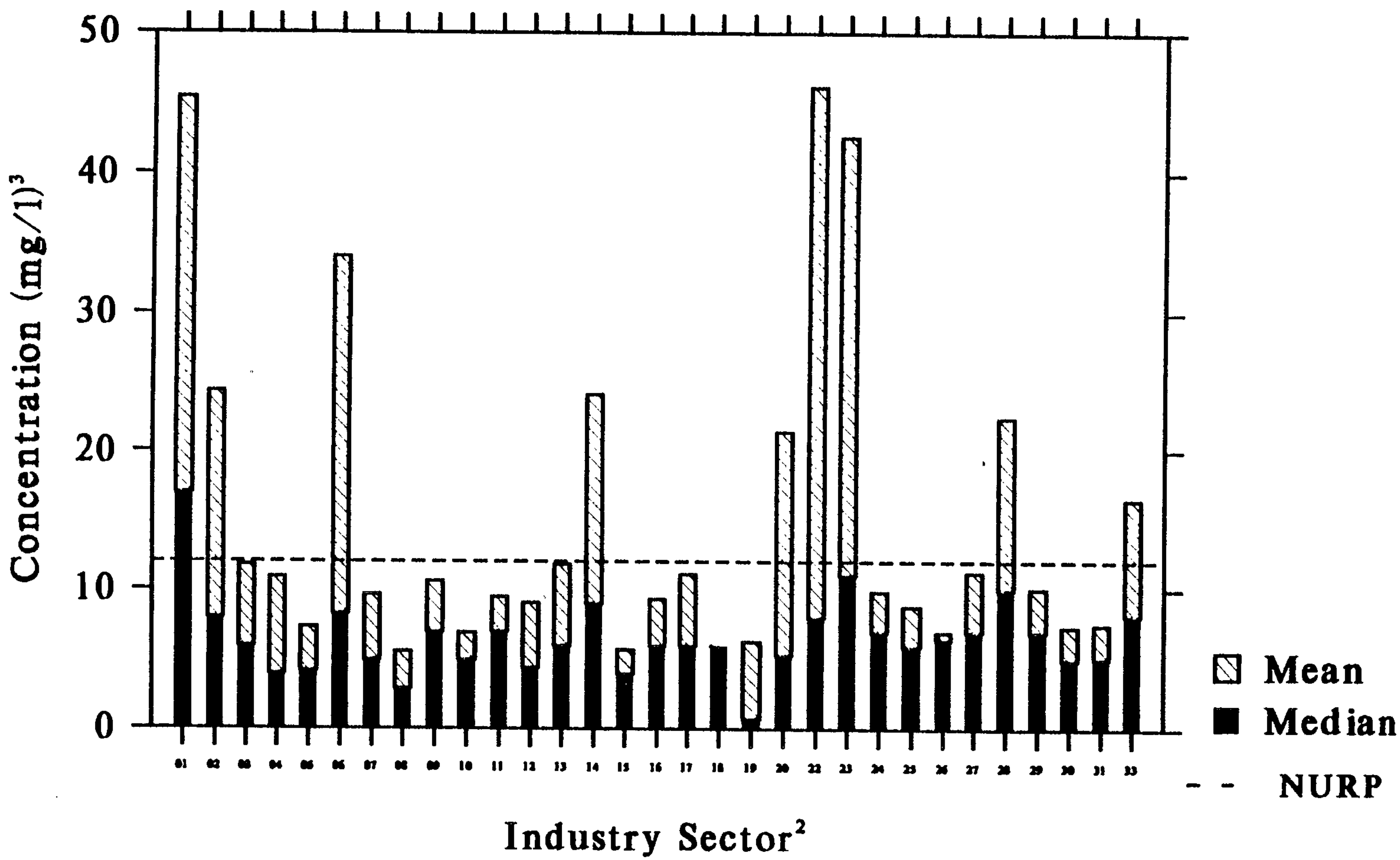
Sector	DESCRIPTION	Grab Samples No.	Grab Samples Mean	Grab Samples Median	Grab Samples 95 %	Composite Samples No.	Composite Samples Mean	Composite Samples Median	Composite Samples 95 %
	FOR POLLUTANT	BOD5				BOD5			
NURP	Median Urban Site *						12	9	15
USGS	Commercial Site *						16	8	NR
01	Lumber & Wood Products	198	39.63	13.00	193.00	200	45.37	17.00	135.50
02	Paper & Allied Products	121	34.72	8.00	115.00	111	24.25	8.00	93.00
03	Chemicals & Allied Products	165	36.42	7.00	67.00	156	11.74	6.00	45.00
04	Petrol Refining & Related Ind.	61	39.99	7.00	47.00	51	10.87	4.00	22.00
05	Stone, Clay, Glass Products	310	14.30	5.00	32.00	300	7.32	4.20	26.00
06	Primary Metal Ind.	163	32.15	11.00	83.00	140	34.08	8.30	61.50
07	Metal Mining	18	10.02	9.00	27.00	12	10.63	6.00	44.00
08	Coal & Lignite Mining	7	3.63	1.80	9.00	4	6.55	3.90	17.40
09	Oil & Gas Extraction	35	13.79	9.71	44.00	33	10.59	7.00	21.80
10	Nonmetallic Mineral Mining	55	7.09	5.00	24.00	51	6.89	5.00	17.00
11	Hazardous Waste TSDFs	8	17.75	11.50	45.00	9	9.44	7.00	45.00
12	Industrial Landfills & Dumps	51	13.66	7.00	59.00	48	9.04	4.40	34.00
13	Used Motor Vehicle Parts	13	7.15	6.00	16.00	30	12.61	6.50	48.00
14	Scrap & Waste Materials	130	23.49	9.00	89.00	120	24.00	9.00	88.00
15	Steam Electric Power Plants	76	5.71	4.25	20.00	78	5.69	4.00	20.00
16	Railroad Transport	116	11.29	6.00	34.00	105	9.27	6.00	28.00
17	Transport: Trucks, Freight, etc.	400	17.11	8.00	60.50	376	11.07	6.00	41.00
18	Water Transport	15	8.60	7.00	39.00	14	6.00	6.00	11.00
19	Ship & Boat Building, Repair	44	5.00	2.80	15.00	37	7.40	0.90	23.00
20	Air Transport	96	23.95	7.50	42.00	89	21.34	5.30	41.40
22	Wastewater Treatment	90	33.26	11.50	53.40	89	46.11	8.00	200.00
23	Food, Tobacco Manufact.	298	51.15	13.90	206.00	287	42.54	11.00	180.00
24	Textile & Apparel Manufact.	110	11.41	7.75	38.00	107	9.82	7.00	29.00
25	Furniture & Fixtures	25	12.22	9.00	44.00	24	8.80	5.95	26.00
26	Printing & Publishing	27	10.99	9.00	49.00	27	6.95	6.40	22.20
27	Rubber & Plastic Products	90	13.92	7.15	51.00	89	11.21	7.00	34.00
28	Leather/Products	31	33.07	11.00	140.00	31	22.32	10.00	77.00
29	Fabricated Metal Products, Jewelry	115	28.31	7.60	81.00	111	10.04	7.00	40.00
30	Ind. & Comm. & Transport Equip.	182	13.01	6.00	32.00	179	7.32	5.00	19.00
31	Electronic Equip. & Instruments	64	8.81	5.50	32.00	56	7.48	5.10	14.00

*NURP and USGS results were reported only as composite samples, not grab.
NR = Not Reported



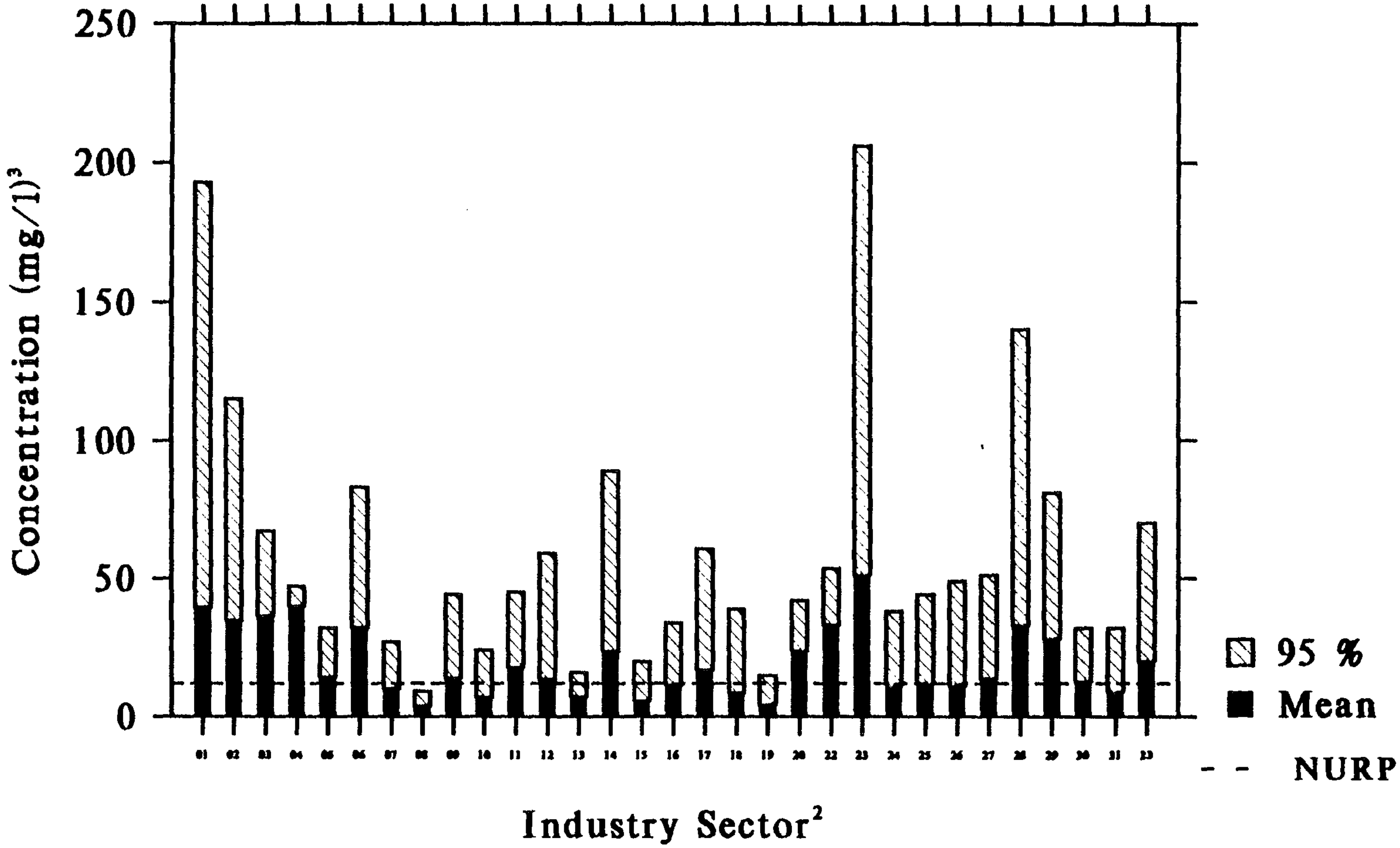
1. Based upon part 2 group application data submitted by Jan 1, 1992
2. See Table 1 for List of Industry Sectors by number
3. Values reported as Nondetect were assumed to be 0.0 mg/l

Figure F-1. BOD_5 Concentration Storm Water Discharges[1]
Grab Samples by Industry Sector



1. Based upon part 2 group application data submitted by Jan 1. 1992
2. See Table 1 for List of Industry Sectors by number
3. Values reported as Nondetect were assumed to be 0.0 mg/l

Figure F-2. BOD_5 Concentration Storm Water Discharges[1] Composite Samples by Industry Sector

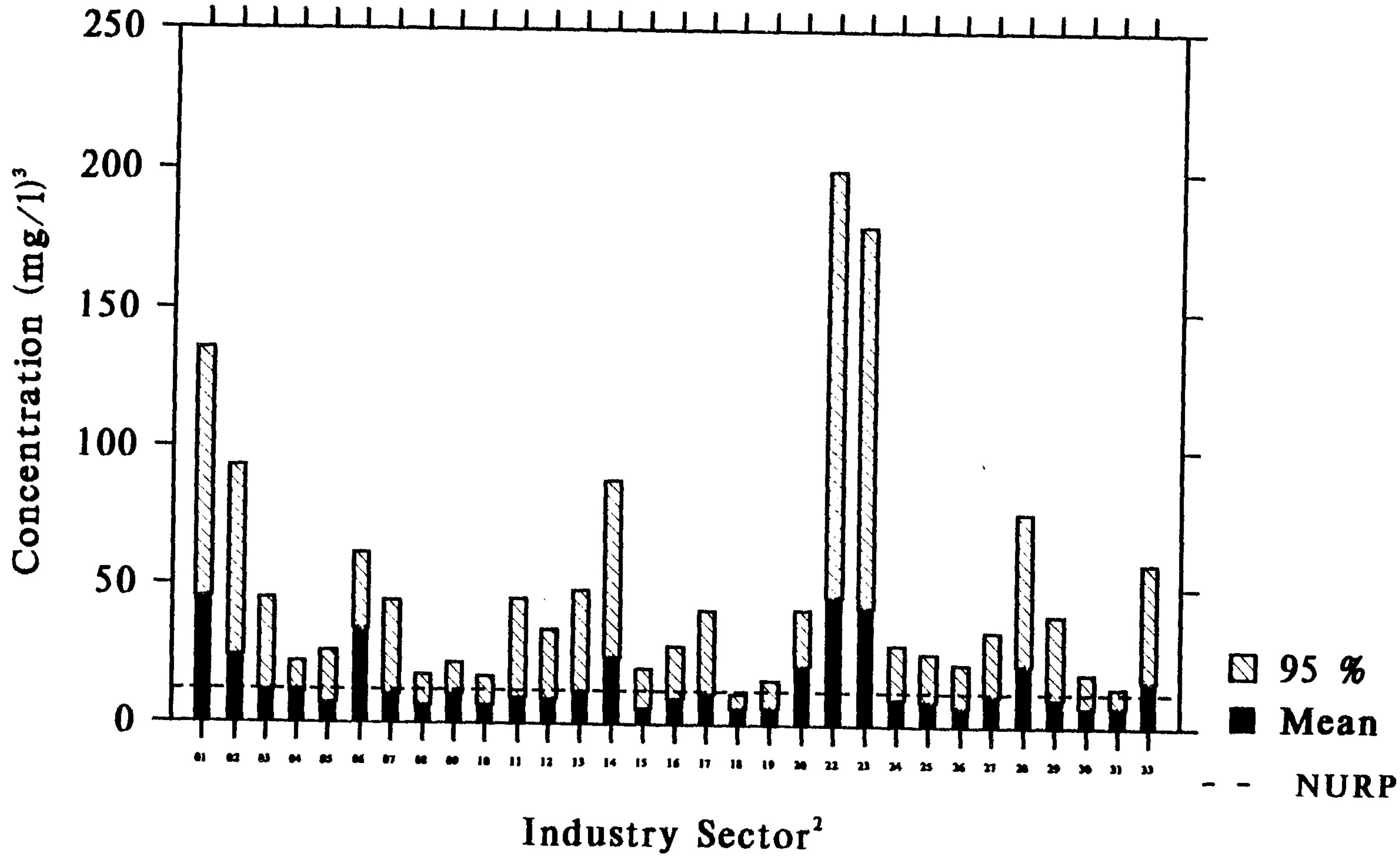


1. Based upon part 2 group application data submitted by Jan 1. 1992

2. See Table 1 for List of Industry Sectors by number

3. Values reported as Nondetect were assumed to be 0.0 mg/l

Figure F-3. BOD_5 Concentration Storm Water Discharges[1] Grab Samples by Industry Sector



1. Based upon part 2 group application data submitted by Jan 1. 1992
2. See Table 1 for List of Industry Sectors by number
3. Values reported as Nondetect were assumed to be 0.0 mg/l

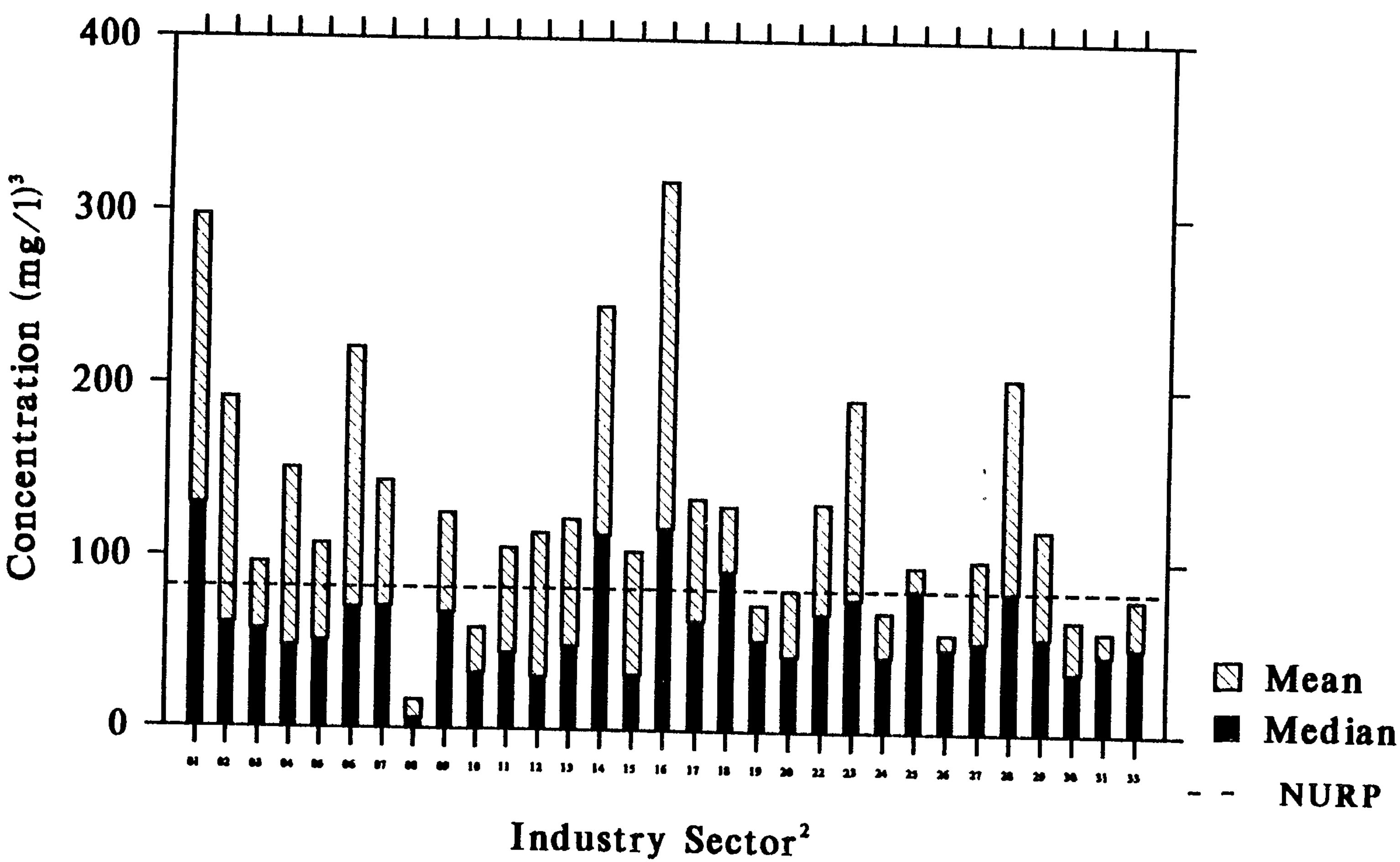
Figure F-4. BOD_5 Concentration Storm Water Discharges[1]
Composite Samples by Industry Sector

Table F-2
Summary of Sampling Data From Phase I Part II Permit Applications (With Comparison to NURP and USGS Studies) for COD (mg/l)

Sector	DESCRIPTION	Grab Samples No.	Grab Samples Mean	Grab Samples Median	Grab Samples 95 %	Composite Samples No.	Composite Samples Mean	Composite Samples Median	Composite Samples 95 %
	FOR POLLUTANT	COD				COD			
NURP	Median Urban Site *						82	65	140
USGS	Commercial Site *						NR	NR	NR
01	Lumber & Wood Products	198	297.64	131.00	1500.00	198	242.50	122.50	1080.00
02	Paper & Allied Prod.	121	191.69	61.00	740.00	113	133.90	51.00	530.00
03	Chemicals & Allied Products	168	96.14	57.50	290.00	159	77.24	41.00	320.00
04	Petrol Refining & Related Ind.	64	151.55	48.00	485.00	53	86.93	50.00	375.00
05	Stone, Clay, Glass Products	313	107.47	51.30	317.00	302	77.53	43.15	240.00
06	Primary Metal Ind.	162	221.34	70.50	870.00	151	109.84	60.00	420.00
07	Metal Mining	18	144.54	71.10	630.00	15	195.07	160.00	740.00
08	Coal & Lignite Mining	13	16.45	6.00	83.90	8	26.86	13.50	115.00
09	Oil & Gas Extraction	36	140.12	82.00	352.00	31	115.94	92.00	445.00
10	Nonmetallic Mineral Mining	56	58.79	33.00	247.00	51	66.20	37.00	185.00
11	Hazardous Waste TSDFs	8	117.40	41.00	500.00	9	48.90	34.00	131.00
12	Industrial Landfills & Dumps	51	114.46	31.00	825.00	48	102.02	27.50	548.00
13	Used Motor Vehicle Parts	30	135.00	61.00	250.00	13	66.23	60.00	155.00
14	Scrap & Waste Materials	130	253.33	120.00	1100.00	117	203.71	110.00	700.00
15	Steam Electric Power Plants	76	104.02	32.50	360.00	77	69.47	39.50	280.00
16	Railroad Transport	117	318.10	118.00	781.00	102	189.46	89.00	489.00
17	Transport: Trucks, Freight, etc.	408	135.16	63.95	498.00	374	85.64	48.00	250.00
18	Water Transport	15	130.93	93.00	500.00	14	75.79	50.50	203.00
19	Ship & Boat Building, Repair	51	73.22	53.00	260.00	43	68.80	28.00	240.00
20	Air Transport	95	81.49	44.00	286.00	88	75.63	36.00	182.00
22	Wastewater Treatment	84	133.03	68.65	410.00	84	157.95	61.59	880.00
23	Food, Tobacco Manufact.	296	192.46	77.00	745.00	286	141.65	63.00	463.00
24	Textile & Apparel Manufact.	110	69.19	44.00	228.00	107	48.05	37.00	111.00
25	Furniture & Fixtures	25	95.96	83.00	230.00	24	76.33	72.50	180.00
26	Printing & Publishing	27	57.19	49.00	176.00	27	42.37	39.00	119.00
27	Rubber & Plastic Products	90	100.00	53.00	330.00	87	72.08	43.00	240.00
28	Leather/Products	31	205.45	82.00	900.00	31	91.94	50.00	340.00
29	Fabricated Metal Products, Jewelry	115	118.16	56.00	440.00	114	86.17	47.50	249.00
30	Ind. & Comm. & Transport Equip.	174	66.89	36.00	310.00	169	46.55	29.00	149.20
31	Electronic Equip. & Instruments	65	59.19	46.00	170.00	56	36.32	24.00	200.00

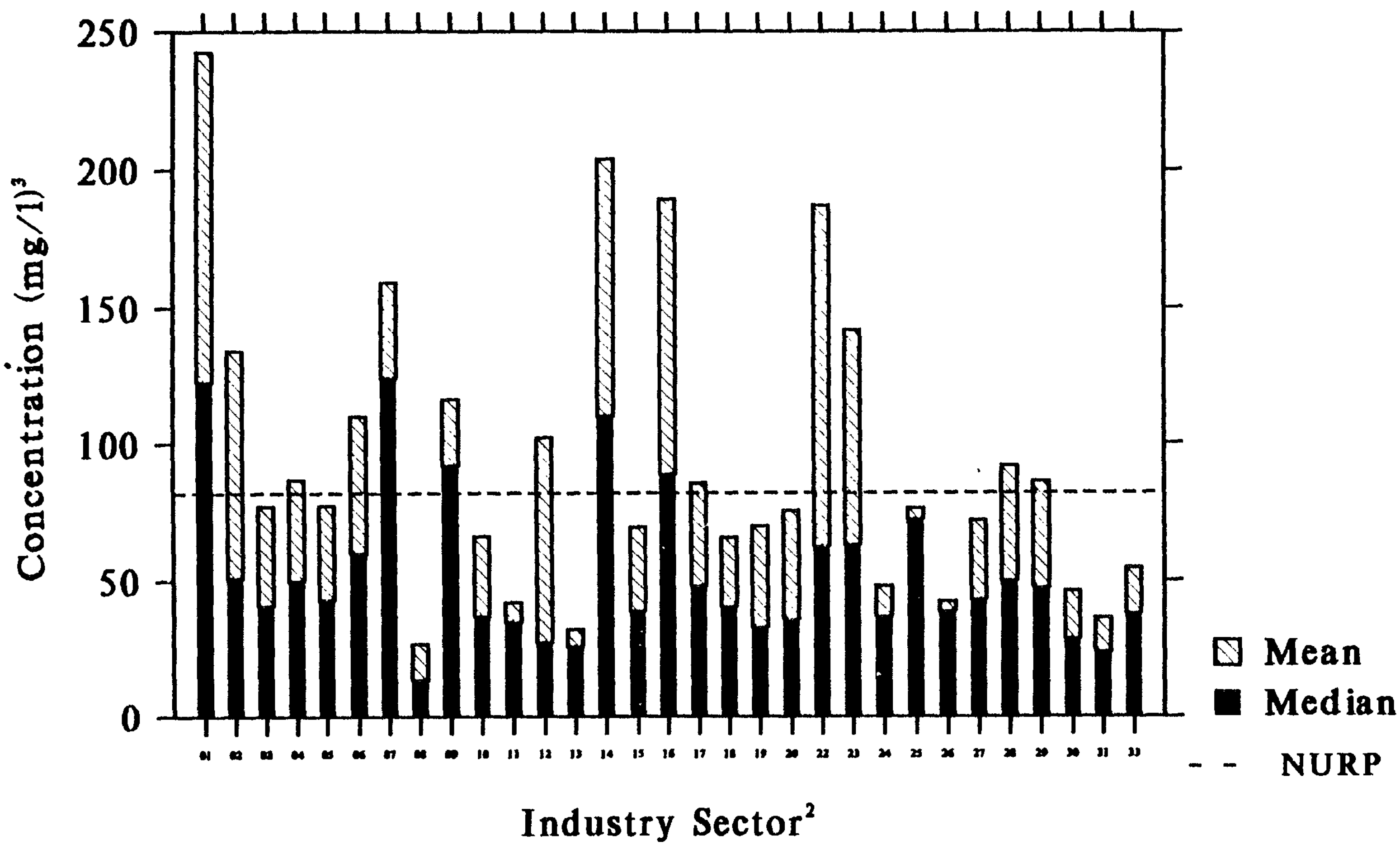
*NURP and USGS results were reported only as composite samples, not grab.
NR = Not Reported

R0015444



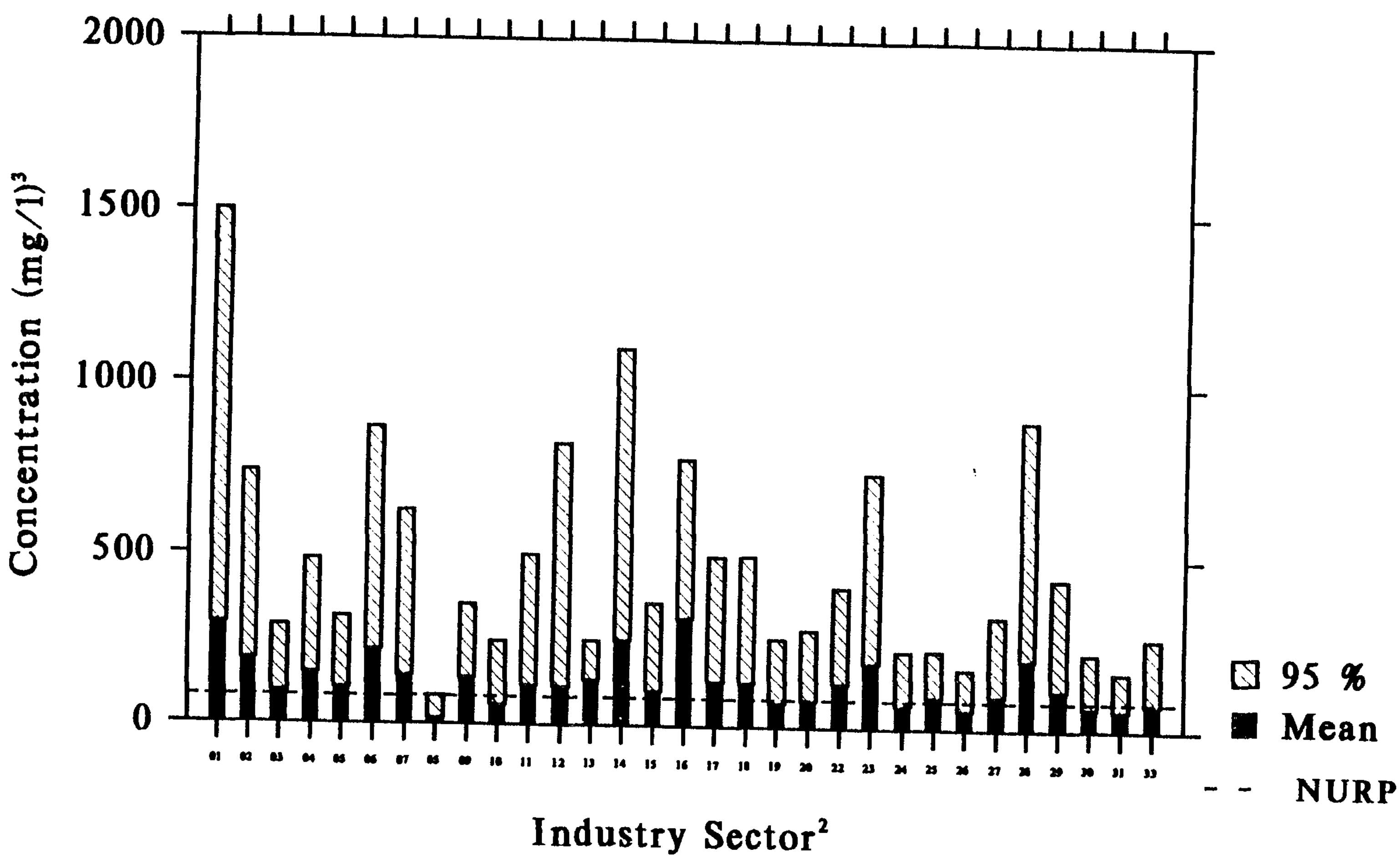
1. Based upon part 2 group application data submitted by Jan 1, 1992
2. See Table 1 for List of Industry Sectors by number
3. Values reported as Nondetect were assumed to be 0.0 mg/l

Figure F-5. COD Concentration Storm Water Discharges[1]
Grab Samples by Industry Sector



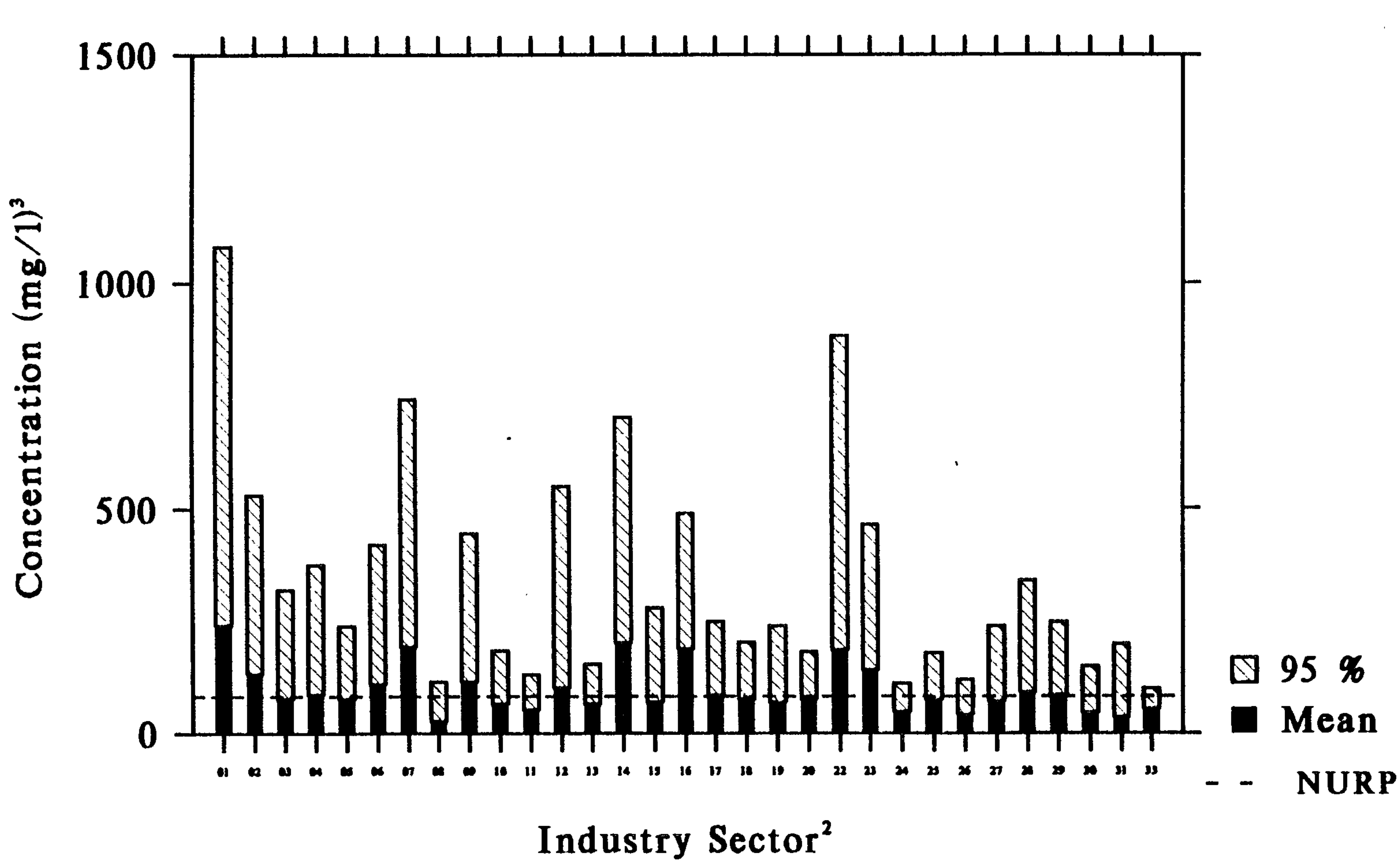
1. Based upon part 2 group application data submitted by Jan 1. 1992
2. See Table 1 for List of Industry Sectors by number
3. Values reported as Nondetect were assumed to be 0.0 mg/l

Figure F-6. COD Concentration Storm Water Discharges[1]
Composite Samples by Industry Sector



1. Based upon part 2 group application data submitted by Jan 1, 1992
2. See Table 1 for List of Industry Sectors by number
3. Values reported as Nondetect were assumed to be 0.0 mg/l

Figure F-7. COD Concentration Storm Water Discharges[1]
Grab Samples by Industry Sector



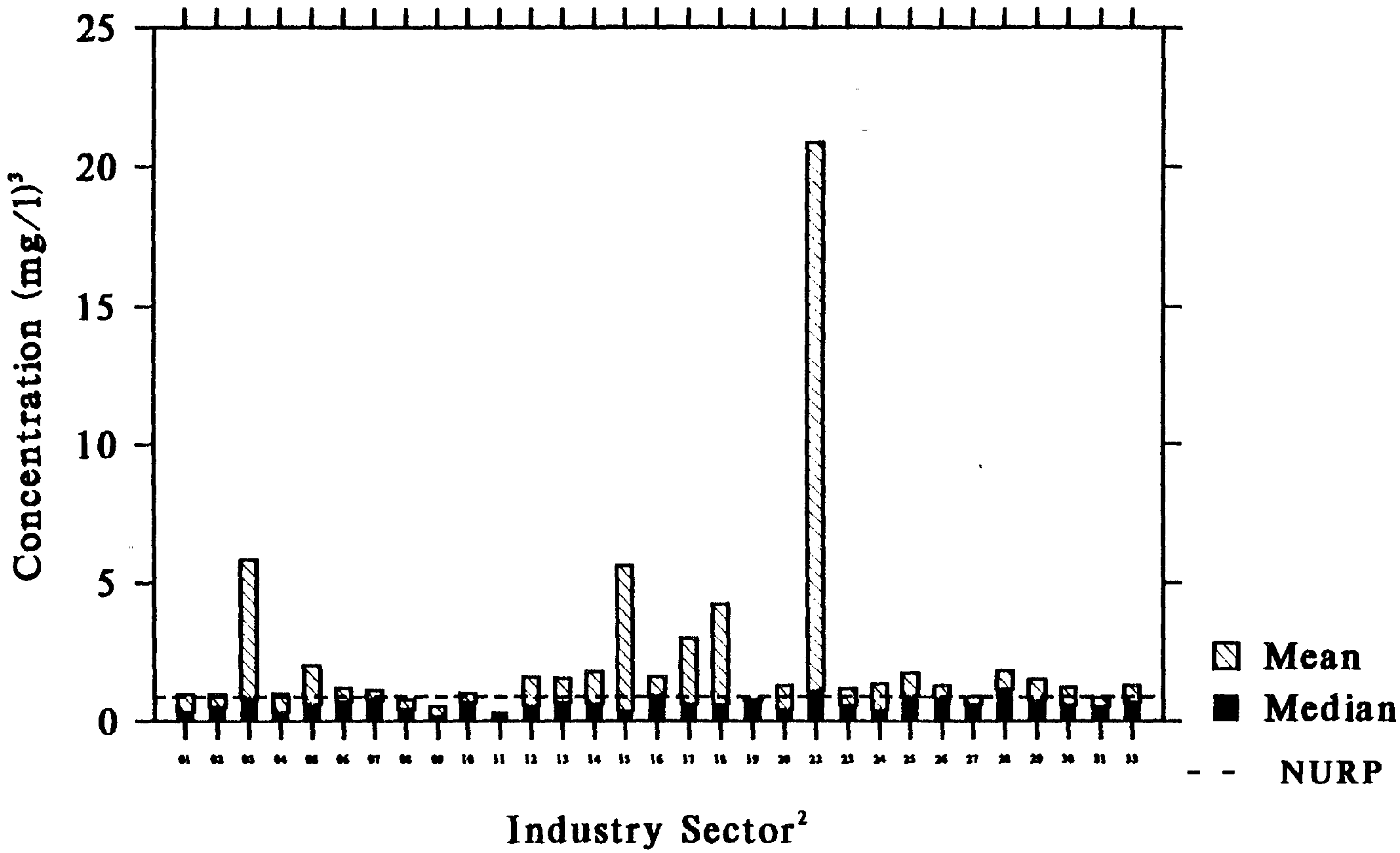
1. Based upon part 2 group application data submitted by Jan 1, 1992
2. See Table 1 for List of Industry Sectors by number
3. Values reported as Nondetect were assumed to be 0.0 mg/l

Figure F-8. COD Concentration Storm Water Discharges[1]
Composite Samples by Industry Sector

Table F-3
Summary of Sampling Data From Phase I Part II Permit Applications (With Comparison to NURP and USGS Data) for NO_2 + NO^3 - N (mg/l)

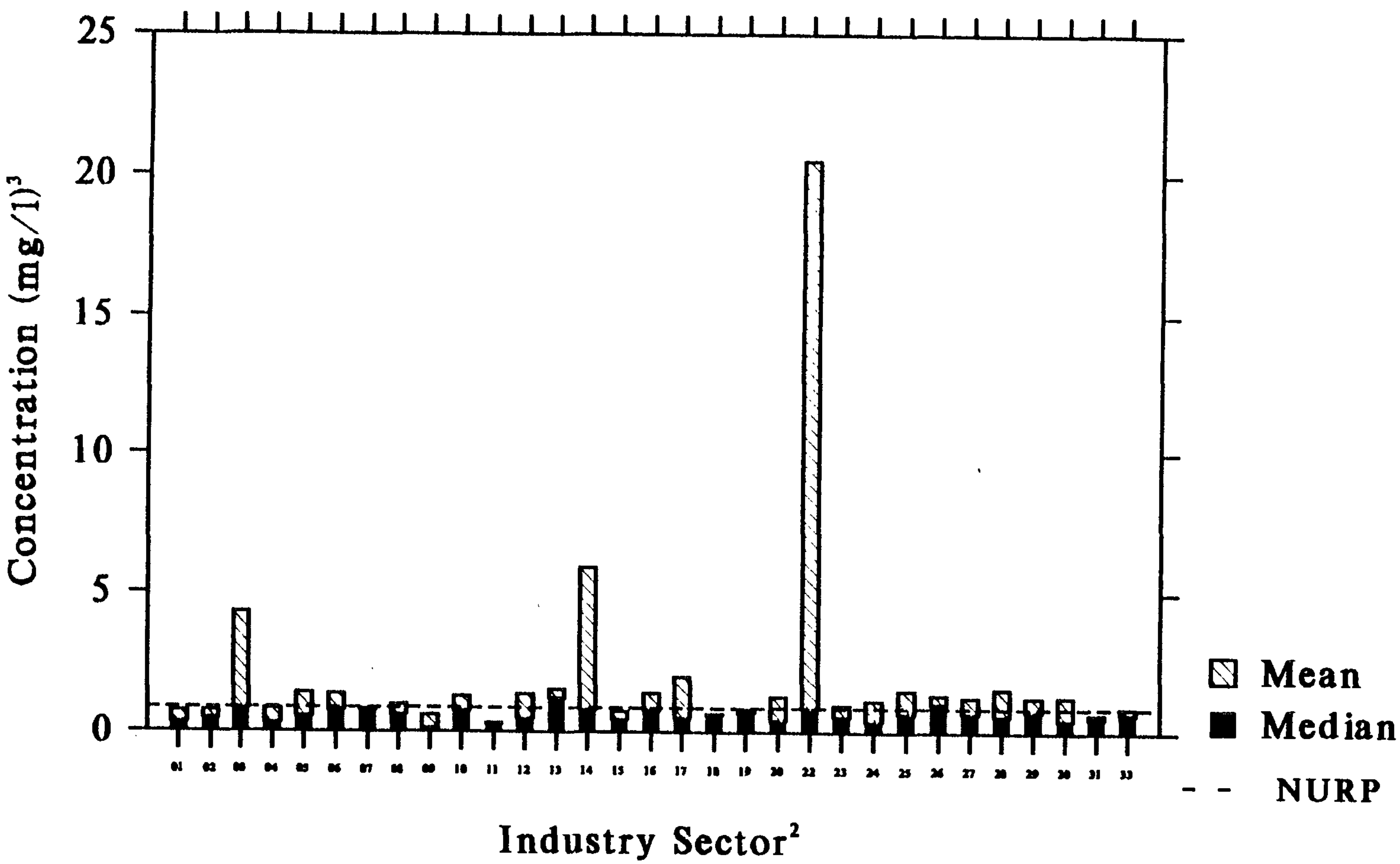
Sector	DESCRIPTION	Grab Samples				Composite Samples			
		No.	Mean	Median	95 %	No.	Mean	Median	95 %
	FOR POLLUTANT	NO_2+NO_3-N				NO_2+NO_3-N			
NURP	Median Urban Site *						0.86	0.68	1.75
USGS	Commercial Site *						0.38	0.25	NR
01	Lumber & Wood Products	189	0.95	0.32	2.20	188	0.75	0.34	1.79
02	Paper & Allied Prod.	121	0.95	0.50	3.93	111	0.76	0.47	2.44
03	Chemicals & Allied Products	164	5.83	0.80	16.00	154	4.29	0.82	17.00
04	Petrol Refining & Related Ind.	62	0.97	0.31	2.63	52	0.82	0.30	2.43
05	Stone, Clay, Glass Products	303	1.99	0.60	3.03	292	1.40	0.55	3.03
06	Primary Metal Ind.	148	1.17	0.68	3.60	135	1.38	0.77	4.30
07	Metal Mining	16	1.10	0.75	5.30	13	0.90	0.86	2.10
08	Coal & Lignite Mining	8	0.77	0.40	3.12	6	1.00	0.61	3.12
09	Oil & Gas Extraction	35	0.52	0.15	4.10	31	0.60	0.12	3.30
10	Nonmetallic Mineral Mining	50	0.98	0.65	3.00	45	1.27	0.76	4.17
11	Hazardous Waste TSDFs	9	0.46	0.47	0.79	9	0.39	0.34	0,67
12	Industrial Landfills & Dumps	50	1.57	0.55	4.10	47	1.38	0.50	6.02
13	Used Motor Vehicle Parts	13	1.70	0.83	5.65	30	1.62	1.32	4.87
14	Scrap & Waste Materials	129	1.78	0.62	3.30	117	5.88	0.80	12.00
15	Steam Electric Power Plants	76	5.62	0.36	3.70	77	0.75	0.45	3.20
16	Railroad Transport	118	1.59	0.92	6.07	102	1.41	0.78	4.26
17	Transport: Trucks, Freight, etc.	399	2.99	0.61	9.00	372	1.99	0.52	5.10
18	Water Transport	15	4.23	0.60	54.00	14	0.66	0.65	1.61
19	Ship & Boat Building, Repair	51	0.79	0.72	1.60	45	0.85	0.72	1.80
20	Air Transport	75	1.27	0.41	7.90	65	1.29	0.43	7.70
22	Wastewater Treatment	84	20.86	1.09	136.00	83	20.50	0.87	131.27
23	Food, Tobacco Manufact.	301	1.17	0.56	3.70	289	0.98	0.55	3.60
24	Textile & Apparel Manufact.	110	1.33	0.39	2.50	107	1.14	0.39	1.87
25	Furniture & Fixtures	25	1.73	0.90	6.20	24	1.51	0.68	5.60
26	Printing & Publishing	20	1.27	0.82	4.00	20	1.35	1.05	4.49
27	Rubber & Plastic Products	89	0.86	0.58	2.93	86	1.26	0.67	3.56
28	Leather/Products	31	1.86	1.20	4.70	31	1.88	0.90	9.10
29	Fabricated Metal Products, Jewelry	115	1.48	0.74	7.00	114	1.27	0.77	3.50
30	Ind. & Comm. & Transport Equip.	184	1.20	0.58	5.00	174	1.28	0.45	4.50
31	Electronic Equip. & Instruments	64	0.83	0.51	2.80	57	0.66	0.51	1.43

*NURP and USGS results were reported only as composite samples, not grab.
NR = Not Reported



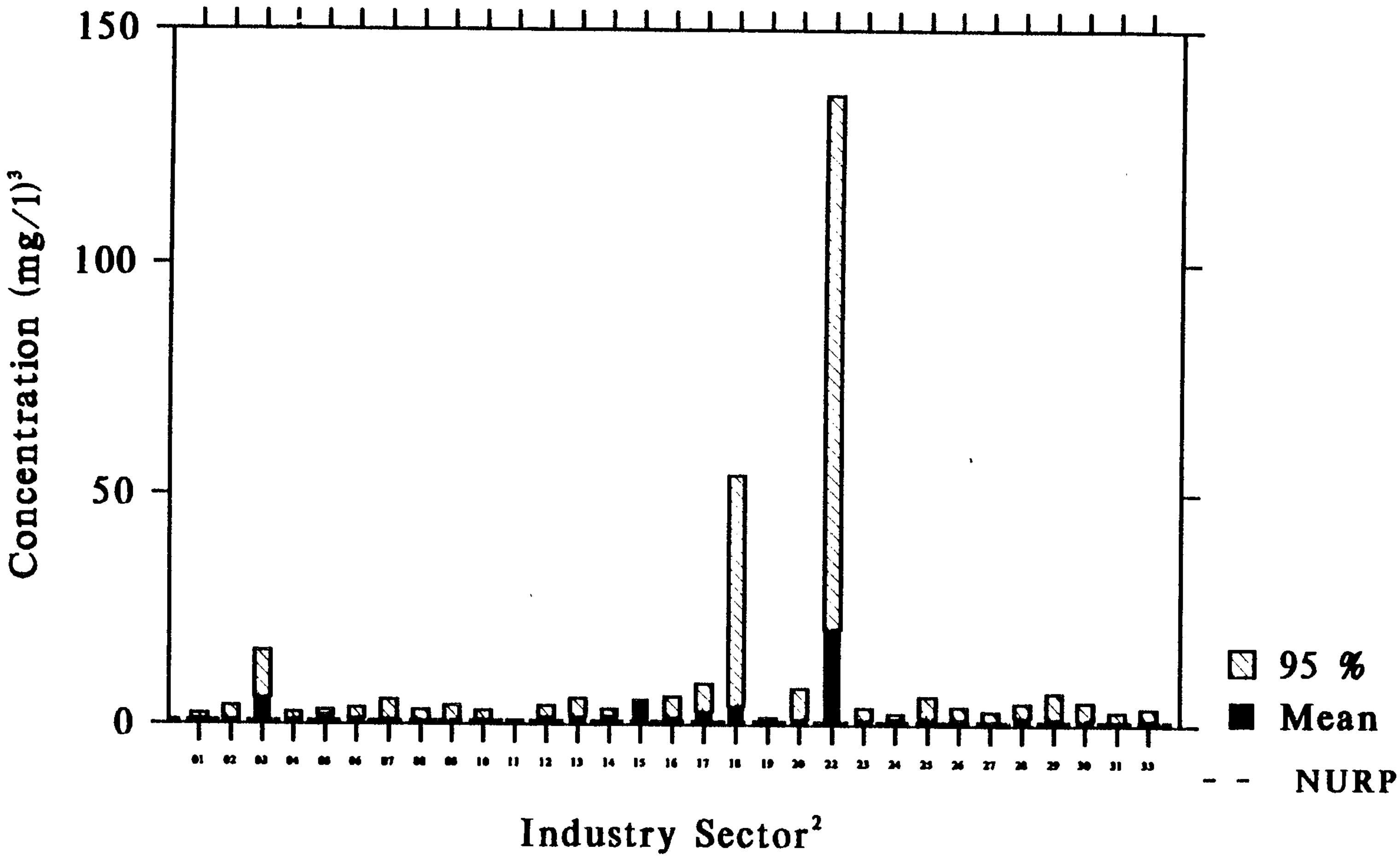
1. Based upon part 2 group application data submitted by Jan 1. 1992
2. See Table 1 for List of Industry Sectors by number
3. Values reported as Nondetect were assumed to be 0.0 mg/l

Figure F-9. Nitrate Plus Nitrite Nitrogen Concentration Storm Water Discharges[1]
Grab Samples by Industry Sector



1. Based upon part 2 group application data submitted by Jan 1. 1992
2. See Table 1 for List of Industry Sectors by number
3. Values reported as Nondetect were assumed to be 0.0 mg/l

Figure F-10. Nitrate Plus Nitrite Nitrogen Concentration Storm Water Discharges[1] Composite Samples by Industry Sector



1. Based upon part 2 group application data submitted by Jan 1. 1992
2. See Table 1 for List of Industry Sectors by number
3. Values reported as Nondetect were assumed to be 0.0 mg/l

Figure F-11. Nitrate Plus Nitrite Nitrogen Concentration Storm Water Discharges[1] Grab Samples by Industry Sector

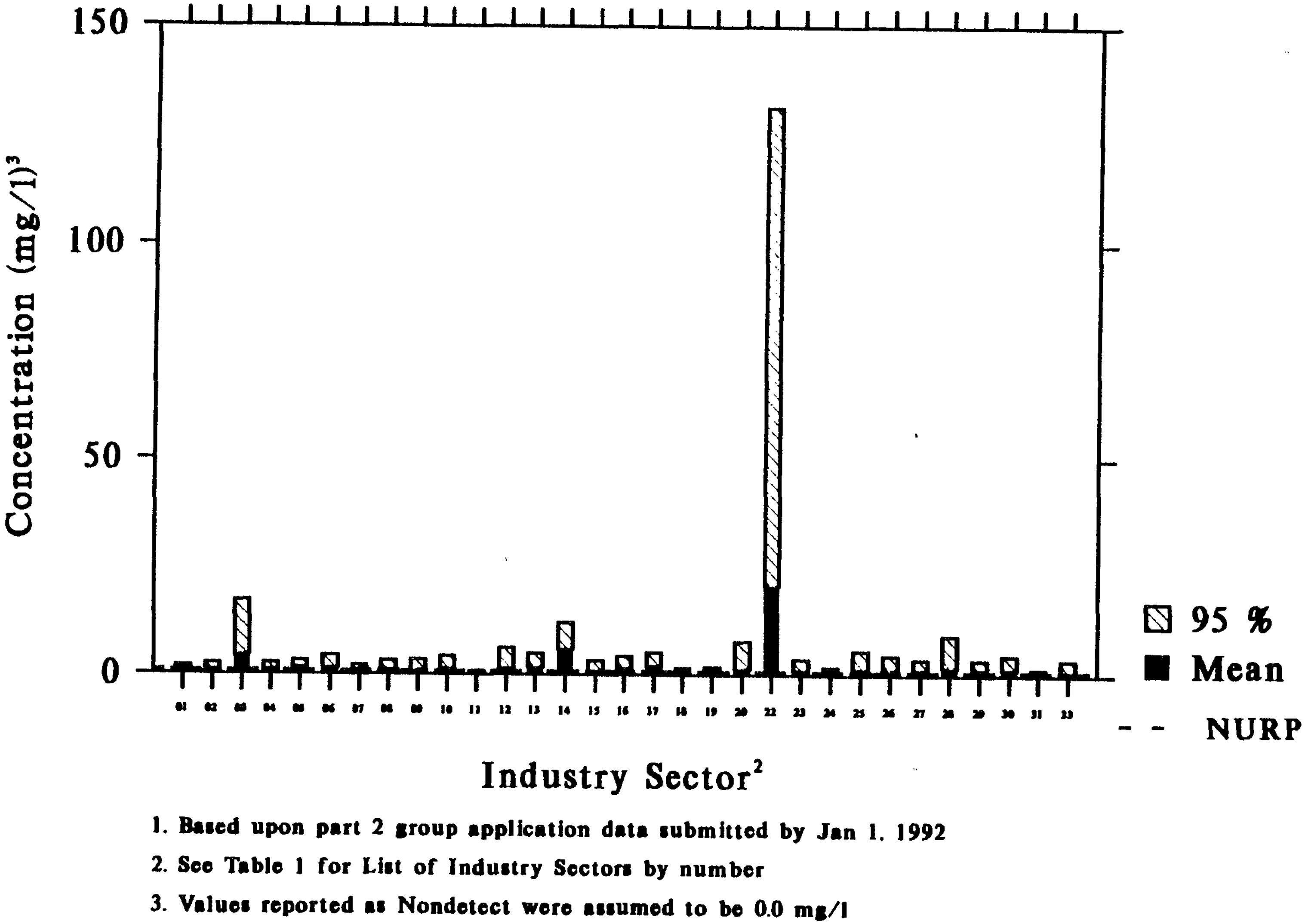
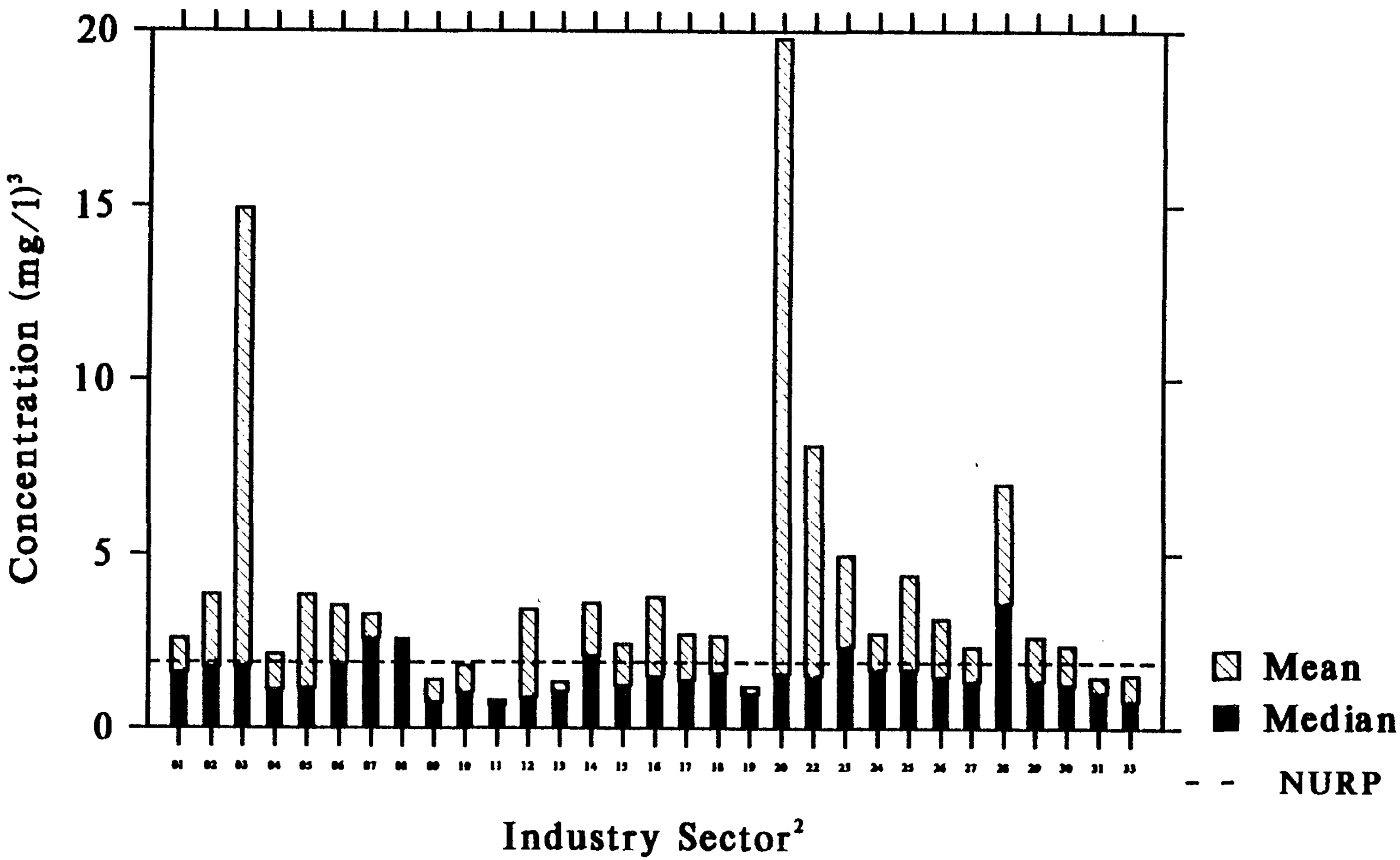


Figure F-12. Nitrate Plus Nitrite Nitrogen Concentration Storm Water Discharges[1] Composite Samples by Industry Sector

Table F-4
Summary of Sampling Data From Phase I Part II Permit Applications (With Comparison to NURP and USGS Studies) for TKN (mg/l)

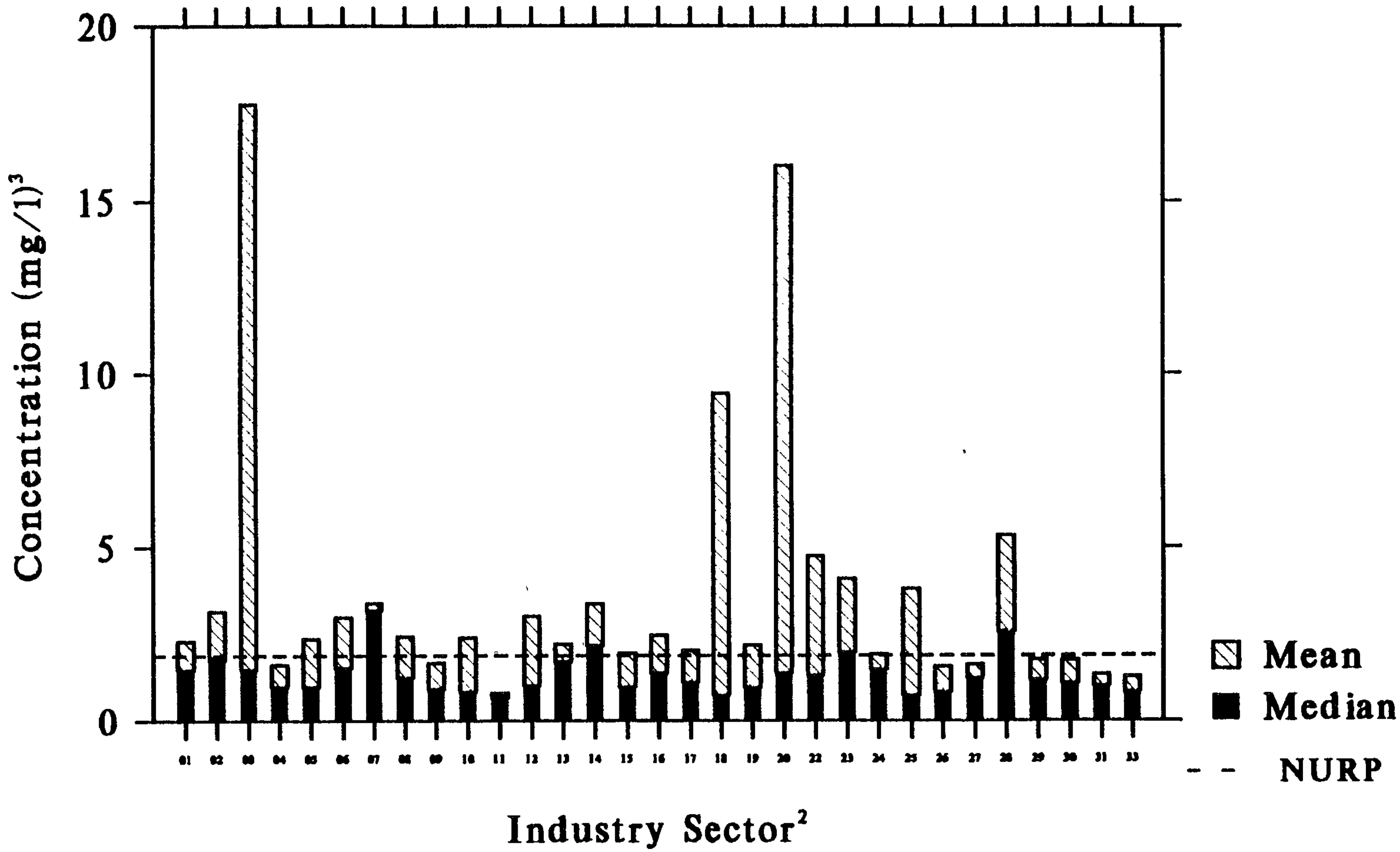
Sector	DESCRIPTION	Grab Samples				Composite Samples			
		No.	Mean	Median	95 %	No.	Mean	Median	95 %
	FOR POLLUTANT	TKN				TKN			
NURP	Median Urban Site *						1.90	1.50	3.30
USGS	Commercial Site *						NR	NR	NR
01	Lumber & Wood Products	188	2.57	1.62	9.26	188	2.32	1.50	7.50
02	Paper & Allied Prod.	121	3.83	1.76	10.20	112	3.17	1.77	10.10
03	Chemicals & Allied Products	171	15.50	1.90	27.00	159	18.30	1.70	23.70
04	Petrol Refining & Related Ind.	63	2.13	1.13	7.16	51	1.63	0.99	6.28
05	Stone, Clay, Glass Products	304	3.82	1.16	7.00	292	2.37	1.00	5.00
06	Primary Metal Ind.	160	3.56	1.98	13.00	149	3.05	1.60	9.70
07	Metal Mining	15	3.27	2.60	9.40	13	3.39	3.20	11.80
08	Coal & Lignite Mining	9	2.56	2.60	5.20	8	2.65	1.46	7.40
09	Oil & Gas Extraction	36	1.39	0.76	5.20	30	1.69	0.93	5.67
10	Nonmetallic Mineral Mining	55	1.81	1.05	8.00	50	2.41	0.84	6.89
11	Hazardous Waste TSDFs	9	1.43	1.30	3.00	9	1.07	0.92	3.92
12	Industrial Landfills & Dumps	51	3.36	1.10	12.00	48	3.03	1.04	14.20
13	Used Motor Vehicle Parts	13	2.17	1.90	4.87	30	2.27	1.77	6.63
14	Scrap & Waste Materials	127	3.44	2.05	11.10	114	3.38	2.20	9.20
15	Steam Electric Power Plants	76	2.41	1.25	8.55	78	1.95	1.00	10.00
16	Railroad Transport	118	3.75	1.50	13.40	102	2.48	1.40	8.80
17	Transport: Trucks, Freight, etc.	405	2.69	1.40	7.70	373	2.04	1.13	6.30
18	Water Transport	15	2.64	1.60	16.00	14	9.41	0.75	118.00
19	Ship & Boat Building, Repair	51	1.19	1.00	2.40	43	2.20	0.97	3.90
20	Air Transport	95	19.79	1.58	27.00	88	16.00	1.40	18.80
22	Wastewater Treatment	79	8.10	1.52	18.00	78	4.74	1.33	11.00
23	Food, Tobacco Manufact.	300	4.95	2.35	18.00	290	4.07	2.00	17.00
24	Textile & Apparel Manufact.	110	2.72	1.70	6.50	107	1.92	1.50	5.40
25	Furniture & Fixtures	25	4.37	1.70	15.00	24	4.40	1.35	13.00
26	Printing & Publishing	27	3.13	1.50	10.00	27	1.57	0.84	4.60
27	Rubber & Plastic Products	89	2.34	1.36	6.00	86	1.63	1.25	4.70
28	Leather/Products	31	7.70	4.30	22.00	31	6.22	3.50	15.00
29	Fabricated Metal Products, Jewelry	115	2.61	1.37	7.20	114	1.78	1.20	5.75
30	Ind. & Comm. & Transport Equip.	170	2.47	1.30	5.80	165	1.81	1.10	4.75
31	Electronic Equip. & Instruments	62	1.46	1.05	4.09	56	1.36	1.01	3.70

*NURP and USGS results were reported only as composite samples, not grab.
NR = Not Reported



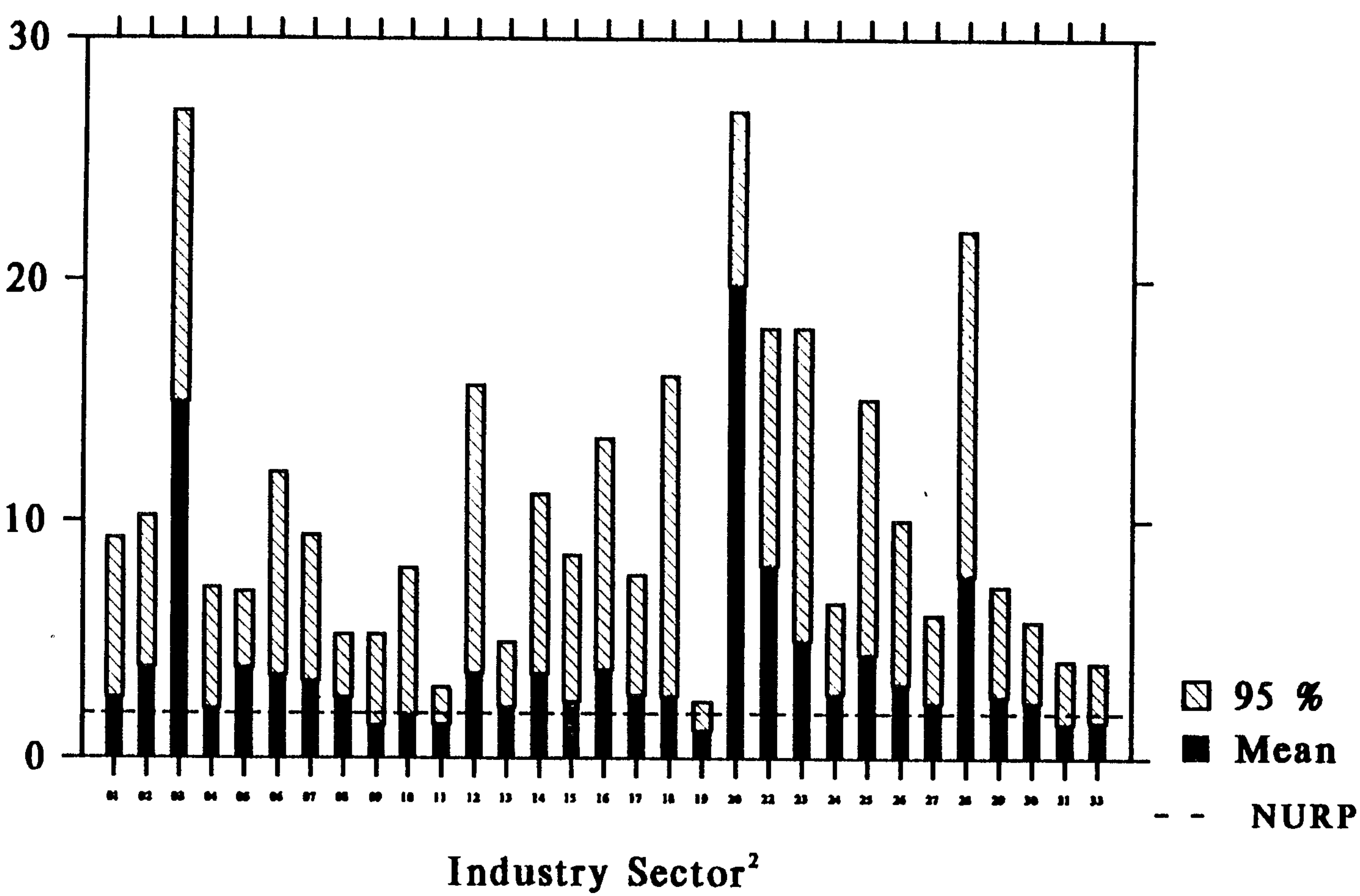
1. Based upon part 2 group application data submitted by Jan 1, 1992
2. See Table 1 for List of Industry Sectors by number
3. Values reported as Nondetect were assumed to be 0.0 mg/l

Figure F-13. TKN Concentration Storm Water Discharges[1]
Grab Samples by Industry Sector



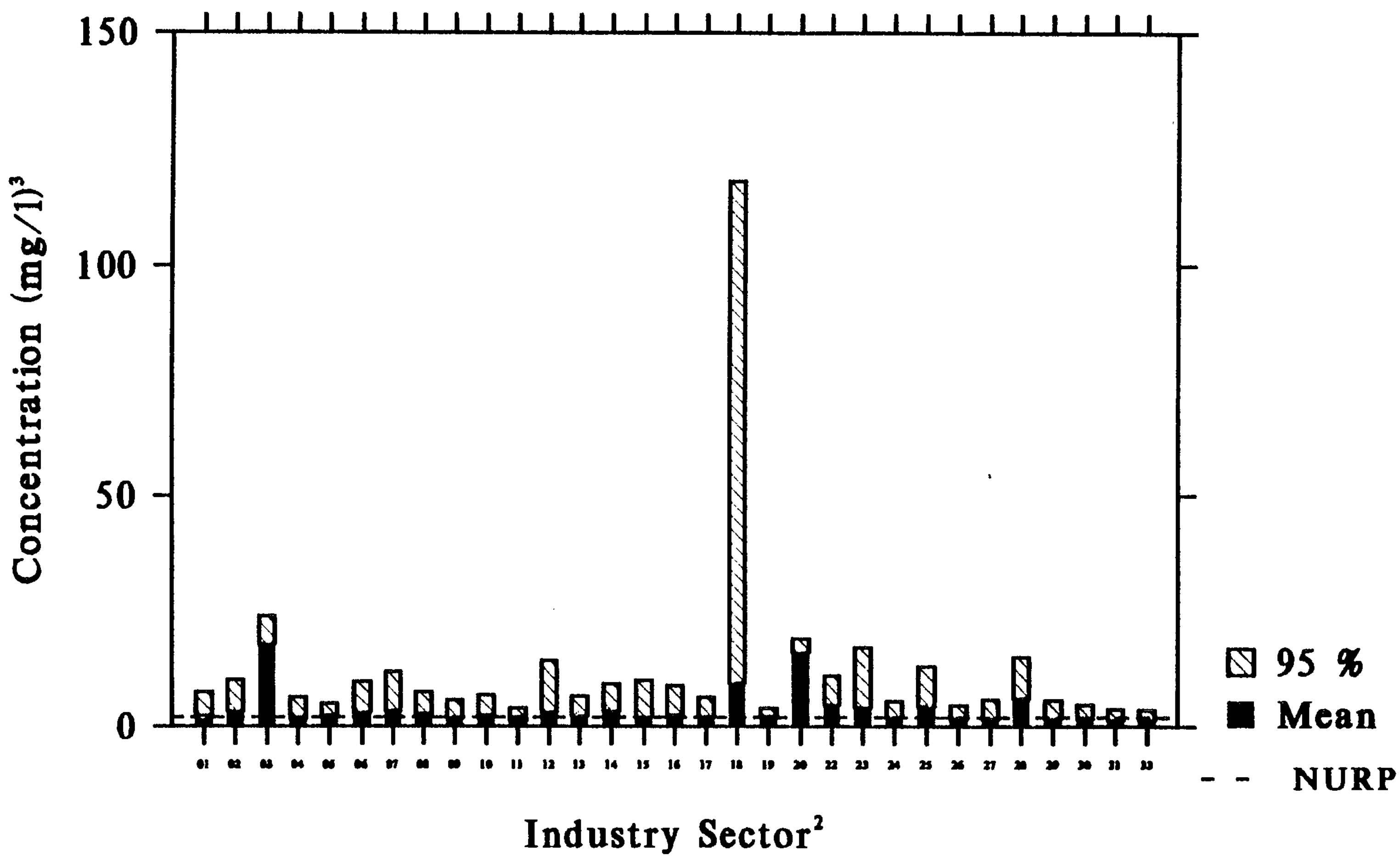
1. Based upon part 2 group application data submitted by Jan 1. 1992
2. See Table 1 for List of Industry Sectors by number
3. Values reported as Nondetect were assumed to be 0.0 mg/l

Figure F-14. TKN Concentration Storm Water Discharges[1]
Composite Samples by Industry Sector



1. Based upon part 2 group application data submitted by Jan 1. 1992
2. See Table 1 for List of Industry Sectors by number
3. Values reported as Nondetect were assumed to be 0.0 mg/l

Figure F-15. TKN Concentration Storm Water Discharges[1]
Grab Samples by Industry Sector



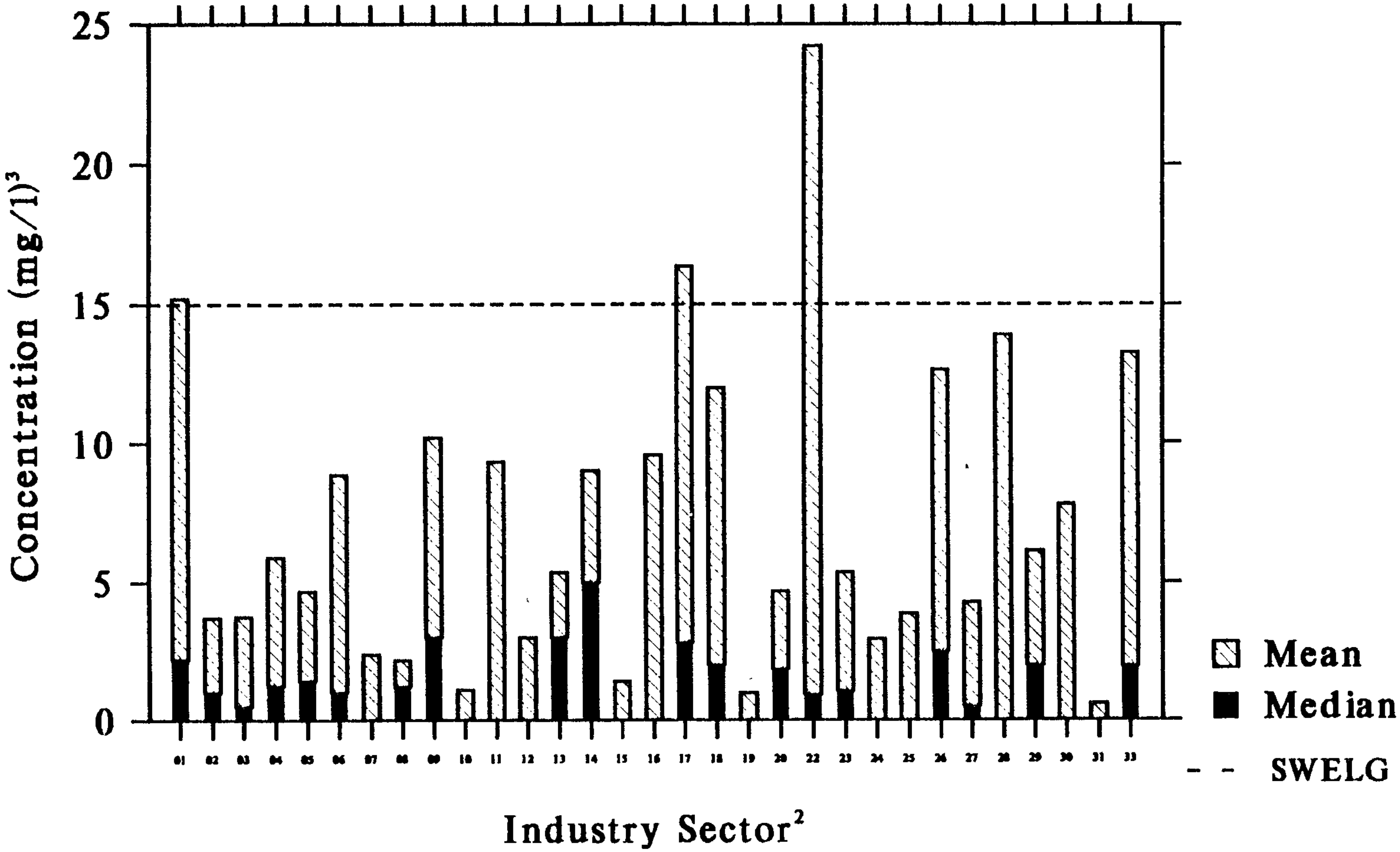
1. Based upon part 2 group application data submitted by Jan 1, 1992
2. See Table 1 for List of Industry Sectors by number
3. Values reported as Nondetect were assumed to be 0.0 mg/l

Figure F-16. TKN Concentration Storm Water Discharges[1]
Composite Samples by Industry Sector

Table F-5
Summary of Sampling Data From Phase I Part II Permit Applications (With Comparison to NURP and USGS Data) for Oil and Grease (mg/l)

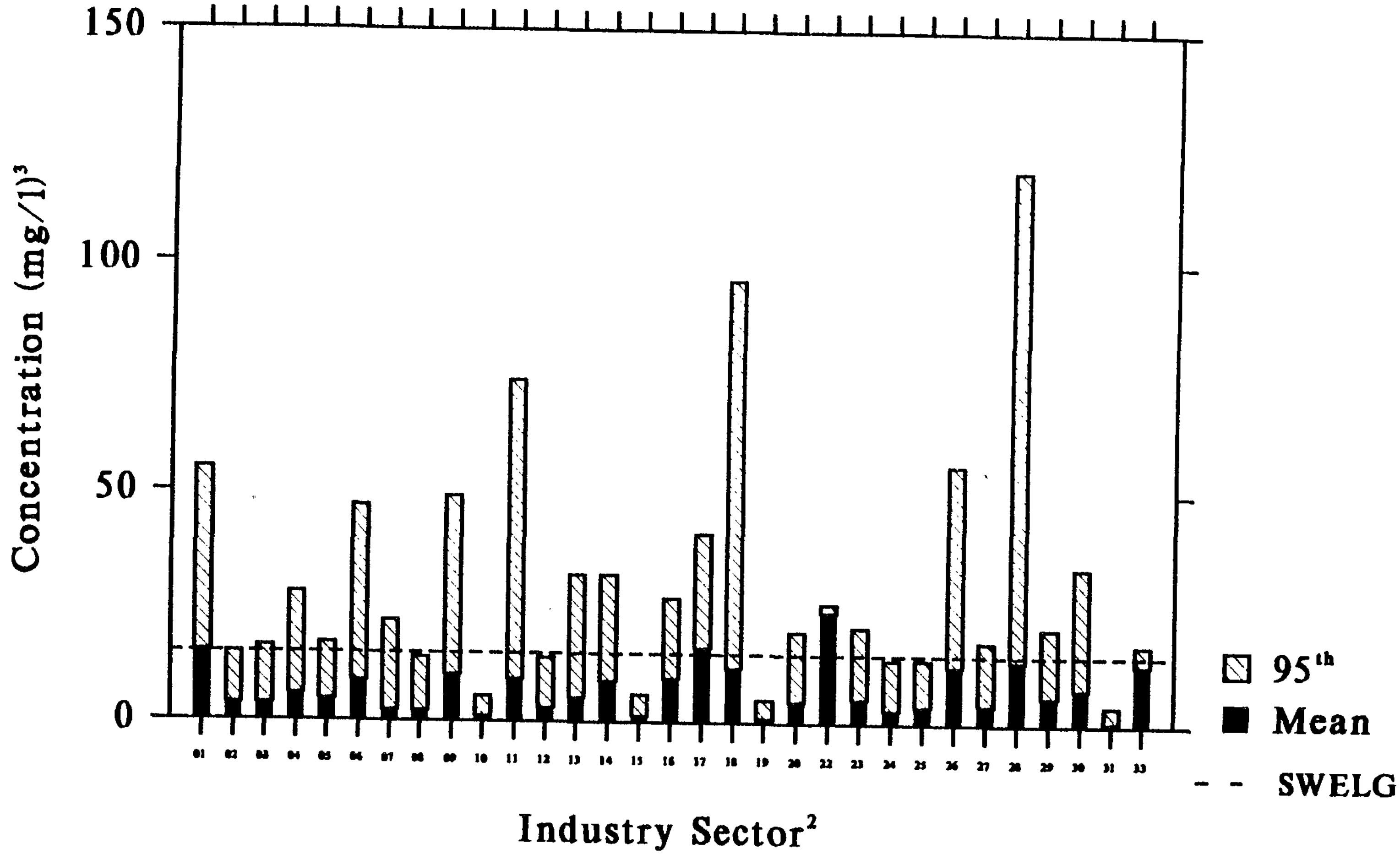
Sector	DESCRIPTION	Grab Samples No.	Grab Samples Mean	Grab Samples Median	Grab Samples 95 %	Composite Samples No.	Composite Samples Mean	Composite Samples Median	Composite Samples 95 %
	FOR POLLUTANT	Oil & Grease				Oil & Grease			
NURP	Median Urban Site *						NR	NR	NR
USGS	Commercial Site *						NR	NR	NR
01	Lumber & Wood Products	207	15.21	2.20	55.00				
02	Paper & Allied Prod.	122	3.69	1.00	15.00				
03	Chemicals & Allied Products	169	3.75	0.50	16.30				
04	Petrol Refining & Related Ind.	64	5.89	1.25	28.00				
05	Stone, Clay, Glass Products	315	4.67	1.40	17.10				
06	Primary Metal Ind.	163	8.88	1.00	47.00				
07	Metal Mining	16	2.36	0.00	22.00				
08	Coal & Lignite Mining	19	2.17	1.20	13.90				
09	Oil & Gas Extraction	36	10.18	3.00	49.00				
10	Nonmetallic Mineral Mining	60	1.08	0.00	5.45				
11	Hazardous Waste TSDFs	9	9.33	0.00	74.00				
12	Industrial Landfills & Dumps	53	2.97	0.00	14.00				
13	Used Motor Vehicle Parts	30	5.35	3.00	32.00				
14	Scrap & Waste Materials	135	8.95	5.00	32.00				
15	Steam Electric Power Plants	88	1.38	0.00	6.00				
16	Railroad Transport	118	9.56	0.00	27.00				
17	Transport: Trucks, Freight, etc.	418	16.38	2.80	41.00				
18	Water Transport	15	11.93	2.00	96.00				
19	Ship & Boat Building, Repair	52	0.98	0.00	5.00				
20	Air Transport	98	4.66	1.85	20.00				
22	Wastewater Treatment	89	24.24	0.90	26.00				
23	Food, Tobacco Manufact.	300	5.35	1.05	20.95				
24	Textile & Apparel Manufact.	111	2.94	0.00	14.00				
25	Furniture & Fixtures	25	3.84	0.00	14.00				
26	Printing & Publishing	27	12.58	2.50	56.00				
27	Rubber & Plastic Products	94	4.26	0.50	18.00				
28	Leather/Products	31	13.87	0.00	120.00				
29	Fabricated Metal Products, Jewelry	114	6.11	2.00	21.00				
30	Ind. & Comm. & Transport Equip.	189	7.84	0.00	34.00				
31	Electronic Equip. & Instruments	69	0.58	0.00	4.10				

*NURP and USGS results were reported only as composite samples, not grab.
NR = Not Reported



1. Based upon part 2 group application data submitted by Jan 1. 1992
2. See Table 1 for List of Industry Sectors by number
3. Values reported as Nondetect were assumed to be 0.0 mg/l

Figure F-17. Oil & Grease Concentration Storm Water Discharges[1]
Grab Samples by Industry Sector



1. Based upon part 2 group application data submitted by Jan 1, 1992
2. See Table 1 for List of Industry Sectors by number
3. Values reported as Nondetect were assumed to be 0.0 mg/l

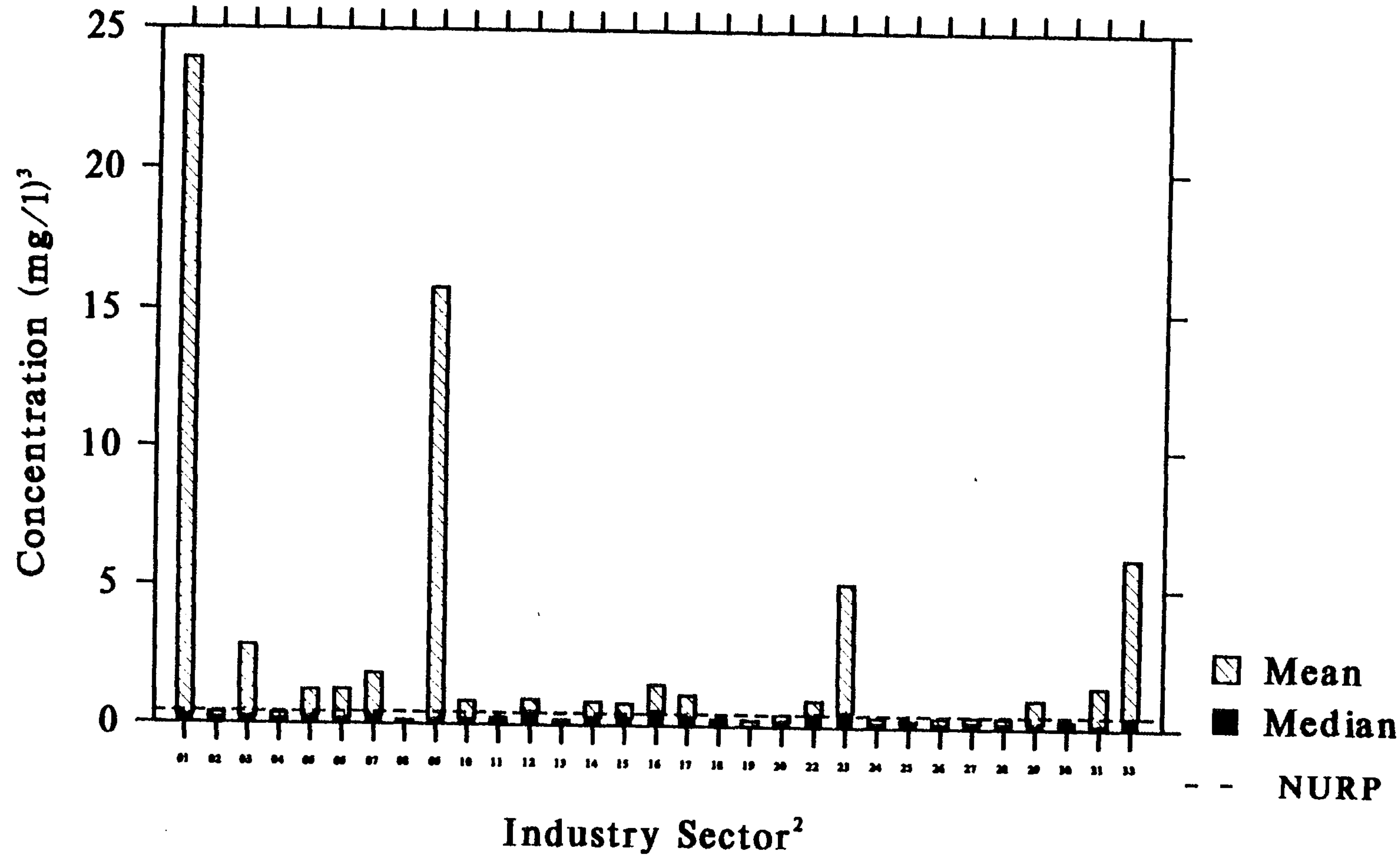
Figure F-18. Oil & Grease Concentration Storm Water Discharges[1]
Grab Samples by Industry Sector

Table F-6
Summary of Sampling Data From Phase I Part II Permit Applications (With Comparison to NURP and USGS Data) for Total Phosphorus (mg/l)

Sector	DESCRIPTION	Grab Samples No.	Grab Samples Mean	Grab Samples Median	Grab Samples 95 %	Composite Samples No.	Composite Samples Mean	Composite Samples Median	Composite Samples 95 %
	FOR POLLUTANT	P, Total				P, Total			
NURP	Median Urban Site *						0.42	0.33	0.70
USGS	Commercial Site *						0.31	0.18	NR
01	Lumber & Wood Products	198	23.91	0.29	2.66	199	6.29	0.30	1.72
02	Paper & Allied Prod.	120	0.39	0.18	1.06	111	0.36	0.16	0.91
03	Chemicals & Allied Products	170	2.82	0.24	12.10	158	9.51	0.23	16.40
04	Petrol Refining & Related Ind.	63	0.37	0.13	1.65	54	0.28	0.15	1.28
05	Stone, Clay, Glass Products	313	1.21	0.28	4.96	300	0.87	0.25	3.24
06	Primary Metal Ind.	163	1.25	0.17	1.80	149	0.52	0.14	0.96
07	Metal Mining	21	1.83	0.30	11.00	16	1.06	0.38	7.00
08	Coal & Lignite Mining	8	0.12	0.04	0.66	5	0.12	0.00	0.58
09	Oil & Gas Extraction	36	15.82	0.18	144.90	33	3.41	0.07	19.46
10	Nonmetallic Mineral Mining	55	0.84	0.20	4.69	51	1.13	0.24	2.61
11	Hazardous Waste TSDFs	9	0.24	0.07	1.60	9	0.11	0.09	0.32
12	Industrial Landfills & Dumps	50	0.91	0.50	3.35	47	0.95	0.38	4.08
13	Used Motor Vehicle Parts	13	0.19	0.05	1.08	30	3.05	0.26	15.70
14	Scrap & Waste Materials	127	0.81	0.30	2.20	114	0.77	0.29	1.80
15	Steam Electric Power Plants	75	0.79	0.29	3.09	78	0.63	0.27	3.10
16	Railroad Transport	118	1.47	0.54	8.10	102	0.92	0.45	3.05
17	Transport: Trucks, Freight, etc.	405	1.12	0.33	3.90	373	0.73	0.29	2.91
18	Water Transport	15	0.27	0.10	1.20	14	0.15	0.17	0.32
19	Ship & Boat Building, Repair	51	0.21	0.00	0.91	45	0.88	0.00	0.76
20	Air Transport	86	0.44	0.20	1.84	79	0.29	0.20	0.88
22	Wastewater Treatment	86	0.95	0.50	3.17	84	0.68	0.45	1.89
23	Food, Tobacco Manufact.	298	5.13	0.56	9.06	287	1.32	0.48	5.96
24	Textile & Apparel Manufact.	110	0.35	0.14	0.66	107	0.31	0.11	0.60
25	Furniture & Fixtures	25	0.27	0.20	0.89	24	0.26	0.19	0.71
26	Printing & Publishing	27	0.37	0.14	1.50	27	0.35	0.13	1.30
27	Rubber & Plastic Products	89	0.41	0.19	1.61	85	0.34	0.16	0.83
28	Leather/Products	31	0.36	0.16	1.60	31	0.83	0.18	1.30
29	Fabricated Metal Products, Jewelry	113	1.03	0.22	9.80	114	0.84	0.21	4.80
30	Ind. & Comm. & Transport Equip.	176	0.29	0.14	1.00	179	0.40	0.13	1.12
31	Electronic Equip. & Instruments	64	1.50	0.13	1.10	57	1.02	0.16	1.20

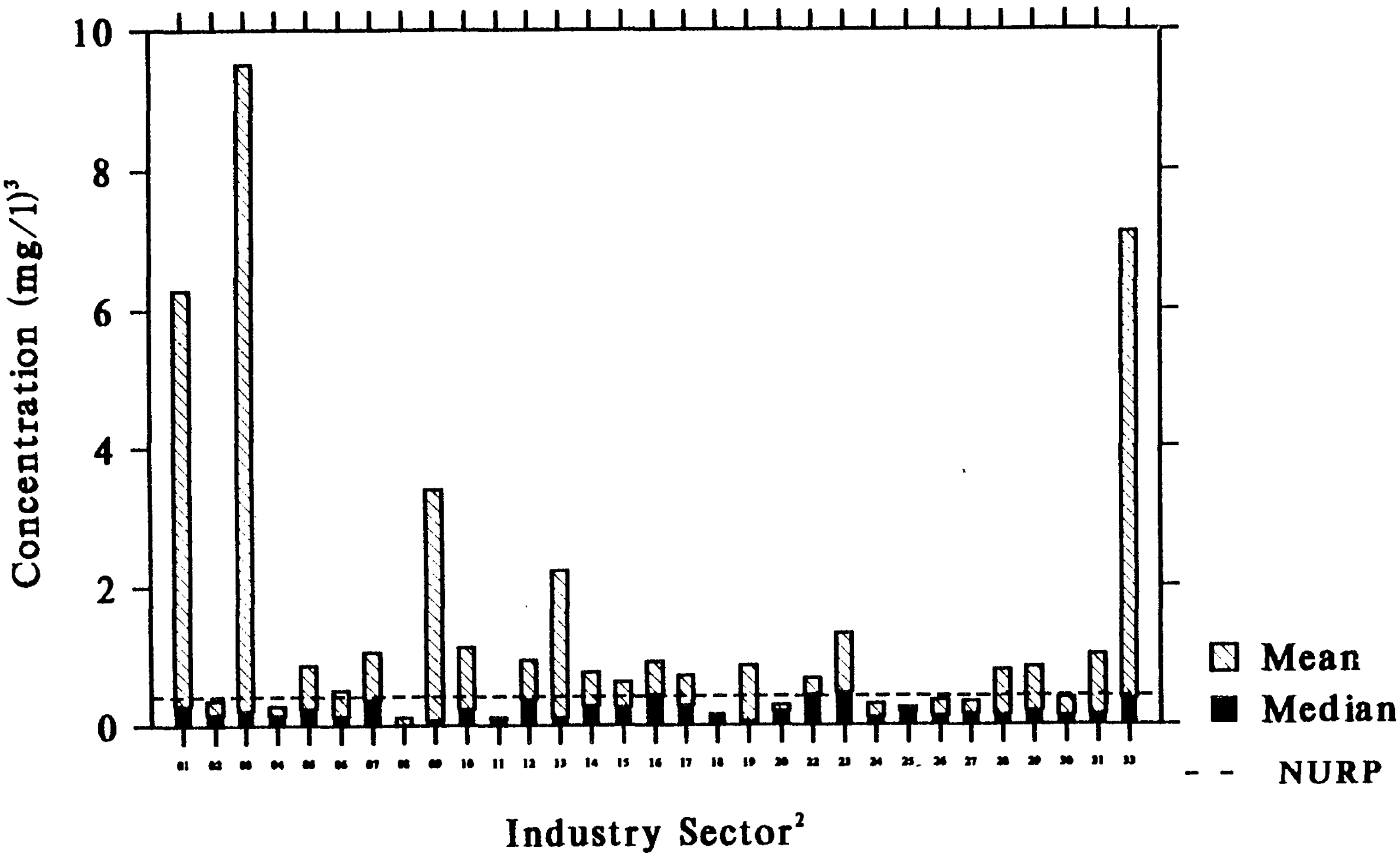
*NURP and USGS results were reported only as composite samples, not grab.
NR = Not Reported

R0015462



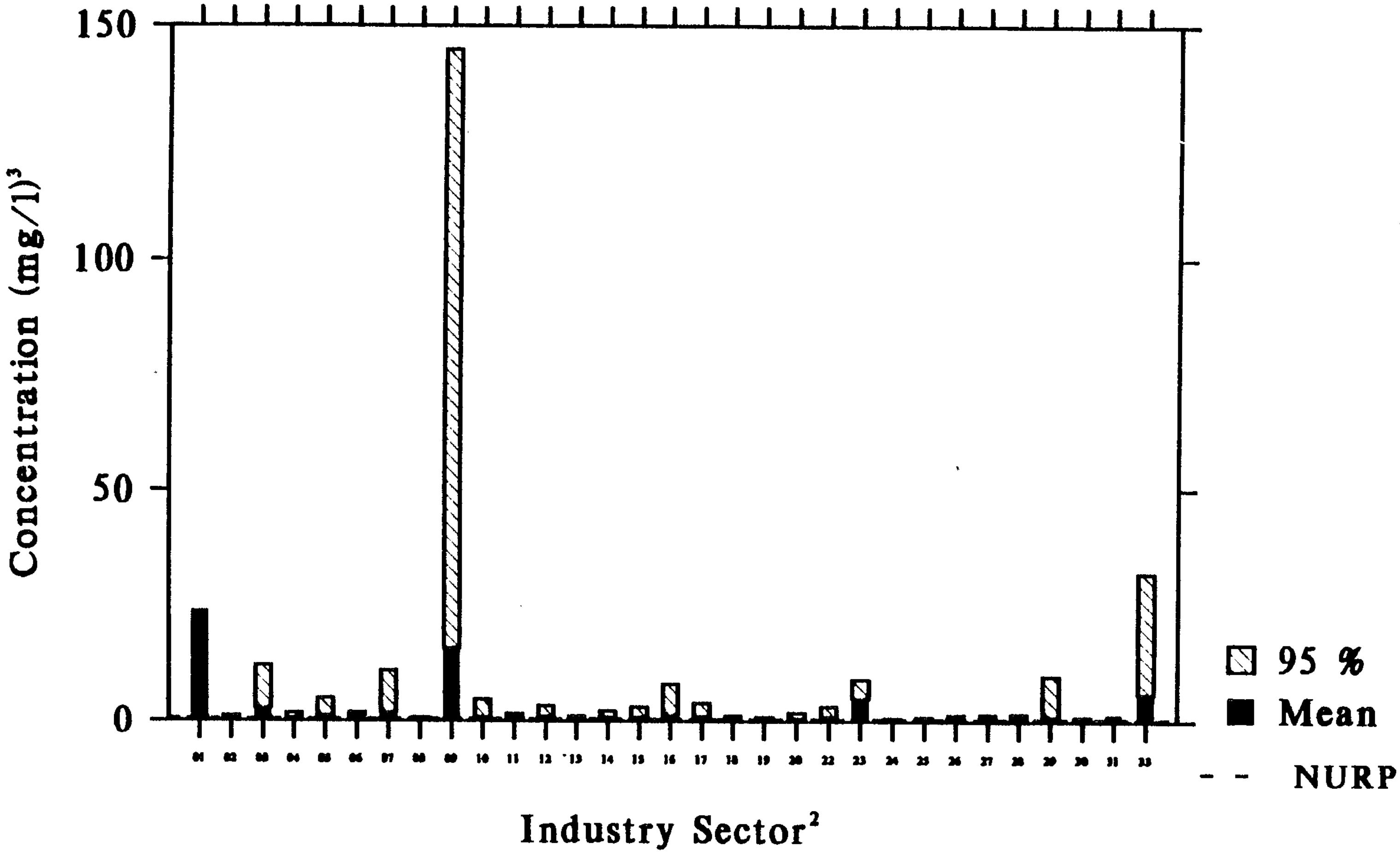
1. Based upon part 2 group application data submitted by Jan 1. 1992
2. See Table 1 for List of Industry Sectors by number
3. Values reported as Nondetect were assumed to be 0.0 mg/l

Figure F-19. Phosphorus Concentration Storm Water Discharges[1]
Grab Samples by Industry Sector



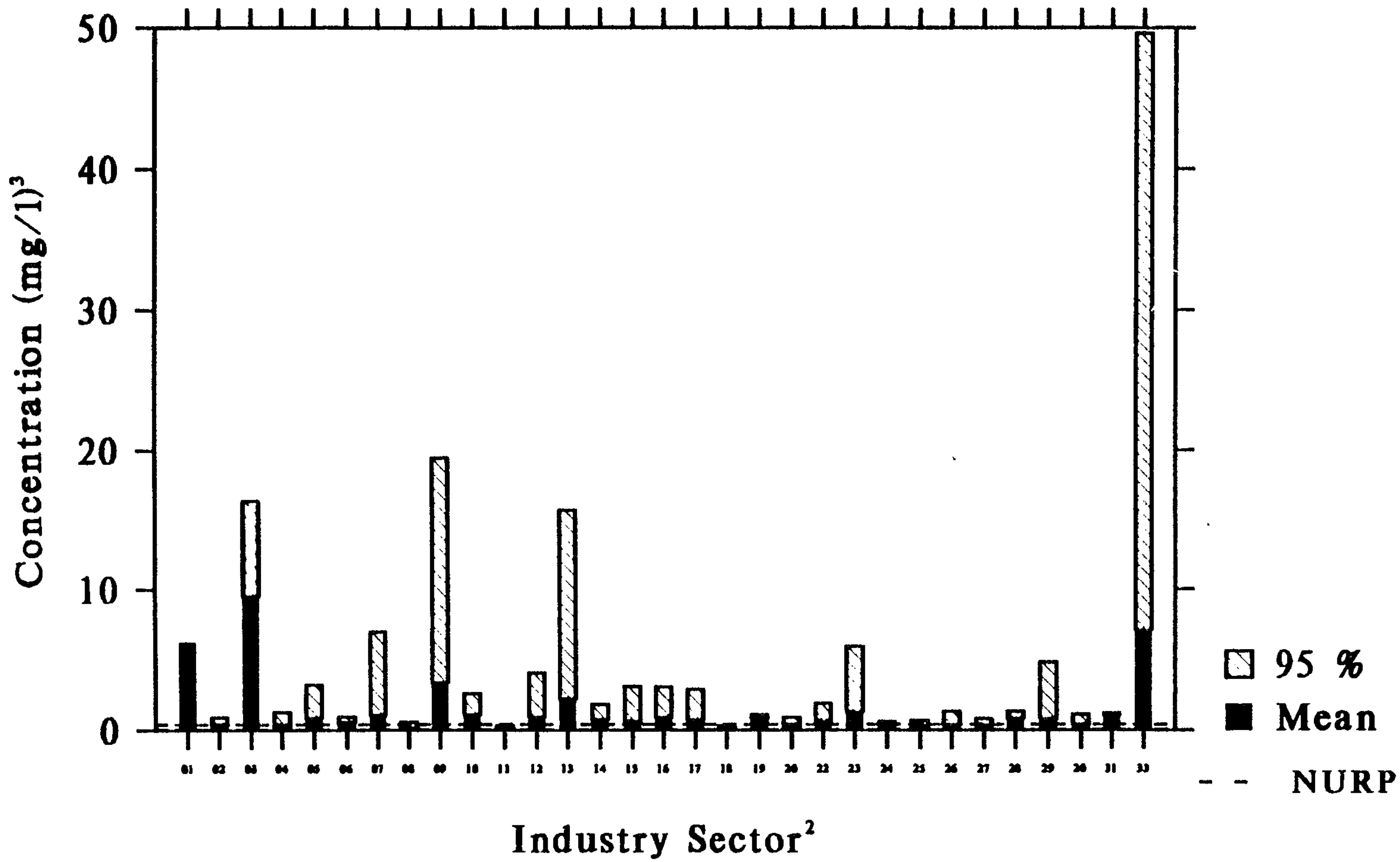
1. Based upon part 2 group application data submitted by Jan 1. 1992
2. See Table 1 for List of Industry Sectors by number
3. Values reported as Nondetect were assumed to be 0.0 mg/l

Figure F-20. Phosphorus Concentration Storm Water Discharges[1]
Composite Samples by Industry Sector



1. Based upon part 2 group application data submitted by Jan 1. 1992
2. See Table 1 for List of Industry Sectors by number
3. Values reported as Nondetect were assumed to be 0.0 mg/l

Figure F-21. Phosphorus Concentration Storm Water Discharges[1]
Grab Samples by Industry Sector



1. Based upon part 2 group application data submitted by Jan 1. 1992
2. See Table 1 for List of Industry Sectors by number
3. Values reported as Nondetect were assumed to be 0.0 mg/l

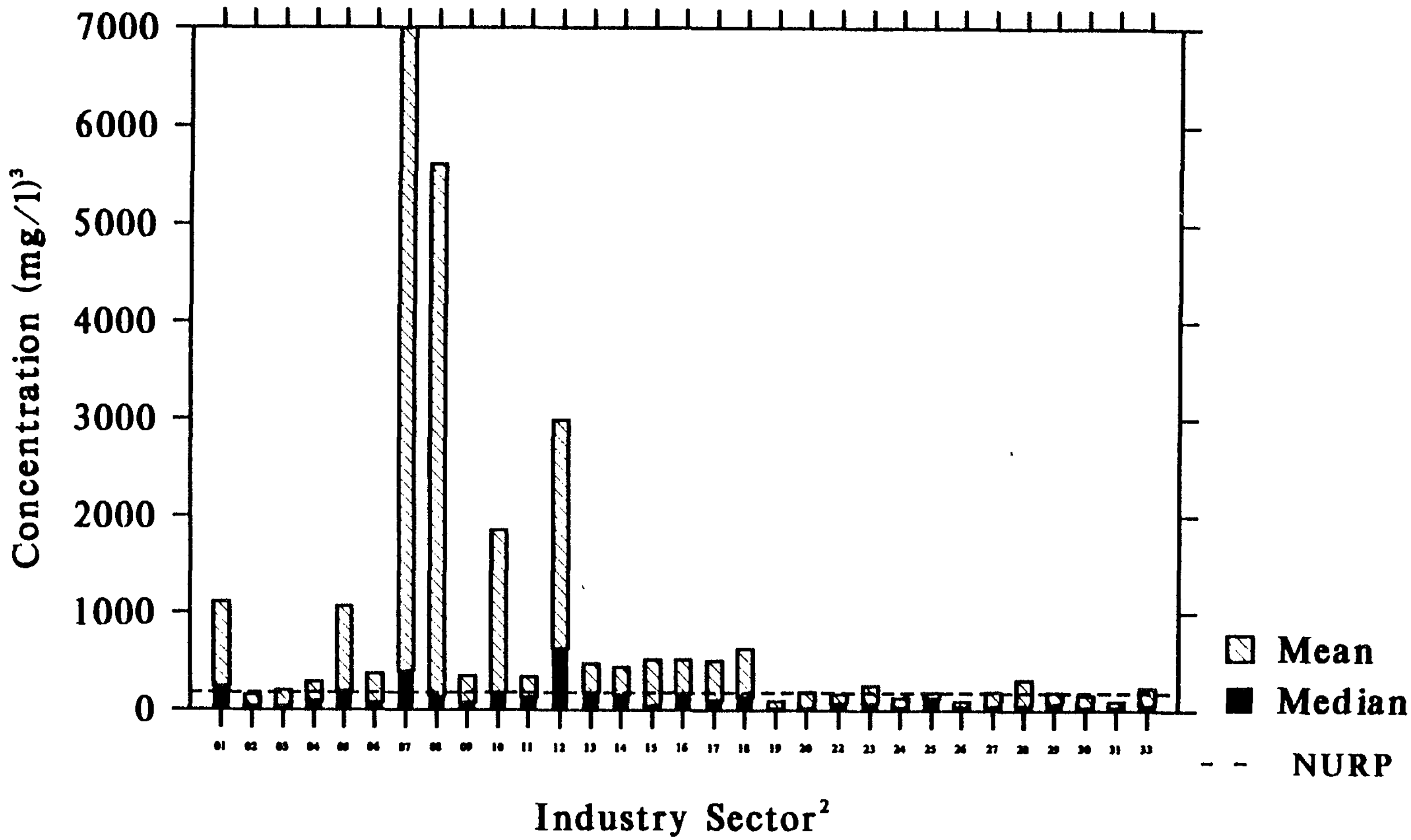
Figure F-22. Phosphorus Concentration Storm Water Discharges[1]
Composite Samples by Industry Sector

Table F-7
Summary of Sampling Data From Phase I Part II Permit Applications (With Comparison to NURP and USGS Studies) for TSS (mg/l)

Sector	DESCRIPTION	Grab Samples No.	Grab Samples Mean	Grab Samples Median	Grab Samples 95 %	Composite Samples No.	Composite Samples Mean	Composite Samples Median	Composite Samples 95 %
	FOR POLLUTANT	TSS				TSS			
NURP	Median Urban Site *						180	100	300
USGS	Commercial Site *						248	109	NR
01	Lumber & Wood Products	198	1108	242	4800	198	575	230	2288
02	Paper & Allied Prod.	121	153	41	520	111	44	13	198
03	Chemicals & Allied Products	169	200	40	793	159	94	25	453
04	Petrol Refining & Related Ind.	63	287	93	1330	54	165	46	860
05	Stone, Clay, Glass Products	311	1067	200	2620	302	386	149	1440
06	Primary Metal Ind.	162	368	72	1700	149	162	69	717
07	Metal Mining	17	6996	403	100000	15	623	330	3050
08	Coal & Lignite Mining	10	5608	150	33420	8	690	251	3880
09	Oil & Gas Extraction	37	353	75	1520	30	413	48	2056
10	Nonmetallic Mineral Mining	55	1848	181	11120	51	1576	296	10080
11	Hazardous Waste TSDFs	8	338	128	1100	9	83	32	304
12	Industrial Landfills & Dumps	51	2979	633	19370	47	1850	370	9140
13	Used Motor Vehicle Parts	13	474	183	2300	30	839	226	5100
14	Scrap & Waste Materials	130	437	148	2096	116	376	85	1700
15	Steam Electric Power Plants	76	516	44	1200	77	212	40	810
16	Railroad Transport	118	517	172	2800	102	249	90	917
17	Transport: Trucks, Freight, etc.	406	503	104	1890	375	454	67	1100
18	Water Transport	15	634	135	4330	14	224	68	944
19	Ship & Boat Building, Repair	51	92	17	505	45	2	8	200
20	Air Transport	96	185	29	1080	87	80	22	258
22	Wastewater Treatment	90	160	68	575	88	114	56	414
23	Food, Tobacco Manufact.	298	252	73	1320	286	200	54	900
24	Textile & Apparel Manufact.	110	126	36	410	107	80	22	380
25	Furniture & Fixtures	25	188	130	440	24	143	91	550
26	Printing & Publishing	27	92	30	433	27	31	28	82
27	Rubber & Plastic Products	90	189	44	893	87	119	30	476
28	Leather/Products	31	310	49	1300	31	115	86	460
29	Fabricated Metal Products, Jewelry	115	187	76	758	114	125	32	423
30	Ind. & Comm. & Transport Equip.	173	163	30	576	169	100	17	319
31	Electronic Equip. & Instruments	63	89	29	348	56	67	14	370

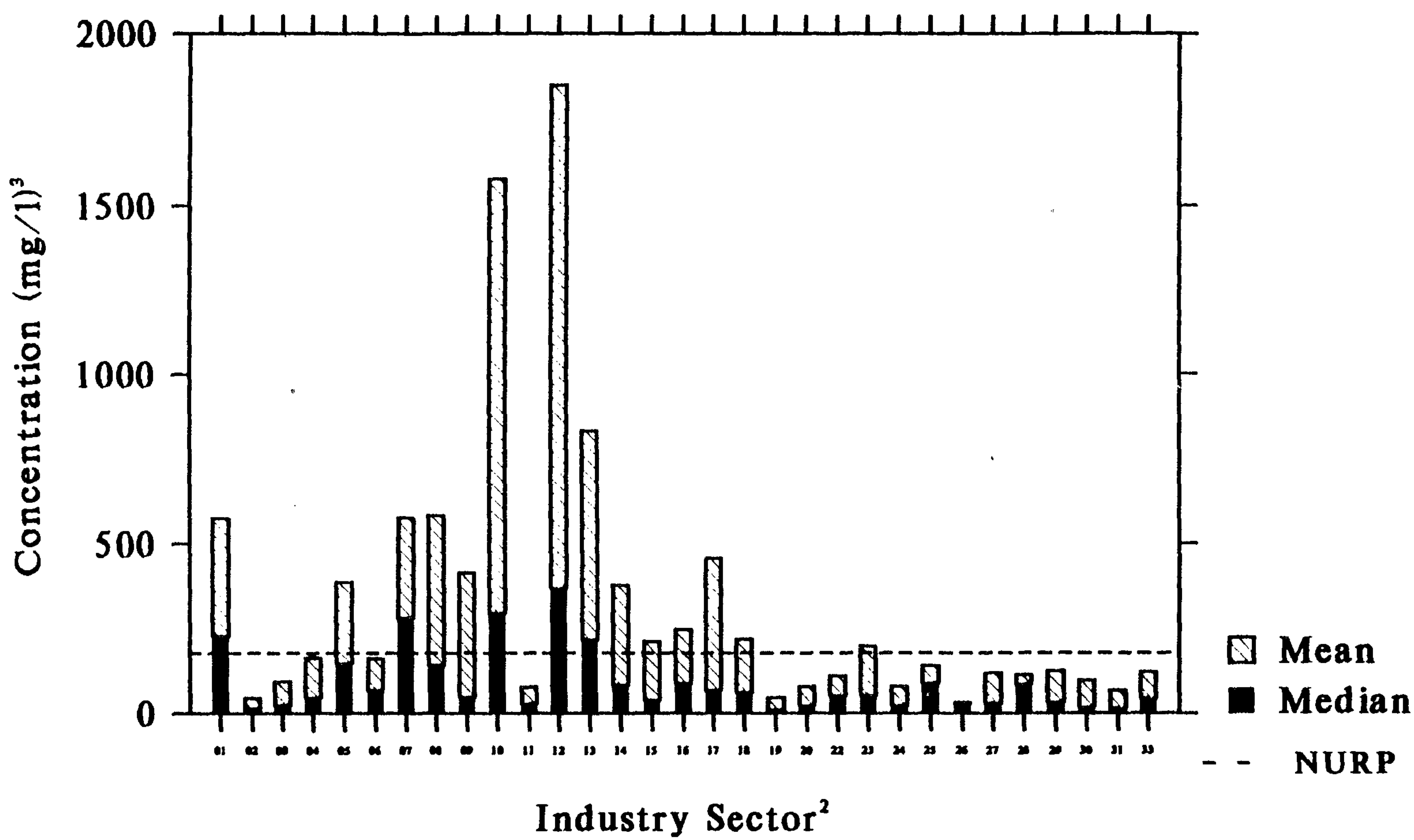
*NURP and USGS results were reported only as composite samples, not grab.
NR = Not Reported

R0015467



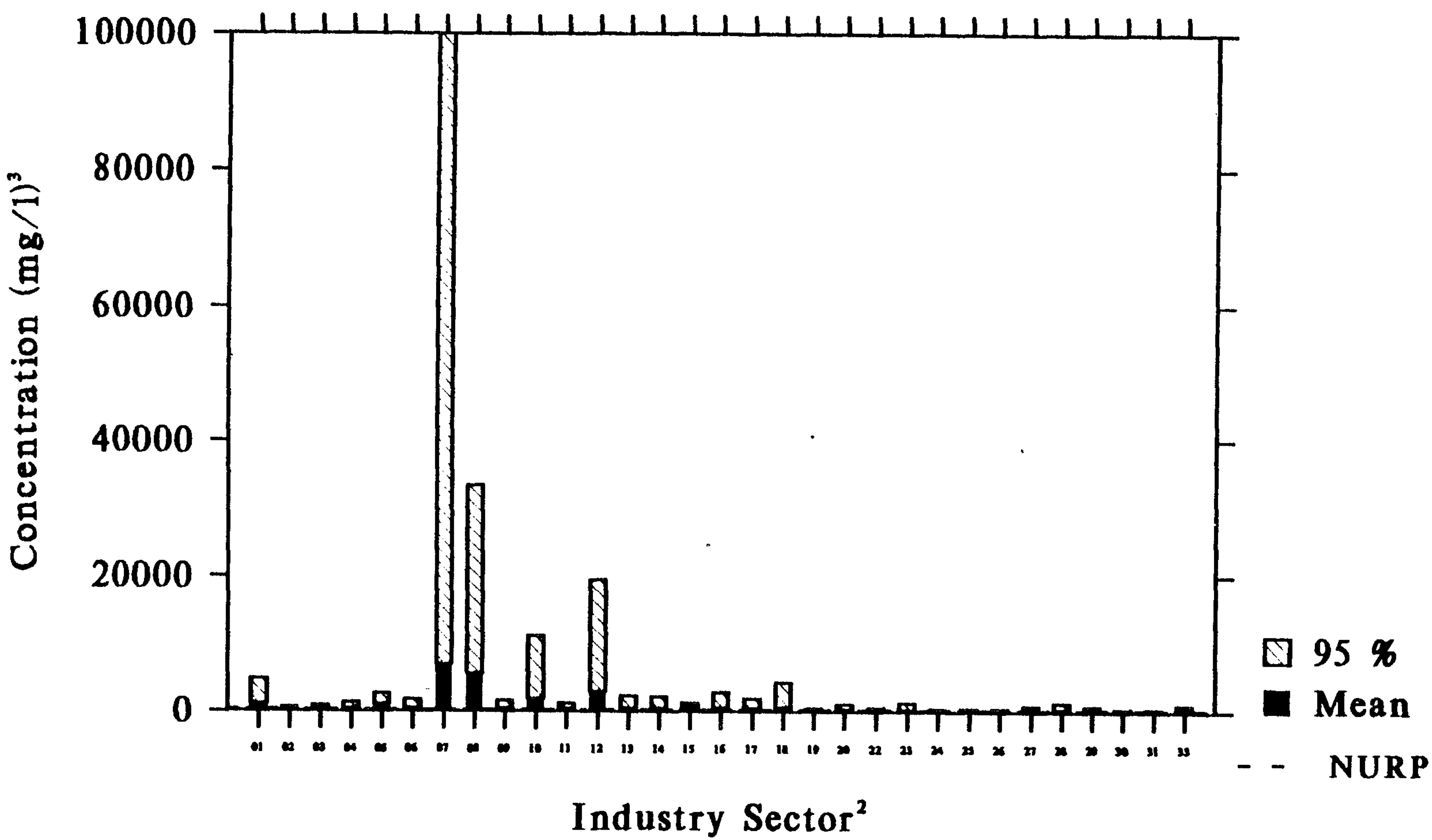
1. Based upon part 2 group application data submitted by Jan 1. 1992
2. See Table 1 for List of Industry Sectors by number
3. Values reported as Nondetect were assumed to be 0.0 mg/l

Figure F-23. TSS Concentration Storm Water Discharges[1] Grab Samples by Industry Sector



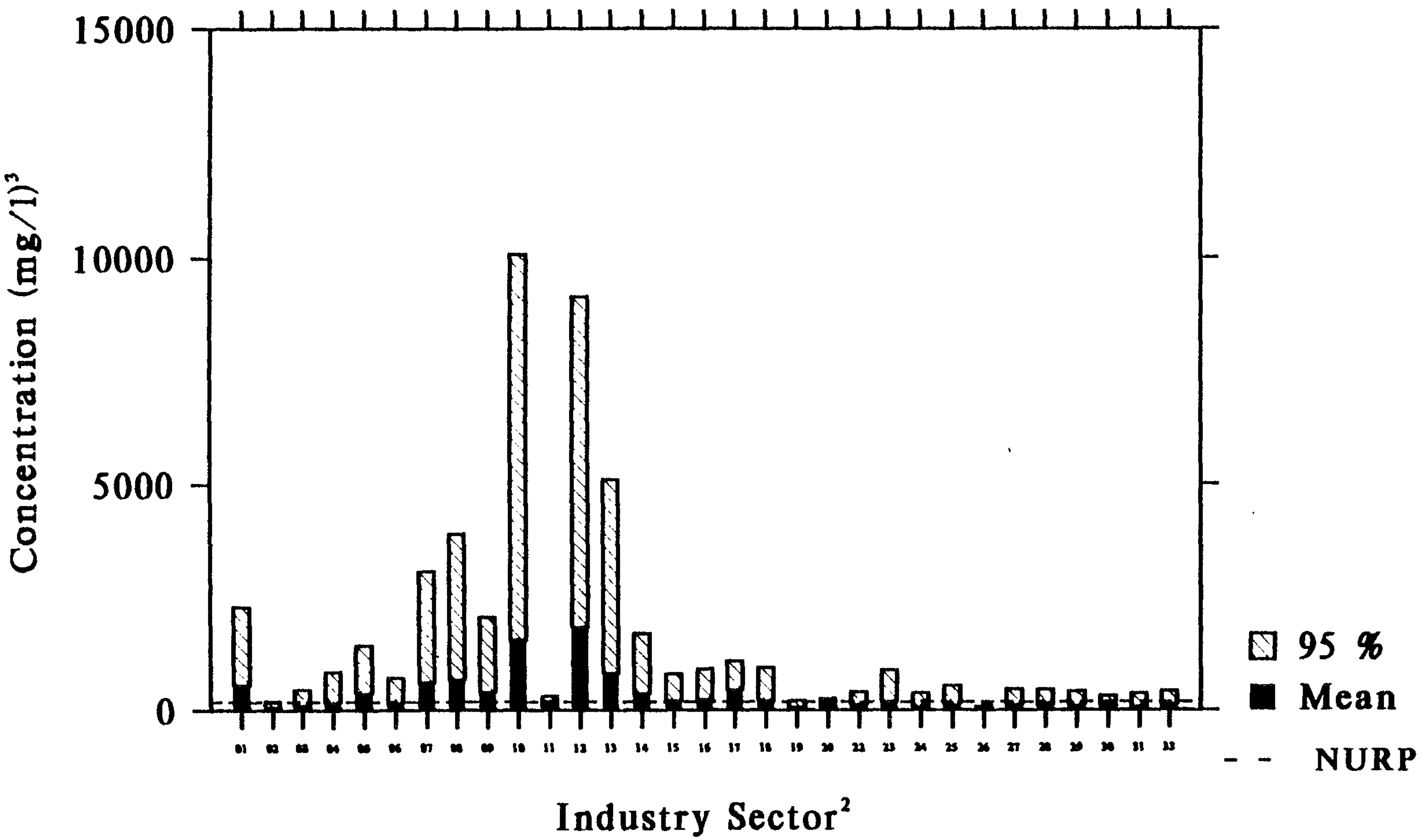
1. Based upon part 2 group application data submitted by Jan 1. 1992
2. See Table 1 for List of Industry Sectors by number
3. Values reported as Nondetect were assumed to be 0.0 mg/l

Figure F-24. TSS Concentration Storm Water Discharges[1]
Composite Samples by Industry Sector



1. Based upon part 2 group application data submitted by Jan 1. 1992
2. See Table 1 for List of Industry Sectors by number
3. Values reported as Nondetect were assumed to be 0.0 mg/l

Figure F-25. TSS Concentration Storm Water Discharges[1]
Grab Samples by Industry Sector



1. Based upon part 2 group application data submitted by Jan 1. 1992
2. See Table 1 for List of Industry Sectors by number
3. Values reported as Nondetect were assumed to be 0.0 mg/l

Figure F-26. TSS Concentration Storm Water Discharges[1]
Composite Samples by Industry Sector

Table F-8
Summary of Sampling Data From Phase I Part II Permit Applications (With Comparison to NURP and USGS Studies) for Copper (mg/l)

Sector	DESCRIPTION	Grab Samples No.	Grab Mean	Grab Median	Grab 95 %	Composite Samples No.	Composite Mean	Composite Median	Composite 95 %
	FOR POLLUTANT	Copper				Copper			
NURP	Median Urban Site *						0.04	0.04	0.09
USGS	Commercial Site *						0.03	0.02	NR
01	Lumber & Wood Products	32	0.05	0.03	0.16	29	0.04	0.03	0.12
02	Paper & Allied Prod.	2	0.03	0.03	0.05	2	0.03	0.03	0.07
03	Chemicals & Allied Products	51	0.19	0.01	0.21	46	0.12	0.00	0.19
04	Petrol Refining & Related Ind.								
05	Stone, Clay, Glass Products	6	0.13	0.02	0.40	5	0.16	0.04	0.40
06	Primary Metal Ind.	143	3.46	0.10	3.40	131	2.25	0.07	3.10
07	Metal Mining	19	3.88	0.14	46.80	13	0.59	0.09	3.40
08	Coal & Lignite Mining	1	0.00	0.00	0.00	2	0.00	0.00	0.00
09	Oil & Gas Extraction								
10	Nonmetallic Mineral Mining	6	0.05	0.01	0.15	4	0.01	0.01	0.01
11	Hazardous Waste TSDFs								
12	Industrial Landfills & Dumps								
13	Used Motor Vehicle Parts								
14	Scrap & Waste Materials	102	0.77	0.26	3.00	95	0.63	0.22	2.50
15	Steam Electric Power Plants	70	0.08	0.00	0.21	75	0.03	0.02	0.13
16	Railroad Transport								
17	Transport: Trucks, Freight, etc.	19	0.02	0.01	0.06	20	0.02	0.01	0.08
18	Water Transport								
19	Ship & Boat Building, Repair	5	0.16	0.15	0.32	5	0.08	0.09	0.13
20	Air Transport	2	0.03	0.03	0.04	3	0.01	0.01	0.02
22	Wastewater Treatment	28	0.07	0.01	0.22	27	0.05	0.02	0.11
23	Food, Tobacco Manufact.	17	0.08	0.04	0.27	17	0.05	0.03	0.24
24	Textile & Apparel Manufact.	16	0.03	0.01	0.15	14	0.07	0.01	0.61
25	Furniture & Fixtures	4	0.04	0.04	0.07	4	0.00	0.00	0.02
26	Printing & Publishing	7	0.03	0.03	0.08	6	0.02	0.03	0.04
27	Rubber & Plastic Products	5	0.00	0.00	0.01	5	0.03	0.05	0.05
28	Leather/Products								
29	Fabricated Metal Products, Jewelry	36	0.63	0.03	4.30	33	0.46	0.02	0.64
30	Ind. & Comm. & Transport Equip.	79	0.20	0.01	0.84	74	0.06	0.01	0.36
31	Electronic Equip. & Instruments	54	0.04	0.00	0.11	50	0.01	0.00	0.05

*NURP and USGS results were reported only as composite samples, not grab.
NR = Not Reported

Table F-9
Summary of Sampling Data From Phase I Part II Permit Applications (With Comparison to NURP and USGS Studies) for Lead (mg/l)

Sector	DESCRIPTION	Grab Samples No.	Grab Samples Mean	Grab Samples Median	Grab Samples 95 %	Composite Samples No.	Composite Samples Mean	Composite Samples Median	Composite Samples 95 %
	FOR POLLUTANT	Lead				Lead			
NURP	Median Urban Site *						0.18	0.14	0.35
USGS	Commercial Site *						0.22	0.07	NR
01	Lumber & Wood Products								
02	Paper & Allied Prod.	2	0.05	0.05	0.09	2	0.03	0.03	0.05
03	Chemicals & Allied Products	47	0.07	0.01	0.17	42	0.02	0.01	0.07
04	Petrol Refining & Related Ind.	-							
05	Stone, Clay, Glass Products	15	0.24	0.01	3.30	15	0.25	0.01	3.40
06	Primary Metal Ind.	136	0.78	0.02	1.41	123	0.19	0.02	1.00
07	Metal Mining	23	0.89	0.00	1.20	13	6.07	0.05	65.00
08	Coal & Lignite Mining	2	0.02	0.02	0.04	2	0.00	0.00	0.00
09	Oil & Gas Extraction								
10	Nonmetallic Mineral Mining	6	0.00	0.00	0.00	4	0.00	0.00	0.00
11	Hazardous Waste TSDFs								
12	Industrial Landfills & Dumps	9	9.62	0.08	83.70	7	20.64	0.18	143.00
13	Used Motor Vehicle Parts								
14	Scrap & Waste Materials	103	0.85	0.21	4.00	96	0.88	0.22	3.40
15	Steam Electric Power Plants	28	0.02	0.00	0.08	23	0.02	0.01	0.07
16	Railroad Transport								
17	Transport: Trucks, Freight, etc.	32	0.03	0.01	0.11	31	0.01	0.00	0.06
18	Water Transport	4	0.20	0.05	0.70	3	0.10	0.10	0.10
19	Ship & Boat Building, Repair	6	0.75	0.04	4.24	5	11.00	0.06	0.33
20	Air Transport	2	0.02	0.02	0.03	3	0.00	0.00	0.00
22	Wastewater Treatment	27	0.03	0.00	0.15	26	0.01	0.00	0.09
23	Food, Tobacco Manufact.	12	0.01	0.01	0.03	10	0.01	0.01	0.04
24	Textile & Apparel Manufact.	8	0.07	0.02	0.28	7	0.04	0.03	0.11
25	Furniture & Fixtures	3	0.08	0.06	0.16	3	0.01	0.01	0.02
26	Printing & Publishing	1	0.03	0.03	0.03	0			
27	Rubber & Plastic Products	1	0.00	0.00	0.00	1	0.01	0.01	0.01
28	Leather/Products	2	0.02	0.02	0.04	2	0.02	0.02	0.04
29	Fabricated Metal Products, Jewelry	32	0.11	0.00	0.89	30	0.06	0.00	0.22
30	Ind. & Comm. & Transport Equip.	76	0.22	0.00	0.97	75	0.18	0.00	0.94
31	Electronic Equip. & Instruments	60	0.02	0.00	0.08	56	0.01	0.00	0.04

*NURP and USGS results were reported only as composite samples, not grab.
NR = Not Reported

Table F-10
Summary of Sampling Data From Phase I Part II Permit Applications (With Comparison to NURP and USGS Studies) for Zinc (mg/l)

Sector	DESCRIPTION	Grab Samples				Composite Samples			
		No.	Mean	Median	95 %	No.	Mean	Median	95 %
	FOR POLLUTANT	Zinc				Zinc			
NURP	Median Urban Site *						0.20	0.16	0.50
USGS	Commercial Site *						0.31	0.11	NR
01	Lumber & Wood Products	16	0.47	0.37	1.70	15	0.36	0.30	1.20
02	Paper & Allied Prod.	1	0.62	0.62	0.62	1	0.78	0.78	0.78
03	Chemicals & Allied Products	75	2.11	0.24	7.70	70	1.74	0.24	4.20
04	Petrol Refining & Related Ind.	-							
05	Stone, Clay, Glass Products	8	0.35	0.14	1.17	7	0.39	0.18	1.12
06	Primary Metal Ind.	144	8.85	0.46	11.80	132	6.55	0.43	9.67
07	Metal Mining	14	3.04	0.59	16.30	8	3.87	0.66	20.90
08	Coal & Lignite Mining	2	0.17	0.17	0.30	2	0.06	0.06	0.09
09	Oil & Gas Extraction								
10	Nonmetallic Mineral Mining	5	0.18	0.18	0.34	3	0.29	0.30	0.30
11	Hazardous Waste TSDFs								
12	Industrial Landfills & Dumps								
13	Used Motor Vehicle Parts								
14	Scrap & Waste Materials	97	3.16	1.40	12.00	90	3.20	1.40	10.00
15	Steam Electric Power Plants	35	0.32	0.05	0.66	39	0.27	0.06	0.92
16	Railroad Transport	1	0.14	0.14	0.14	1	0.28	0.28	0.28
17	Transport: Trucks, Freight, etc.	30	0.23	0.13	1.10	28	1.34	0.11	0.66
18	Water Transport	4	0.68	0.22	2.20	3	0.42	0.21	0.87
19	Ship & Boat Building, Repair	2	0.31	0.31	0.36	1	39.00	0.33	0.33
20	Air Transport	8	0.14	0.08	0.58	3	0.35	0.04	1.00
22	Wastewater Treatment	23	0.23	0.06	0.75	22	0.12	0.06	0.43
23	Food, Tobacco Manufact.	33	0.78	0.21	2.10	31	0.79	0.24	5.83
24	Textile & Apparel Manufact.	16	0.33	0.19	1.06	14	0.30	0.21	0.88
25	Furniture & Fixtures	4	2.97	0.78	10.00	4	0.59	0.40	1.50
26	Printing & Publishing	4	0.48	0.37	1.00	3	0.47	0.52	0.65
27	Rubber & Plastic Products	34	0.98	0.19	4.90	34	0.80	0.25	2.86
28	Leather/Products								
29	Fabricated Metal Products, Jewelry	60	4.20	0.36	9.77	58	2.17	0.21	10.50
30	Ind. & Comm. & Transport Equip.	88	0.58	0.20	2.55	85	0.39	0.14	1.40
31	Electronic Equip. & Instruments	51	0.16	0.09	0.53	48	0.15	0.09	0.47

*NURP and USGS results were reported only as composite samples, not grab.
NR = Not Reported

APPENDIX G

GEOGRAPHIC ANALYSIS OF SIC CODES

APPENDIX G: GEOGRAPHIC ANALYSIS OF SIC CODES

SIC	SIC NAME	COUNT	%	PERCENT OF FACILITIES LOCATED IN PART OF COUNTY ASSOCIATED WITH ...												
				Organized by "Urbanized Area" percent (cum.)					Organized by "Places" percent (cum.)				Coastal Areas percent		Growing Areas percent	
			Phs I	Phs I+UAs	All UAs	UA>250	UA>100	UA>50	Inc>50k	Inc>25k	Inc>10k	Inc>5k	UAs	All	UAs	All
	ALL FACILITIES	7,736,471	32	45	61	49	57	61	45	61	79	88	37	48	18	25
	AG & SILVICULTURE CAT	310,086	14	20	31	21	26	31	23	36	57	72	16	28	10	17
	MANUFACTURING CAT	1,554,013	30	44	61	49	56	61	45	61	80	89	37	49	18	25
	COMMERCIAL/RETAIL CAT	5,872,372	33	46	63	51	59	63	47	63	80	89	38	49	19	25
	ALL POTENTIAL PHASE II	1,015,239	28	40	56	44	51	56	41	57	76	86	32	44	16	23
	PHASE II GROUP B "SECTORS"															
	Automotive Service	369,870	27	38	55	43	50	55	41	57	77	87	32	44	16	22
	Transport, Rail and other	14,808	47	64	81	72	78	81	57	72	87	94	57	63	23	27
	Petrol. Pipelines & Distributors	35,319	16	25	39	27	34	39	30	45	66	79	23	37	8	15
	Various Utilities	22,242	24	36	53	40	48	53	39	55	75	86	30	42	16	23
	National Security	2,414	34	43	60	45	53	60	44	62	81	90	36	48	16	23
	Munic. Services, Vehicle Maint.	4,611	25	35	51	38	46	51	39	55	76	86	30	46	13	21
	Wholesale, Wood Products	48,593	26	36	53	39	47	53	39	55	76	86	30	43	15	22
	Wholesale, Coal & Ores	1,384	23	31	48	35	45	48	38	57	79	87	18	23	7	12
	Wholesale, Metal Products	14,303	36	54	75	65	72	75	54	69	85	93	45	53	19	23
	Wholesale, Machinery	77,562	32	47	65	53	61	65	47	62	80	89	35	45	16	20
	Livestock, Feedlots	43,421	8	11	20	11	15	20	16	29	53	69	8	21	6	13
	Intensive Ag. Chemical Use	121,861	26	38	54	41	49	54	39	54	74	85	31	44	18	25
	Extensive Ag. Chemical Use	18,992	31	42	62	47	56	62	47	64	81	90	34	46	17	23
	Wholesale, Food	11,372	36	49	67	56	63	67	48	64	82	90	50	67	19	25
	Photographic Activities	30,684	40	53	70	57	65	70	52	68	84	91	42	51	23	29
	Machinery & Electrical Repair	135,744	29	40	56	43	51	56	42	58	77	87	32	44	18	25
	Laboratories	10,683	38	56	74	60	69	74	53	69	85	93	45	55	26	31
	Laundries	51,376	38	52	71	59	67	71	52	67	84	92	44	53	21	26
	General Farms	8,240	5	8	13	7	10	13	10	19	43	61	3	9	4	11

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APPENDIX G: GEOGRAPHIC ANALYSIS OF SIC CODES (CONTINUED)

			PERCENT OF FACILITIES LOCATED IN PART OF COUNTY ASSOCIATED WITH ...														
			%	Organized by "Urbanized Area" percent (cum.)					Organized by "Places" percent (cum.)				Coastal Areas percent		Growing Areas percent	
SIC	SIC NAME	COUNT	Phs I	Phs I+UAs	All UAs	UA>250	UA>100	UA>50	Inc>50k	Inc>25k	Inc>10k	Inc>5k	UAs	All	UAs	All
	SELECTED (90) 4-DIGIT CODES															
0181	Ornamental Nurseries	11,019	24	33	49	35	43	49	35	53	75	86	30	49	19	29
0211	Beef Cattle Feedlots	2,972	7	9	17	9	12	17	13	22	42	59	3	8	5	10
0212	Beef Cattle, not Feedlots	14,684	7	9	15	8	11	15	11	20	43	61	4	11	5	13
0213	Hogs	4,328	3	6	12	5	8	12	10	22	43	63	4	16	2	5
0214	Sheep and Goats	618	6	8	16	8	12	16	12	24	42	58	4	11	6	16
0219	Gen'l Livestock, not Dairy	1,160	5	7	12	6	9	12	9	17	39	58	3	8	3	8
0241	Dairy Farms	12,298	6	8	19	9	13	19	17	36	62	76	8	29	5	13
0251	Broiler, Fryer, Roaster Chicken	941	4	6	15	7	9	15	13	32	60	78	7	25	4	17
0252	Chicken Eggs	1,171	9	12	26	12	20	26	23	42	67	80	14	36	8	16
0254	Poultry Hatcheries	719	7	10	20	9	15	20	17	35	62	78	9	25	4	13
0273	Animal Aquaculture	595	17	18	25	17	21	25	18	30	59	77	17	33	15	27
0291	General Farms	8,240	5	8	13	7	10	13	10	19	43	61	3	9	4	11
0782	Lawn & Garden Services	36,369	34	52	70	56	65	69	49	65	83	91	42	55	25	33
0783	Shrub & Tree Services	7,260	27	42	60	46	55	60	43	60	79	89	35	49	18	25
4612	Crude Petroleum Pipelines	390	21	26	41	29	36	41	30	44	64	78	13	20	7	9
4613	Refined Petroleum Pipelines	347	24	34	49	36	43	49	37	51	73	84	22	32	12	16
4619	Pipelines, NEC	18	17	39	78	61	72	78	50	67	89	94	44	44	22	22
4731	Arrange. Freight Trans	12,303	49	66	82	74	80	82	58	73	88	94	59	65	24	27
4741	Rental of Railroad Cars	175	33	46	75	62	70	75	53	68	85	93	38	45	21	27
4783	Packing and Crating	1,099	39	60	79	68	75	79	55	70	87	94	52	60	23	29
4785	Weighing: Vehicle Trans.	332	40	60	77	66	74	77	55	69	85	92	58	69	20	26
4789	Transport Services, NEC	899	32	45	63	52	59	63	47	62	81	89	35	44	17	22
4925	Gas Producers, Distributors	604	11	18	28	19	24	28	21	34	58	74	12	22	7	11
4932	Gas & Services	212	25	34	49	36	43	49	36	52	73	84	24	31	11	14
4939	Utilities, NEC	297	20	25	41	27	35	41	28	43	63	75	24	34	14	22

APPENDIX G: GEOGRAPHIC ANALYSIS OF SIC CODES (CONTINUED)

			PERCENT OF FACILITIES LOCATED IN PART OF COUNTY ASSOCIATED WITH ...													
			%	Organized by "Urbanized Area" percent (cum.)					Organized by "Places" percent (cum.)				Coastal Areas percent		Growing Areas percent	
SIC	SIC NAME	COUNT	Phs I	Phs I+UAs	All UAs	UA>250	UA>100	UA>50	Inc>50k	Inc>25k	Inc>10k	Inc>5k	UAs	All	UAs	All
4941	Water Supply	4,904	19	26	41	28	35	41	30	47	71	83	20	33	16	28
4953	Refuse Systems	10,797	26	40	58	45	53	58	43	59	79	88	36	49	15	21
4959	Sanitary Services, NEC	1,894	30	48	68	55	64	68	50	65	82	91	41	54	21	28
4971	Irrigation System	662	17	22	36	22	28	36	27	40	59	76	10	15	19	32
5031	Lumber, Millwork	13,836	37	50	67	54	62	67	49	66	83	91	38	48	20	27
5039	Consruct Materials	4,036	37	50	68	55	63	68	50	65	82	90	35	45	21	27
5051	Metal Service Centers	10,267	35	56	78	69	76	78	56	71	87	93	49	57	18	22
5052	Coal/Minerals & Ores Wholesale	1,384	23	31	48	35	45	48	38	57	79	87	18	23	7	12
5082	Constr. & Min. Mach.	7,143	34	46	62	48	57	62	46	63	81	90	30	40	17	23
5083	Farm Mach. & Equip.	13,670	11	15	24	15	19	24	18	32	55	71	9	20	7	12
5084	Industrial Mach. & Equip.	38,880	37	55	75	63	71	75	54	69	86	93	42	50	18	22
5085	Industrial Supplies	17,869	36	55	75	62	71	75	54	70	86	93	44	53	18	22
5144	Poultry & Products	1,495	27	37	53	41	48	53	41	58	77	87	32	43	12	19
5146	Fish & Seafoods	4,579	39	50	66	54	62	66	46	62	81	90	58	87	23	31
5147	Meat & Products	5,298	37	53	71	62	67	71	52	67	84	91	48	57	17	22
5154	Livestock	4,351	9	12	22	10	16	22	17	29	51	68	5	12	6	12
5159	Farm Products Raw Mats.	1,895	28	36	47	35	41	47	40	52	74	85	26	39	9	15
5169	Chemical & Allied Prod., NEC	10,355	37	56	74	63	70	74	52	68	85	92	43	52	19	24
5171	Petroleum, Bulk	8,086	9	12	22	12	17	22	16	29	53	70	8	19	5	10
5172	Petroleum Products/Dist.	11,128	22	31	45	33	40	45	34	49	69	82	23	36	12	17
5191	Farm Supplies	20,189	10	14	23	14	19	23	18	31	54	71	9	20	7	12
5211	Lumber & Build. Materials	34,757	21	31	47	34	41	47	35	51	73	84	27	41	13	21
5261	Lawn & Garden Supply	19,443	20	29	44	32	39	44	33	51	73	84	25	41	14	22
5511	Car Dealers, New & Used	37,387	22	32	49	36	44	49	36	54	75	85	28	41	13	20
5521	Car Dealers, Used Only	32,145	26	34	51	37	45	51	39	57	78	88	26	38	15	21
5541	Gas/Service Stations	91,924	23	34	49	38	44	49	35	51	72	84	29	42	13	19

APPENDIX G: GEOGRAPHIC ANALYSIS OF SIC CODES (CONTINUED)

			PERCENT OF FACILITIES LOCATED IN PART OF COUNTY ASSOCIATED WITH ...														
			%	Organized by "Urbanized Area" percent (cum.)					Organized by "Places" percent (cum.)				Coastal Areas percent		Growing Areas percent	
SIC	SIC NAME	COUNT	Phs I	Phs I+UAs	All UAs	UA>250	UA>100	UA>50	Inc>50k	Inc>25k	Inc>10k	Inc>5k	UAs	All	UAs	All
5983	Fuel Oil Dealers	7,233	16	36	58	45	54	58	46	63	80	89	50	71	8	13
5984	Fuel and Coal Dealers	6,226	11	15	26	16	21	26	20	35	60	75	12	28	8	17
5989	Fuel Oil Dealers, NEC	1,075	17	24	39	27	34	39	34	52	73	84	19	34	10	20
7211	Laundries	2,940	36	47	63	50	58	63	48	63	82	90	35	46	15	20
7212	Garment Cleaners	7,280	43	57	76	67	73	76	57	71	86	93	52	60	21	25
7216	Dry Cleaning	22,042	38	54	73	63	70	73	52	68	85	92	48	56	21	25
7217	Carpet Cleaners	13,636	34	47	66	51	60	66	48	64	82	91	35	46	23	30
7218	Ind. Launderers	903	33	48	66	51	60	66	50	66	84	92	37	45	16	21
7219	Laundry Services	4,575	40	55	74	62	70	74	55	70	86	93	45	53	22	26
7221	Photographic Studios	20,010	39	51	67	55	62	67	51	66	83	91	38	47	22	28
7342	Disinfect/Exterminating	12,359	36	48	63	50	58	63	46	63	82	91	35	46	22	29
7384	Photo Finishing Labs	10,674	43	58	74	62	70	74	55	70	86	93	49	58	26	32
7513	Truck Rental	7,799	30	45	64	50	58	64	47	64	82	91	36	46	15	20
7514	Passenger Car Rental	7,939	38	54	74	59	68	74	53	69	85	93	46	57	22	29
7521	Parking Structures	3,088	58	72	90	82	88	90	74	83	92	96	64	69	13	16
7532	Top, Body Repair	48,800	26	39	56	43	51	56	41	57	77	87	33	45	16	21
7538	General Auto. Repair	87,994	30	41	56	45	52	56	42	58	77	87	34	45	19	26
7539	Specialized Repair	26,381	31	43	60	47	54	60	45	61	80	89	32	43	19	25
7542	Car Washes	12,842	28	43	62	47	56	62	46	62	80	89	32	42	16	21
7549	Misc. Automotive Services	13,571	34	49	68	56	63	68	48	65	83	91	40	51	21	27
7622	Radio and Television Repair	20,527	28	39	56	43	51	56	41	58	77	87	32	44	16	22
7623	Refrig. & Air Condition Repair	8,504	33	43	59	47	54	59	44	59	79	88	33	46	18	25
7629	Electrical Repair Shops, NEC	19,448	31	43	60	47	55	60	44	61	79	89	34	46	19	25
7692	Welding Repair	14,305	18	26	40	28	35	40	30	46	67	80	22	36	12	19
7694	Armature Rewinding Shops	2,865	23	32	49	35	43	49	37	54	76	87	26	39	12	18
7699	Repair Shops & Related Serv, NEC	70,095	31	42	58	45	53	58	43	59	78	88	34	46	19	26

APPENDIX G: GEOGRAPHIC ANALYSIS OF SIC CODES (CONTINUED)

			PERCENT OF FACILITIES LOCATED IN PART OF COUNTY ASSOCIATED WITH ...														
			%	Organized by "Urbanized Area" percent (cum.)					Organized by "Places" percent (cum.)				Coastal Areas percent		Growing Areas percent	
SIC	SIC NAME	COUNT	Phs I	Phs I+UAs	All UAs	UA>250	UA>100	UA>50	Inc>50k	Inc>25k	Inc>10k	Inc>5k	UAs	All	UAs	All
7948	Race Tracks/Stables	2,271	27	42	59	45	53	59	44	61	80	89	34	47	18	26
7992	Golf Courses, Public	4,295	18	28	46	31	40	46	35	54	75	85	25	45	14	21
7996	Amusement Parks	1,371	23	32	51	36	45	51	38	56	78	87	26	42	13	22
8221	Colleges and Universities	6,829	35	47	69	51	62	69	53	70	85	92	38	46	16	21
8222	Junior Colleges	1,850	27	37	54	41	49	54	40	57	77	87	31	44	14	22
8249	Vocational Schools	4,647	41	54	71	60	67	71	53	68	85	92	41	50	22	28
8422	Botanical Gardens & Zoos	285	41	55	71	56	67	72	53	68	83	91	42	56	21	27
8731	Comm. Research Labs.	6,382	39	58	75	62	71	75	53	70	86	93	48	58	27	34
8734	Testing Laboratories	4,301	37	53	72	58	67	72	52	68	85	92	41	50	23	28
9221	Police Protection	2,508	21	33	50	37	44	50	36	53	74	85	31	47	12	20
9223	Jails	1,714	29	37	52	37	46	52	40	57	78	88	28	44	14	23
9229	Fire Protection	389	34	45	62	46	55	62	47	63	81	90	32	43	15	22
9511	Air, H_2O & Solid Waste Mgmt.	3,688	24	34	50	38	45	50	38	54	73	85	23	36	14	21
9711	National Security	2,414	34	43	60	45	53	60	44	62	81	90	36	48	16	23
	ALL TWO-DIGIT CODES															
01	Ag. Product-Crops	148681	7	10	17	9	13	17	13	24	45	64	7	18	5	10
02	Ag. Product.-Livestock	53788	7	10	18	9	14	18	15	27	51	68	6	18	5	13
07	Ag. Services	100857	29	42	58	45	53	58	42	58	77	87	33	46	21	29
08	Forestry	4167	15	19	28	16	23	28	22	40	66	81	15	40	9	20
09	Fishing, Hunting	2593	19	25	42	25	36	42	30	47	70	82	36	78	17	30
10	Metal Mining	1762	35	41	49	37	45	49	37	51	65	78	12	18	28	45
12	Coal & Lignite Mining	5684	8	9	18	11	15	18	20	45	72	81	3	5	4	8
13	Oil & Gas Extraction	27254	26	33	44	33	40	44	36	49	69	81	11	18	7	10
14	Nonmetalic Minerals	5236	15	23	34	24	30	34	26	42	66	80	15	30	11	20
15	Building Contractors	292337	30	44	61	48	56	61	44	61	80	89	36	50	20	28
16	Heavy Const Contractors	41258	26	36	51	39	46	51	37	54	75	86	29	43	18	27

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APPENDIX G: GEOGRAPHIC ANALYSIS OF SIC CODES (CONTINUED)

			PERCENT OF FACILITIES LOCATED IN PART OF COUNTY ASSOCIATED WITH ...													
			%	Organized by "Urbanized Area" percent (cum.)					Organized by "Places" percent (cum.)				Coastal Areas percent		Growing Areas percent	
SIC	SIC NAME	COUNT	Phs I	Phs I+UAs	All UAs	UA>250	UA>100	UA>50	Inc>50k	Inc>25k	Inc>10k	Inc>5k	UAs	All	UAs	All
17	Spec. Trade Contractors	471505	29	43	61	48	56	61	44	61	79	89	36	49	19	26
20	Man. Food, etc.	28791	29	39	56	43	50	56	42	58	77	87	33	45	16	22
21	Man. Tobacco	267	47	55	74	56	68	74	59	72	87	93	44	53	19	22
22	Man. Textile	11592	32	45	60	48	55	60	47	67	84	91	40	49	12	20
23	Man. Apparel	27667	50	63	75	67	72	75	58	72	86	93	57	65	21	26
24	Lumber & Wood	42363	18	24	35	25	30	35	27	44	70	83	20	41	12	20
25	Furniture & Fixtures	16127	39	51	67	55	62	67	50	66	84	92	43	52	24	30
26	Paper & Allied Prod.	8656	32	50	71	59	66	71	51	67	85	93	44	55	15	19
27	Printing & Publish.	93128	40	55	72	61	68	72	54	68	84	92	46	54	21	26
28	Chemicals & Allied	19980	35	54	72	61	68	72	51	67	84	92	46	55	20	24
29	Petroleum & Coal	3453	30	44	61	50	57	61	44	60	80	89	34	44	17	21
30	Rubber & Plastic Pds.	16910	29	47	67	55	63	67	49	66	84	92	43	55	18	23
31	Leather/Products	3398	35	47	62	52	58	62	49	63	80	89	43	53	15	20
32	Stone, Clay & Glass	21388	27	37	53	41	48	53	40	56	76	87	30	41	17	24
33	Primary Metal Ind.	10560	27	44	67	55	62	67	49	66	83	91	43	54	15	19
34	Fab. Metal Pds.	42861	31	49	69	58	65	69	51	67	84	92	44	55	18	23
35	Machinery - electric	73472	29	47	66	54	62	66	49	65	83	91	42	53	19	24
36	Electronic Equip.	24834	38	57	75	64	72	75	54	70	86	93	49	57	26	32
37	Transportation Equip.	16339	36	48	64	52	59	64	48	64	82	90	43	57	26	32
38	Instrument & Related	17129	37	58	77	66	73	77	55	71	87	94	50	59	25	31
39	Misc. Manufacturing	32916	39	53	72	61	68	72	54	69	85	92	47	57	22	28
40	Railroad Transport	3113	20	28	47	35	42	47	34	50	71	82	21	31	9	13
41	Local Pass. Transit	21908	31	48	65	54	61	65	48	64	81	90	48	59	13	18
42	Trucking	145846	26	38	55	43	50	55	40	56	76	87	32	43	14	20
43	U.S. Postal Service	1669	18	29	54	38	48	54	40	57	74	85	32	46	14	25
44	Water Transport	10769	33	44	59	47	55	59	40	57	77	87	49	76	19	28
45	Air Transport	13841	36	47	63	50	58	63	46	62	79	88	35	47	19	27

APPENDIX G: GEOGRAPHIC ANALYSIS OF SIC CODES (CONTINUED)

			PERCENT OF FACILITIES LOCATED IN PART OF COUNTY ASSOCIATED WITH ...														
			%	Organized by "Urbanized Area" percent (cum.)					Organized by "Places" percent (cum.)				Coastal Areas percent		Growing Areas percent	
SIC	SIC NAME	COUNT	Phs I	Phs I+UAs	All UAs	UA>250	UA>100	UA>50	Inc>50k	Inc>25k	Inc>10k	Inc>5k	UAs	All	UAs	All
46	Pipe Lines-Nat. Gas	755	22	30	46	33	40	46	34	48	69	81	17	26	10	13
47	Transport Services	44141	46	62	79	70	76	79	57	72	87	94	57	64	25	30
48	Communication	33732	29	39	55	42	50	55	41	57	76	87	30	41	16	23
49	Electric, Gas & Sani.	31120	21	31	47	35	42	47	34	51	71	83	26	38	13	21
50	Wholesale-Durables	369442	39	54	71	60	68	71	52	67	84	92	42	51	21	26
51	Wholesale-Nondurables	213239	36	49	64	54	60	64	47	61	78	88	41	50	18	22
52	Building & Garden Materials	103721	22	31	47	35	42	47	35	52	73	84	27	42	14	21
53	General Stores	48496	22	30	44	33	39	44	34	50	72	84	26	41	11	18
54	Food Stores	218896	28	39	55	43	50	55	41	57	77	87	35	48	14	21
55	Auto Deals & Service	234029	25	34	50	38	45	50	37	54	75	86	29	41	15	21
56	Apparel Stores	160303	38	51	67	55	62	67	50	65	82	91	44	54	21	27
57	Furniture Stores	170139	32	43	60	47	55	60	44	61	80	89	36	47	19	26
58	Eat & Drink Places	381020	33	45	63	51	58	63	47	62	80	89	39	50	18	24
59	Misc. Retail	533517	32	44	60	48	55	60	45	61	79	88	35	47	18	25
60	Banking	90152	30	43	60	48	55	60	44	60	78	88	38	50	16	22
61	Credit Agencies	34685	44	57	74	62	70	74	54	70	86	93	44	52	26	32
62	Security Brokers	30301	49	63	81	71	77	81	62	75	88	94	54	60	21	25
63	Insurance Carriers	13634	44	58	76	63	72	76	57	73	87	94	40	48	21	26
64	Insurance Agents	141608	32	45	63	50	58	63	46	62	80	89	35	45	18	23
65	Real Estate	333354	38	53	70	57	65	70	51	67	84	91	42	53	22	29
67	Investment Offices	28959	46	63	79	70	76	79	59	73	87	94	49	56	24	28
70	Hotels & Lodging	70760	23	29	43	30	38	43	33	49	71	83	25	44	17	30
72	Personal Services	291063	31	43	61	49	56	61	45	61	79	89	37	47	18	23
73	Business Services	386364	42	58	76	64	72	76	55	71	86	93	46	55	24	30
75	Auto Repair Services	228471	30	43	60	47	55	60	44	61	79	88	35	46	18	24
76	Misc. Repair	155412	29	40	56	44	51	56	42	58	77	87	32	44	18	24
78	Motion Pictures	38445	44	57	72	63	69	72	55	69	85	92	50	58	27	32

APPENDIX G: GEOGRAPHIC ANALYSIS OF SIC CODES (CONTINUED)

			PERCENT OF FACILITIES LOCATED IN PART OF COUNTY ASSOCIATED WITH ...													
			%	Organized by "Urbanized Area" percent (cum.)					Organized by "Places" percent (cum.)				Coastal Areas percent		Growing Areas percent	
SIC	SIC NAME	COUNT	Phs I	Phs I+UAs	All UAs	UA>250	UA>100	UA>50	Inc>50k	Inc>25k	Inc>10k	Inc>5k	UAs	All	UAs	All
79	Amusement Services	88067	30	42	61	47	55	61	45	61	79	88	37	49	18	25
80	Health Services	386373	35	50	68	56	64	68	50	66	83	91	43	53	20	26
81	Legal Services	127352	38	53	70	59	66	70	52	68	84	92	47	57	18	23
82	Educational Services	181729	24	36	52	40	47	52	39	54	74	84	31	44	13	19
83	Social Services	127245	32	43	61	47	56	61	46	63	81	89	36	48	17	23
84	Museums	5315	35	45	62	49	57	62	48	63	80	88	40	51	17	25
86	Membership Organizations	235386	30	40	59	45	53	59	44	60	79	89	33	44	15	20
87	Research & Development	253149	43	59	76	65	73	76	55	71	86	93	49	58	25	31
88	Households with Employees	645	23	29	45	33	40	45	33	49	71	82	28	41	17	23
89	Services, NEC	9974	45	60	76	65	72	76	58	72	87	93	48	57	24	31
91	Executive, Gen'l Govt.	26273	15	23	37	26	32	37	27	42	64	77	19	33	8	16
92	Justice, Public Order	16450	20	29	46	33	41	46	35	52	73	85	26	43	12	21
93	Public Finance, Taxes	1477	36	46	65	51	60	65	52	67	84	91	36	48	13	18
94	Human Resource Admin.	7853	23	32	48	35	42	47	38	53	72	83	26	38	9	15
95	Env. Quality & Housing Admin.	10344	22	31	47	35	42	47	35	51	72	84	25	38	12	19
96	Econ. Prog. Admin.	5692	30	39	54	41	49	54	41	57	76	86	28	40	13	20
97	National Security	3290	47	55	69	58	64	69	55	70	85	92	49	58	15	21

APPENDIX H

EPA REQUEST FOR COMMENT ON ALTERNATIVE APPROACHES FOR PHASE II STORM WATER PROGRAM

federal register

Wednesday
September 9. 1992

Part IV

Environmental Protection Agency

40 CFR Part 122

National Pollutant Discharge Elimination System, Request for Comment on Alternative Approaches for Phase II Storm Water Program

R0015485

ENVIRONMENTAL PROTECTION AGENCY

40 CFR Part 122

[FRL-4202-9]

National Pollutant Discharge Elimination System, Request for Comment on Alternative Approaches for Phase II Storm Water Program

AGENCY: Environmental Protection Agency.

ACTION: Request for comment.

SUMMARY: In a memorandum dated January 28, 1992, the President asked regulatory agencies to review existing and proposed rules to improve cost effectiveness, minimize economic impact, and reduce regulatory burden. In response, today's notice requests information and public input on Phase II of the national storm water program mandated under section 402(p)(6) of the Clean Water Act (CWA). More specifically, EPA is today requesting public comment on a number of issues including scope of coverage under Phase II, identification of high risk Phase II discharges, alternative control strategies, and appropriate deadlines. With respect to each of these issues, the Agency is requesting input on how to meet environmental objectives and requirements set forth under section 402(p)(6) while at the same time identifying cost-effective control strategies that minimize the economic impact on the regulated community as well as the administrative burden on Federal, State and local government.

DATES: Comments on this notice must be received on or before November 9, 1992.

ADDRESSES: Respondents should send an original and two copies of their comments to Michael Plehn, Office of Wastewater Enforcement and Compliance (EN-336), United States Environmental Protection Agency, 401 M Street, SW., Washington, DC, 20460, (202) 260–6929. The public record for this notice is located at EPA Headquarters, NE Mall room 220, 401 M Street, SW., Washington, DC, 20460. Appointments to view the record can be made by contacting Michael Plehn at the above address. A reasonable fee may be charged for copying. The public record for previous rulemaking activity related to Phase I of the storm water program is located at EPA Headquarters, EPA Public Information Reference Unit, room 2402, 401 M Street, SW., Washington, DC, 20460.

FOR FURTHER INFORMATION CONTACT: For further information on this notice, contact the NPDES Storm Water Hotline at (703) 821–4823, or Michael Plehn, Office of Wastewater Enforcement and Compliance (EN–336), United States Environmental Protection Agency, 401 M Street, SW., Washington, DC 20460, (202) 260–6929.

SUPPLEMENTARY INFORMATION:

I. Background

The 1972 amendments to the Federal Water Pollution Control Act (FWPCA, later referred to as the Clean Water Act or CWA) prohibit the discharge of any pollutant to the navigable waters of the United States from a point source unless the discharge is authorized by a National Pollutant Discharge Elimination System (NPDES) permit. Efforts to improve water quality under the NPDES program have focused traditionally on reducing pollutants in discharges of industrial process wastewater and discharges from municipal sewage treatment plants. This program emphasis developed because many industrial and municipal sources were not controlled at that time and were easily identified as contributing to water quality impairment. Over time, as pollution control measures were implemented for these discharges and as data collection efforts have provided additional information, it has become evident that more diffuse sources of water pollution, such as agricultural and urban runoff, are important contributors to water quality problems and use impairment. Some diffuse sources of water pollution, such as agricultural runoff and irrigation return flows, are exempted statutorily from the NPDES program. Controls for other point source discharge of storm water runoff, however, are addressed in this notice.

A. Environmental Impacts

Several national assessments have been conducted to evaluate the impacts of diffuse sources of storm water runoff on receiving water quality. The "National Water Quality Inventory, 1990 Report to Congress" provides a general assessment of water quality based on biennial reports submitted by the States under section 305(b) of the CWA. In section 305(b) Reports, States indicate the fraction of the States' waters that have been assessed, the fraction of those assessed waters that are not supporting designated uses, and the sources of use impairment for those waters (e.g., diffuse sources, point sources, and natural sources). The Report indicates that roughly 30 to 40 percent of assessed rivers, lakes and estuaries are not supporting the uses for which they are designated. Based on information from 51 States and Territories that reported on sources of pollution, the Report indicates that storm water runoff from a number of diffuse sources, including agricultural areas, urban areas, construction sites, land disposal activities, and resource extraction activities, is the leading cause of water quality impairment cited by States. For those States reporting in each category, diffuse sources were cited as causing use impairments in the following magnitudes: For rivers and streams, 11 percent of impaired river miles are caused by separate storm sewers, 6 percent are caused by construction activities, and 14 percent are caused by resource extraction. For lakes, 28 percent of impaired lake acres are caused by separate storm sewers and 25 percent are caused by land disposal. For the Great Lakes' shoreline, 6 percent of impaired shoreline miles are caused by separate storm sewers, and 41 percent are caused by land disposal. For estuaries, 30 percent of impaired acres are caused by separate storm sewers. For coastal areas, 36 percent of impairments are caused by separate storm sewers, and 37 percent are caused by land disposal.

In 1985, the States conducted a different study of diffuse pollution sources under the sponsorship of the Association of State and Interstate Water Pollution Control Administrators (ASIWPCA) and EPA. The study resulted in the report entitled "America's Clean Water—The States' Nonpoint Source Assessment, 1985." In that study, 38 States reported urban storm water runoff as a major cause of beneficial use impairment. In addition, 21 States reported construction site runoff as a major cause of use impairment.

Studies conducted by the National Oceanic and Atmospheric Administration (NOAA) indicate that urban storm water runoff is indeed a major pollutant source that adversely affects shellfish growing waters.[1] The NOAA studies concluded that urban runoff affects 39 percent of harvest-limited area on the East Coast, 59 percent in the Gulf of Mexico, and 52 percent on the West Coast.

B. Water Quality Act of 1987

In response to growing concerns with the environmental impact of storm water runoff, Congress addressed this issue as part of the Water Quality Act of 1987 (WQA) by adding section 402(p) to the CWA to require the establishment of a comprehensive two-phased approach for the control of storm water discharges. Section 402(p)(1) prohibits EPA or NPDES States from requiring permits for storm water discharges until October 1, 1992, except for 5 classes of storm water discharges specifically listed under section 402(p)(2) (see appendix A). These 5 classes of discharges make up Phase I of the existing national storm water program and include storm water discharges:

(A) Permitted before February 4, 1987;

(B) Associated with industrial activity;

(C) From a municipal separate storm sewer system serving a population of 250,000 or more;

(D) From a municipal separate storm sewer system serving a population of 100,000 or more, but less than 250,000;

(E) Which EPA or a NPDES State determines contributes to a violation of a water quality standard or is a significant contributor of pollutants to the waters of the United States.

Section 402(p)(3) confirms that, like all other point source discharges under the CWA, discharges of storm water associated with industrial activity must meet all applicable provisions of CWA sections 402 and 301, including technology-based requirements and any necessary water quality-based requirements. Permits for discharges from municipal separate storm sewer systems may be issued on a system- or jurisdiction-wide basis and must meet a new statutory standard requiring controls to reduce pollutant discharges to the maximum extent practicable (MEP).

Phase II of the storm water program covers all storm water discharges not addressed under the five Phase I classes described above. Under the current provisions of section 402(p), the existing statutory prohibition against permitting Phase II storm water discharges expires on October 1, 1992 (see appendix B).

Under CWA section 402(p)(5), EPA, in consultation with the States, is required to conduct two studies on Phase II storm water discharges for which permits cannot be required before October 1, 1992. The first study will identify those sources or classes of discharges that may be addressed in Phase II and determine the nature and extent of pollutants in such discharges. The second study is to establish procedures and methods to control Phase II storm water discharges to the extent necessary to mitigate impacts on water quality. These studies have not been completed.

Under section 402(p)(6), EPA, in consultation with State and local officials and based on the two studies, is required to issue regulations by October 1, 1992, which designate particular sources or classes of Phase II storm water discharges to be regulated to protect water quality and which establish a comprehensive program to regulate such designated sources. This program must establish priorities, requirements for State storm water management programs, and expeditious deadlines. The program may include performance standards, guidelines, guidance, and management practices and treatment requirements, as appropriate.

The approach mandated by section 402(p)(2) is fully consistent with the intent and requirements of Section 319 of the WQA of 1987. Section 319 was enacted to require States to prevent and control nonpoint source pollution.

Under section 319 States are required to submit Nonpoint Source Assessment Reports identifying State waters which, without additional control of nonpoint sources of pollution, cannot be expected to attain or maintain designated uses. States were also required to prepare and submit for EPA approval a statewide management program for controlling nonpoint source water pollution to navigable waters within the State and improving the quality of such waters to levels sufficient for attaining or maintaining applicable water quality standards or goals. Furthermore, the State program submittal was to identify specific best management practices and measures which the state proposes to implement, in the first four years after program submission, to reduce pollutant loadings from identified nonpoint sources to levels required to achieve the stated water quality objectives.

Although the State nonpoint source programs are not enforceable under Federal law, States were encouraged to adopt both regulatory and non-regulatory approaches under State and local law. Section 319(b)(2)(B) specifies that a combination of "non-regulatory or regulatory programs for enforcement, technical assistance, financial assistance, education, training, technology transfer, and demonstration projects" may be used, as necessary, to achieve implementation of the best management practices or measures identified in the section 319 submittal.

To date, all States have approved section 319 assessments and approved management programs. EPA has awarded approximately $38 million in FY90 funds, $51 million in FY91 funds, and is in the process of awarding $52.5 million in FY92 funds to assist States in implementing the section 319 programs. EPA expects that State nonpoint source management programs will be revised and refined periodically in response to re-evaluated priorities and new strategies and technologies.

Numerous States and local governments have implemented regulations and enforceable policies to control nonpoint source pollution. States such as Delaware and Florida as well as local governments such as the Lower Colorado River Authority are aggressively pursuing storm water management goals through numerical treatment standards for new development. Many States and local governments have enforceable erosion and sediment control regulations. On a broader scale, nonpoint source pollution is being addressed at the watershed level by programs such as those being implemented by the State of Wisconsin and the Puget Sound Water Quality Authority and the states which are parties to the International Agreement on the Great Lakes. A number of individual States and local communities have adopted legislation or regulations like Maryland's Critical Areas Bill which limits development and/or

[1] "The Quality of Shellfish Growing Waters on the East Coast of the United States," 1989; "The Quality of Shellfish Growing Waters in the Gulf of Mexico," 1988; and "The Quality of Shellfish Growing Waters on the West Coast of the United States," 1989.

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requires special management practices in areas surrounding water resources of special concern. California has also recently created Storm water management districts to better address the control of nonpoint source pollution.

A further development in the area of Federally-mandated nonpoint source management occurred in 1990 with the enactment of section 6217 of the Coastal Zone Act Reauthorization Amendments (CZARA). Section 6217 provides that States with approved coastal zone management programs must develop and submit to EPA and NOAA for approval a coastal nonpoint pollution control program. Failure to submit an approvable program will result in the loss of Federal grants under both the Coastal Zone Management Act and section 319 of the CWA. State nonpoint pollution control programs must also include enforceable policies and mechanisms which ensure implementation of the management measures throughout the coastal management area. Management measures as defined in section 6217(g)(5) are: "Economically achievable measures for the control of the addition of pollutants from existing and new categories and classes of nonpoint sources of pollution, which reflect the greatest degree of pollutant reduction achievable through the application of the best available nonpoint pollution control practices, technologies, processes, siting criteria, operating methods, or other alternatives."

The section 6217(g) guidance was issued for public comment in May, 1991. Final guidance is expected by October, 1992. The technology-based approach used in the guidance provides State Officials flexibility to meet the management measures using best management practices identified in the guidance or other methods and strategies which achieve equivalent or higher levels of pollutant control. If the technology-based approach fails to achieve and maintain applicable water quality standards and protect designated uses, additional management measures are required under CZARA section 6217(b)(3). Congress mandated a technology-based approach founded on technical and economic achievability under the rationale that neither States nor EPA have the money, time, or other resources to create and implement a program which depends on establishing cause and effect linkages between particular land use activities and specific water quality problems. Nonpoint sources addressed in the proposed guidance include: urban runoff from both developing and developed areas, roads, highways and bridges, agriculture, forestry, marinas, hydromodification, dams and levees.

C. Current (Phase I) Storm Water Permitting Program

EPA promulgated permit application regulations for Phase I storm water discharges on November 16, 1990 (55 FR 47990). The November 16, 1990 regulations established the scope of the Phase I storm water program by defining two major classes of storm water discharges identified under section 402(p)(2)(B), (C), and (D) of the CWA: Storm water discharges associated with industrial activity;[2] and discharges from municipal separate storm sewer systems (MS4s) serving a population of 100,000 or more.[3] In addition, the November 16, 1990 regulations established permit application requirements, including deadlines for these two classes of discharges (for a summary of Phase I see appendix A).

The November 16, 1990 regulations defined municipal separate storm sewer system serving a population of 100,000 or more to include municipal separate storm sewers within the boundaries of 173 incorporated cities, and within unincorporated portions of 47 counties that were identified as having populations of 100,000 or more in unincorporated, urbanized portions of the county.[4] In addition, the regulations allowed for additional municipal separate storm sewers to be designated by the Director of the NPDES program as being part of a large or medium MS4. The November 16, 1990 regulations establish comprehensive two part permit applications for discharges from large or medium MS4s. The permit application requirements for large and medium MS4s, among other things, require municipal applicants to propose municipal storm water management programs to control pollutants to the maximum extent practicable and to effectively prohibit non-storm water discharges to the MS4.[5]

The November 16, 1990 regulations also defined the term "storm water discharges associated with industrial activity" to include 11 categories of industrial facilities (see 40 CFR 122.26(b)(14)). The November 16, 1990 regulations establish two sets of application requirements for storm water discharges associated with industrial activity: Individual applications and group applications. In addition, the notice recognizes a third set of application procedures for storm water discharges associated with industrial activity referred to as "notice of intent" (NOI) requirements associated with general permits.

The Phase I storm water program takes two very different approaches to defining the roles of EPA and authorized NPDES States in controlling pollutants in storm water discharges. With respect to permits for large and medium MS4s, the efforts of the NPDES permitting authority (EPA or an authorized NPDES State) are directed to ensuring that municipalities develop and implement storm water management programs to control pollutants to the maximum extent practicable. Municipal programs address the control of pollutants in storm water from all areas within the boundaries of the MS4 that discharge to the system, including privately-owned lands, as well as modifying municipal activities (e.g. road deicing and maintenance, flood control efforts, maintenance of municipal lands, etc.) to address storm water quality concerns. The Agency has defined the role of municipalities under this program in a flexible manner that allows local governments to assist in defining priority pollutant sources within the municipality, and to develop and implement appropriate controls for such discharges. With respect to permits for storm water discharges associated with industrial activity, the NPDES permitting authority has a more direct role in regulating facilities.[6]

While today's request for comments focuses on developing Phase II of the storm water program, readers may find that a brief summary of progress to date

[2] On June 4, 1992 the United States Court of Appeals for the Ninth Circuit found that EPA's rational for exempting construction sites of less than five acres and certain uncontaminated storm water discharges from light industrial facilities from Phase I of the storm water program to be invalid and has remanded these exemptions for further proceedings (see *Natural Resources Defense Council* versus *EPA* No. 91-70176).

[3] Consistent with Section 402(p)(2) of the CWA, the November 16, 1990 regulations address two subclasses of municipal separate storm sewer systems serving a population of 100,000 or more. Large municipal separate storm sewer systems are defined as systems serving a population of 250,000 or more (see 40 CFR 122.26(b)(4)). Medium municipal separate storm sewer systems are defined as systems serving a population of 100,000 or more, but less than 250,000 (see 40 CFR 122.26(b)(7)).

[4] See appendices F, G, H, and I to 40 CFR part 122.

[5] See 40 CFR 122.26(d)(2)(iv).

[6] NPDES permits for discharges from large and medium MS4s will establish municipal responsibilities for assisting EPA and authorized NPDES States in implementing controls to reduce pollutants in storm water discharges associated with industrial activity which discharge through large and medium MS4s. A more detailed description of the role of municipalities in addressing industrial storm water sources under this Federal/State/Municipal partnership, is provided at 56 FR 40972 (August 16, 1991).

in implementing the first phase of the program would be helpful. Part of current implementation activities include outreach efforts and two rulemakings discussed in more detail below which are specifically designed to provide more flexibility and minimize regulatory and administrative burdens where possible.

As discussed above, the November 1990 storm water rule provided for three different options for storm water discharges associated with industrial activity to seek coverage under the program: individual, group, and general permit applications. Since November 1990, there has been a great deal of activity as EPA and the States have worked with the regulated community to provide guidance and implement the program. The Agency has established a four tier risk-based storm water permitting strategy which emphasizes the use of general permits (April 2, 1992, (57 FR 11394)). As part of the strategy, EPA called for the development of State storm water management programs to track permit issuance, provide for prioritization of risk, and create baselines against which to assess environmental results. As part of the same rule, the Agency extended the deadline for Part 2 of group applications until October 1, 1992, and also deferred regulation of storm water discharges from industrial activities owned or operated by municipalities with a population under 100,000 until Phase 2 of the program, pursuant to section 1068(c) of the Intermodal Surface Transportation Efficiency Act of 1991. In providing for greater flexibility, reduced burdens, extended deadlines, and deferred regulation, this recent storm water rulemaking addresses many of the goals underlying the President's January 28, 1992 request to review existing regulations.

Since November 1990, the Agency has received over 1,200 Part I group applications representing more than 60,000 facilities. EPA is currently processing these applications. Final decisions have been reached on over 1,000 to date. Approximately 75% have been approved, 20% withdrawn or determined not to be covered, and 5% denied. Part I group applications were due on September 30, 1991. Part II sampling information from approved groups is due on October 1, 1992.

At the same time that EPA has been receiving and processing group applications, States have been actively moving to provide for storm water general permit issuance. When the storm water application rules were issued in November 1990, only 17 out of 39 States authorized to administer the NPDES program were also approved to issue NPDES general permits. Since then, an additional 16 States have requested and received Federal approval to issue general permits. Over two thirds of the States that now have general permit authority are presently developing specific general permits to cover storm water discharges.

For the 12 States without NPDES authority, EPA is in the process of issuing storm water general permits that rely heavily upon industrial facilities developing and implementing their own storm water pollution prevention plans.

As part of the four tier risk-based permitting strategy referred to above and discussed in more detail in the Agency's April 2, 1992 notice, EPA believes that the majority of storm water discharges associated with industrial activities should be covered by general permits. The Agency urges all authorized NPDES States without general permit approval to obtain NPDES general permit authority.[7] EPA places a high priority on this effort and is providing direct technical guidance and assistance to support States both in obtaining general permit approval and in developing specific general storm water permits.

With regard to guidance, training, and outreach, EPA has undertaken a number of efforts to provide technical assistance and also to get public input on ways to streamline the existing program. In the area of guidance, EPA has published and distributed thousands of municipal and industrial permit application manuals in addition to numerous summaries, fact sheets and work shop materials over the past eighteen months. The Agency has issued additional guidance on storm water sampling, pollution prevention plan development, and storm water best management practices (BMPs), and is developing guidance for part 2 municipal applications. A list of EPA technical guidance, summaries, and storm water fact sheets can be obtained by calling the Agency's storm water hotline at (703) 821-4823.

In the area of training and outreach, EPA staff has participated in over 60 workshops and presentations throughout the country, training permitting authorities and educating the regulated community. For example, EPA Regions held fourteen public hearings to receive public comment on the Agency's proposed general permits in August and September of 1991. EPA held an additional 26 storm water workshops across the country this summer and would welcome hearing from groups or organizations interested in receiving workshop materials for further in-house or local training.

While EPA recognizes the importance of ongoing training and outreach efforts to provide information on the storm water program, the Agency also regards these activities as an effective mechanism for getting feedback on the program and identifying areas for further improvement. The new guidance documents referred to above and presently being developed reflect input from States and the regulated community on high priority areas requiring clarification and further technical assistance.

In addition to these activities, EPA has recently completed a study, in conjunction with the Rensselaerville Institute, to obtain direct public input and develop recommendations for streamlining the program and making it more effective. This study has two objectives. The first is to develop recommendations to streamline program implementation under existing regulations and legislation (Phase I). The second is to develop cost-effective options for addressing risks from storm water sources not currently required to be permitted that could potentially be addressed under Phase II of the storm water program.

Under the first objective, the Rensselaerville Institute sponsored 6 focus groups across the country with members representing state and local government, the regulated community, and environmental interests for uninterrupted full day discussions on ways to improve the storm water program. Five key issues were raised by all groups: (1) Groups felt that EPA has not been very clear about the intended goals of the regulations and should communicate storm water risks, objectives, and requirements more clearly to the general public as well as the regulated community, (2) participants noted that the cost of program implementation is significantly higher than original EPA estimates and there is great concern regarding the real costs of the program and of achieving compliance, (3) there was consensus that EPA and States must accelerate general permit issuance and focus on general permits to achieve efficient implementation of the program, (4) participants felt that technical outreach should be targeted at the State and local level as opposed to the national level and should provide better guidance on the regulations and how to implement

[7] Currently, DE, IA, KS, MI, NV, NY, OH, SC, VT and the Virgin Islands have authorized NPDES programs, but do not have general permit authority.

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them, and (5) groups noted that coverage under certain industrial storm water categories should be clarified.[8] EPA agrees with these recommendations and is taking steps, some of which are outlined above, to follow up in each of these areas.

The second objective of the Rensselaerville study, consistent with the purpose of today's notice, is to get as much input as possible on different options for identifying and addressing those Phase II storm water discharges not regulated under the current program. Under the study, however, the mechanism for encouraging feedback was more targeted and interactive. The Rensselaerville Institute has obtained input from national experts (representing permitting authorities, the environmental community, and regulated interests) and then followed up with a series of 3 expert discussion forums that were open to the public in June.

The public meetings were held in Denver, San Francisco and Washington, DC. Attendees were divided into task teams and asked to develop their own strategy for addressing Phase II sources. There were 16 task teams: Five each at the Denver and San Francisco meetings, and six in Washington, DC. They were given a strategy template to guide them in their discussion, but were not confined to the template in developing their strategies and recommendations.

Each team considered and then presented the option they had developed over a four hour period. There were common strategy characteristics mentioned across groups within meetings and also across meetings. The recommendations of the focus groups covered four specific areas: Targeting strategies, controls that should be put in place, timetable, and the role of EPA in Phase II. The recommendations made by focus groups regarding the first three areas are discussed below along with the options presented for comment.

With regard to the role of EPA, participants identified the areas of responsibility they felt it would be appropriate for EPA to assume under Phase II. Their recommendations can be classified by four common themes: (1) Teams felt that EPA should provide technical assistance, information dissemination, and do any research necessary as a part of Phase II; (2) participants suggested that EPA should provide funding for research or demonstration projects, but not for program implementation; (3) groups stressed that EPA should set broad guidelines for the program, but allow State and local governments to determine the level of specificity needed to effectively implement the program; and (4) teams felt that EPA should be responsible for training regulators in the program.

II. Today's Notice

A. Purpose and Intent

CWA sections 402(p)(5) and (6) require EPA to identify storm water discharges not covered under Phase I which should be regulated to protect water quality.[9] The purpose of this notice is to solicit public comment on ways to implement the second phase of the storm water permitting program for sources and activities not regulated under the existing program. EPA is seeking comments on approaches for meeting CWA Phase II storm water requirements while at the same time minimizing the economic impacts and regulatory and administrative burdens associated with additional Phase II storm water controls. There are a number of ways to identify additional categories of storm water activities for further controls and EPA requests comment on the alternatives listed below as well as on any other approaches that may not be identified in today's notice.

B. Alternative Approaches

EPA is interested in comments from the general public, state and local government, the regulated community and environmental groups on each of the options outlined below. The goal of the CWA is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters. In practice, programs implemented under the Clean Water Act have two basic goals: To reduce pollutant loadings to the environment and to require more stringent controls where necessary to assure attainment of State water quality standards and designated uses. These goals are compatible. However, the specific regulatory strategy and pollution reduction alternatives to be chosen for addressing Phase II storm water discharges could have a large impact on the size of the regulated universe and regulatory burden associated with the program.

To generate discussion and input from commenters, today's notice discusses several alternative approaches for controlling storm water discharges from currently unregulated sources under Phase II of the storm water program. A number of different control strategies, with variations in scope and timing, are outlined below. They range from comprehensive permitting of all municipal, light industrial, and commercial activities that generate storm water runoff to little or no NPDES permitting of Phase II sources.

A major distinction between several of the options listed below is whether Phase II efforts should focus on developing requirements for targeted municipalities to develop source controls and management programs for storm water discharges within their jurisdictions (for example, see options (b) and (c) below) or whether Phase II should, instead, focus on point source discharges of storm water without reference to the municipality in which they may be located. Under the first approach, EPA would develop NPDES requirements that required targeted municipalities to develop and implement storm water management programs which address storm water discharges within their jurisdiction [10] to the maximum extent practicable. This approach would allow for flexibility based on local factors, but could lead to varying levels of control from one area to another. EPA requests comments on the ability of municipalities to effectively regulate storm water discharges. In addition, the Agency requests comment on appropriate funding mechanisms for municipal programs, in particular the feasibility of implementing storm water utilities, which are currently being used in more than 100 communities nationwide.[11]

To facilitate comment and analysis, the following discussion is organized in terms of three issues: Targeting, control strategies, and deadlines. Each of these areas overlap and any final decision must reflect choices from each group. However, the objective is to solicit input

[8] The regulatory definition of storm water discharge associated with industrial activity identifies 11 categories of industrial facilities (see 40 CFR 122.26(b)(14)). In particular, category viii (certain transportation facilities) and category xi (certain manufacturing facilities with materials and/or materials handling equipment exposed to precipitation) were identified as needing clarification.

[9] Section 502(14) of the CWA excludes agricultural storm water runoff from the definition of point source. Section 402(1)(2) prohibits EPA from requiring an NPDES permit for certain "uncontaminated" storm water discharges from mining sites and oil and gas operations. EPA cannot regulate these discharges under section 402(p)(6) of the CWA.

[10] One issue that needs to be resolved is whether targeted municipalities should be responsible for controlling all priority storm water discharges within their jurisdiction or only those that discharge directly to the MS4.

[11] For more information see "Storm Water Utilities: Innovative Financing for Storm Water Management", EPA, Water Policy Branch, OPPE, 1992.

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on three basic questions. First, what should be covered under Phase II: that is, what additional municipal separate storm sewer systems, municipal industrial activities, commercial, light industrial, retail, or residential activities not presently covered under Phase I of the storm water program should be targeted or identified as needing additional controls? Second, what control strategies should be developed and implemented to address these Phase II activities? Third, what deadlines or time frames should apply in implementing Phase II of the storm water program?

In addressing each of these questions, commenters are requested not only to provide their views on appropriate alternatives (including approaches that may not be included in this notice), but also where possible detailed rationales and additional data or other information which address the practical, administrative and legal feasibility and/or the environmental benefits, of a particular option. In addition, each of the approaches presented could be combined with others to achieve specific environmental objectives. For example, dischargers of specific pollutants in particular water bodies could be targeted for permits or more stringent controls. Along with input on individual options EPA requests comments on possible combinations or other approaches not outlined above. Commenters are also asked to address the roles and responsibilities of Federal, State and local governments under various approaches, particularly with respect to: (1) Identifying approaches that target MS4s in currently unregulated municipal areas as needing permits, and (2) approaches that identify classes of individual facilities (e.g. commercial or retail facilities) as needing permits.

The Agency also requests input on what type of information should be used in identifying sources to be covered and whether commenters believe there is presently sufficient information or monitoring data at the state and local level to expeditiously implement a particular option listed below. If on a national or regional basis there are not sufficient data, the next question to be addressed is whether a comprehensive monitoring and data gathering effort is warranted to assure effective implementation of one approach over another. In other words, there may be a trade off between: (1) Near term general targeting approaches combined with flexible control strategies based on information currently available, and (2) a heavier reliance on longer term specific geographic, watershed, or water body related targeting mechanisms which may require more comprehensive data gathering efforts on both a facility and stream reach basis.

1. Targeting

(a) Seek amendments to the CWA to eliminate Phase II and use designation authority to bring additional sources under Phase I. Section 402(p)(2)(E) presently provides that EPA or a State may designate non-industrial storm water discharges and discharges from MS4s other than those serving a population of 100,000 or more for control under Phase I where the discharge contributes to water quality violations or is a significant contributor of pollutants to waters of the U.S. Some commenters may conclude that the remaining unregulated discharges of storm water (associated with smaller municipalities, commercial activities, and some retail or residential activities) constitute, on the whole, a negligible source of environmental risks, relative to the discharges already regulated.

Under this option, Congress would amend the CWA to eliminate section 402(p)(6) (Phase II requirements) as a part of the NPDES program and expand use of the existing designation authority under 402(p)(2)(E) to designate individual or classes of storm water activities on a category, watershed, stream reach, loadings, or other basis for specific regulation under existing Phase I requirements. Under this option, those storm water activities not designated for Phase I controls could be addressed by an alternative means, possibly under the State nonpoint source management programs funded under section 319 of the CWA or coastal nonpoint pollution control programs developed pursuant to section 6217 of the CZARA. The Agency requests comments on: (1) Whether State programs funded under Section 319 can better ensure appropriate control of diffuse pollutant sources and; (2) whether heavier reliance on State nonpoint source programs to address Phase II storm water point source discharges would have adverse impacts on States' program resources and the ability of States to address agricultural sources. The selective nature of this designation option could reduce the potential economic impact on the economy and small entities. However, using 402(p)(2)(E) may be viewed by some commenters as a reactive approach which does not recognize the advantages of prevention of storm water pollution problems over remediation of these problems after they have been identified. This approach may also increase the administrative burden on States and local government to identify and undertake the necessary administrative process to include additional storm water activity under Phase I.

(b) Identify targeted MS4s as needing an NPDES permit under section 402(p)(6) of the CWA. The Phase I MS4 program currently only applies to municipal separate storm sewer systems serving a population of 100,000 or more. EPA has defined the scope of these Phase I requirements to specifically identify 173 incorporated cities with a population of 100,000 or more and 47 counties with a population of 100,000 or more in unincorporated, urbanized areas.[12] In general, this approach focuses on core cities of large metropolitan areas, but with the exceptions of 47 counties addressed, does not address urban fringes or suburban areas in large metropolitan areas, urbanized areas without large core cities, or smaller isolated cities or population centers.[13] EPA requests comments on factors that should be considered when evaluating options for addressing Phase II MS4s.[14]

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[12] The 220 cities and counties addressed by these definitions have a combined population of over 87.5 million people under the 1990 Census. However, a significant percentage of the population of the 220 municipalities are served by combined sewers (not addressed by the storm water program), which are found primarily in areas of older development.

[13] The 1990 Census indicates that 87.3 million people lived in areas designated as urbanized areas but outside of incorporated cities with a population of 100,000 or more. Portions of over 5,400 incorporated cities, towns and villages, 900 counties and about 1,500 minor civil divisions (unincorporated towns and townships) are in Phase II municipalities that are part of urbanized areas.

[14] EPA outlined seven factors it considered when defining the scope of large and medium MS4s (see December 7, 1988 (53 FR 49444), and Novemoer 16, 1990 (55 FR 48038)). These factors included: the advantages of developing system-wide storm water management programs for municipal systems; the inter-jurisdictional complexities associated with municipal governments; the fact that many municipal storm water programs have traditionally focused on water quantity concerns, and have not evaluated water quality concerns; the geographic basis necessary for planning comprehensive management programs to reduce pollutants in discharges from MS4s; the geographic basis necessary to provide flexibility to target controls on areas where water quality impacts associated with discharges from MS4s are the greatest and to provide an opportunity to develop cost effective controls; the need to establish a reasonable number of permits; Congressional intent to allow the development of jurisdiction-wide, comprehensive storm water programs with priorities given to the most heavily populated areas of the country. The Agency requests comment on which of these factors should be considered in identifying Phase II MS4 sources.

The Agency also requests comment on the advantages of municipalities associated with urbanized areas coordinating storm water management efforts on a regional basis. The Agency notes that a number of municipalities have developed regional administrative approaches to flood control management.[15] Regional administrative approaches appear to provide opportunities for municipalities to lower overall administrative burdens, consolidate efforts to study or evaluate approaches, and adequately plan cost-effective approaches to consider and address the needs of all represented municipalities. The Agency requests input on how it could or should encourage the development and use of regional approaches to storm water management under the NPDES program. Specifically, EPA requests comments on the following targeting options as well as any that may not be included in this notice.

(i) *Focus on population.* Expand coverage to address additional municipalities based on population. Following the Phase I approach, coverage of municipalities could be expanded by lowering the minimum population requirement across the board or by designating additional municipalities or municipal systems by name. EPA requests comments on the appropriate role of county governments and appropriate ways to characterize the population of counties under this approach.[16] This approach controls more sources of storm water, but imposes regulatory burdens on additional municipal entities.

(ii) *Focus on population density.* Alternatively, EPA could focus on the population density of metropolitan areas instead of the population within a particular municipality or municipal system, and require permits for discharges from municipal separate storm sewers in areas of a specified density. Urban storm water runoff is related to the density of urban development, the increase in impervious areas, and the reduction in the area of recharge and infiltration zones. EPA requests comment on the use of urbanized areas designed by the Bureau of Census as a tool for characterizing population density and development patterns.[17]

(iii) *Focus on population growth.* Focussing on population growth in addition to, or in place of, population density might be an additional consideration in implementing this option.[18] Studies have shown that it is much more cost effective to develop measures to prevent or reduce pollutants in storm water during new development than it is to correct these problems later on.[19] In addition, appropriate storm water measures for new development can prevent or minimize irreversible degradation to surface waters. This approach might serve to minimize the impact of small and lightly-developed population centers, but it would still increase the burden on a number of municipalities not presently regulated under Phase I.

(c) *Continued reliance on Phase I MS4s to control Phase II sources which discharge through their system.* Under this approach, EPA would generally not designate additional individual sources (such as commercial and light industrial sources) which discharge through a large or medium MS4 as needing their own NPDES permit. Instead, EPA would continue to rely on municipalities to identify priority storm water discharges and develop appropriate controls for those discharges as part of requirements to develop and implement municipal storm water management programs. This option addresses some currently unregulated sources, allows for flexibility and consideration of local factors, and avoids duplicative regulation at the local, national and State level. This approach also relies on existing institutional frameworks of municipalities[20] as well as the institutional framework that EPA envisions municipalities will develop pursuant to NPDES requirements.[21] However, it imposes additional administrative and regulatory costs on local governments and may result in varying levels of control among municipal programs. The Agency requests comment on whether municipalities are in the best position (with assistance from EPA and authorized NPDES States through technical guidance) to identify priority sources which discharge through their MS4, or whether EPA should attempt to designate such additional sources as needing an NPDES permit. The Agency also requests comments on the appropriate funding mechanisms for MS4s (e.g. storm water utilities, various fees, general revenues, etc.), and opportunities for municipalities to modify existing functions to address storm water concerns.

(d) *Identify additional Phase II activities other than MS4s based on comparative loadings.* EPA could use available information (such as case studies and other research) to prioritize Phase II sources in terms of their relative pollutant loadings as well as the type and nature of those loadings. On this basis the Agency could issue regulations to target those general activities which contribute the highest loadings of pollutants to receiving waters as needing an NPDES permit. This option is consistent with the technology-based approach reflected in the existing CWA. It would provide more comprehensive coverage and clarify the program. It would also avoid expensive and time consuming debates regarding the specific causal relationship between a particular storm water discharge and site by site specific receiving water quality impact. However, it would impose further administrative and analytical burdens in terms of gathering additional loadings information on a national basis. This approach may also result in including

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[15] For more information see: William A. Macaitis, "Regional Storm Water Management Trends", and: L. Scott Tucker, "Current Programs and Practices in Storm Water Management", Water and the City: the Next Century, Public Works Historical Society, 1991.

[16] The 1990 Census indicates that 447 counties have a population of 100,000 or more. The current definitions of large and medium MS4 address 47 of these counties not already covered by Phase I of the program.

[17] The Bureau of Census defines urbanized areas comprised of a central city (or cities) with a surrounding closely settled area. The population of the entire urbanized area must be greater than 50,000 people, and the closely settled area outside the city, the urban fringe, must have a population density generally greater than 1,000 persons per square mile (just over 1.5 persons per acre) to be included. The Bureau of Census defined 396 urbanized areas in the United States based on the 1990 Census. These urbanized areas have a combined population of 158.3 million, or 63.6 percent of the nation's total population. However, these areas only account for 1.5 to 2 percent of the land surface of the country.

[18] Most Urban growth occurs in urban fringe areas outside of large core cities. For example, between 1970 and 1980, the population in those parts of Census designated urbanized areas that are outside of incorporated cities with a population of 100,000 or more increased by 18.9 million. During this same time period, the population of incorporated cities with a population of 100,000 or more (Phase I cities) increased by only 0.8 million, with the population of many of these cities decreasing.

[19] For example, see "Results from the Nationwide Urban Runoff Program, Vol 1—Final Report", EPA, 1983.

[20] Examples of municipal functions that can be adapted to provide for consideration of storm water concerns include oversight of new development, fire safety inspections, pretreatment program implementation, flood control activities, management of municipal lands and activities, and maintenance of public roads.

[21] The NPDES regulatory framework for permits for large and medium MS4s envision that municipalities will be required to develop and implement storm water management programs to reduce pollutants in non-storm water discharges (e.g. illicit connections and improper dumping); storm water from residential and commercial areas; storm water discharges from industrial activities; and storm water discharges from construction activities.

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more sources than necessary due to differences in loadings and existing storm water controls, both structural and non-structural, across similar activities. The regulatory burden would be determined in large part by the overall control strategy chosen to implement this approach.

This approach differs from those outlined under options (b) and (c) in that it relies on direct permitting by EPA and authorized NPDES States rather than requiring municipalities to develop programs to address sources. The Agency requests comments on which sources of pollutants are better addressed by specific NPDES permit requirements rather than through municipal storm water management programs required pursuant to NPDES permits for MS4s. For example, activities generally located in rural areas such as feedlots, orchards, and golf courses most likely are not suited for control through municipal storm water management programs required under permits for MS4s. Although large feedlots (those subject to effluent limitations guidelines) presently are covered under Phase I, smaller feedlots represent a significant source of pollutants such as suspended solids, BOD, and nutrients such as nitrates and phosphates. In addition, storm water discharges from commercial activities such as greenhouses, nurseries, and golf courses might be more effectively controlled under a separate NPDES permit requirement than through a MS4 program. As another example, many commenters from all levels of State and local government have expressed concern about municipalities being required to control pollutants from State highways (see November 16, 1990 (55 FR 48041)).

(e) Geographic targeting. EPA could regulate Phase II storm water activities on a watershed, waterbody, or regional basis to protect water quality, control water quality problems and attain designated uses in specific areas. EPA could:

(i) Designate additional municipal and individual sources for permitting in specific areas. A key aspect of this approach would be developing a list of waters that are not meeting designated uses due to pollution from storm water runoff (from section 305(b) reports or from the section 304(l) list of waters) or where sensitive waters or outstanding national resource waters need special protection. This approach could help to achieve water quality goals and would avoid imposing a burden on other dischargers, but would not be uniformly applied on a national basis. This option is also reactive in nature, and overlooks the advantages of prevention over remediation. The availability of technical information and water quality data limitations and the administrative and regulatory burden associated with collecting and analyzing additional data would have to be carefully considered in evaluating the feasibility of this approach.

(ii) Designate additional sources for permitting or special requirements within rainfall zones. The nature of storm water problems varies between areas with frequent rainfall, where storm water flows are high with continual pollutant loadings, and areas with low or seasonal rainfall, where intermittent flows carry highly concentrated loadings of pollutants accumulated during dry weather which result in high shock loadings to receiving waters. This option would recognize these regional variations and tailor regulatory requirements for Phase II discharges (monitoring, best management practices, reporting) to the local nature of rain events. However, immediate environmental benefits could be delayed due to the inexact nature of rainfall zones and the scarcity of comprehensive information upon which to base regulatory requirements.

(f) Establish requirements for State storm water management programs. Under this approach, EPA could develop requirements for State storm water management programs under section 402(p)(6) for the CWA which would require States to identify additional classes of storm water discharges for control. This approach may offer the advantages of additional flexibility for States to target sources based on State specific factors (climate, water resources, development patterns) and provide additional flexibility in the type of administrative program developed. However, the disadvantages of this approach include the need for generating additional resources at the State level at a time when State capacity is also strained, and possible disparities in programs in different States. Such disparities could make it hard for a State to develop an aggressive program when neighboring States have lesser requirements. Further, this approach may create additional burdens on EPA to provide adequate oversight of the State programs. EPA also requests comments on the appropriate role of EPA in reviewing State plans or developing minimum requirements for State plans and how that role should change, if at all, for States without authorized NPDES programs. The Agency requests comments on appropriate criteria for evaluating the adequacy of State programs, and appropriate procedures for periodic review and evaluation of such programs. EPA also requests comments on whether this approach could be harmonized with the requirements of section 402(p)(6) for EPA to take the lead in developing management practices and controls for Phase II sources, or whether this approach might also require statutory change.

(g) Rensselaerville focus groups. There were several common themes recognized by the focus groups with regard to identifying potential sources to be included in Phase II:

(i) Groups suggested that targeting be done on a watershed basis, with information gathered as a part of Phase I used to help identify sensitive watersheds. It was noted that this type of targeting approach may require intergovernmental agreements for effective implementation.

(ii) Teams emphasized that the focus of Phase II should be on "bad actors", i.e. those sources that are known to cause significant water quality problems. Sources identified by team members included: Gas/auto service industries, transportation, highway systems, land use development and agricultural sources. There was a consensus among groups that facilities not contributing to impairment of water quality should be able to gain an exemption from controls, permits, fees, and implementation of BMP's. Teams concluded that SIC categories are an ineffective way to designate covered sources and that targeting should be done based on the degree of risk that a given facility poses, due to possible differences between facilities in any one industry.

(iii) Focus groups recommended that small municipalities be included in Phase II but with simplified application requirements. Participants felt that municipalities impacting watersheds of concern or those connected to larger MS4s should be targeted.

(iv) Participants in the study felt that EPA should hold off on selecting sources for Phase II until the Agency has carefully looked at the date gathered during Phase I. It was noted that numerous sources of information are available which could help determine targeting priorities, for example, 305(b) reports, information from Phase I program sources, NURP, and the first Report to Congress.

2. Control Strategies

The current Phase I storm water program for industrial sources is implemented through the NPDES program with a heavy emphasis on the use of general NPDES permits which require the implementation of best management practices including development of site specific pollution prevention plans. Phase I requirements for large and medium MS4s focus on system-wide permits which require the development and implementation of municipal storm water management programs:

Regardless of how additional Phase II storm water activities are identified—whether they are designated under 402(p)(2)(E), comprehensively covered, or selectively targeted for further controls, a key issue on which EPA requests comment is what are the appropriate tools or control strategies to put in place which assure pollutant loading reductions and water quality improvement?

(a) Continued reliance on NPDES program. One option is the continued reliance on individual or general NPDES permits for individual sources, and system-wide permits for MS4s. Developing or processing specific application forms for and issuing individual permits for all Phase II sources may well be the most resource intensive of any control approach. Consistent with EPA's four tier Phase I permitting strategy for industrial storm water sources, individual permits may be most appropriate in those case specific situations where a particularly difficult or complex discharge situation needs to be addressed. By contrast, input from the public and regulated community to date suggests that heavy reliance on general permits may well be a very effective alternative within the NPDES system. EPA solicits comments on whether continued reliance on NPDES permitting as the overall control strategy for Phase II is the most appropriate approach. An extensive State and national administrative NPDES infrastructure already exists and is being relied upon for Phase I and reliance on the general permit is increasingly favored as an appropriate storm water control strategy. However, the capacity of the current system with its existing resources to accommodate a significant number of additional permittees has already been called into question for Phase I. A very real issue exists as to whether the permitting Agencies have the resources to address more than a limited number of additional Phase II permittees.

(b) Continued reliance on nonpoint source program. Another approach includes continued reliance on the State nonpoint source programs under section 319 of the CWA and future reliance on programs under section 6217 of the CZARA in coastal areas to control Phase II storm water sources not explicitly addressed or designated under Phase I.

The structure, organization, and working relationship within EPA and State offices for the section 319 program are established and proven successful. The States have taken the lead under section 319 to develop assessments of storm water/nonprofit source impacts and management programs to implement controls. EPA has approved all States assessments, 44 complete management programs, and portions of all the remaining State management programs. The States management programs typically include continued problem assessments and monitoring, voluntary control measures, mandatory control measures established under State and local authorities, State funding assistance, public outreach, technical assistance, enforcement, targeting of priority waters, and coordination with other Federal and State programs and agencies. Therefore, the section 319 program's potential ability to control Phase II sources is high. Also, section 319 programs are founded on a watershed planning and pollution prevention/source reduction approach which may be an effective vehicle to provide program and technical assistance to State and local governments.

In addition, the new CZARA program provides an excellent tool to address Phase II sources in the coastal zone in a comprehensive manner. EPA emphasizes that the goals of the NPDES and CZARA programs are complementary. Many of the techniques and practices used to control urban runoff are equally applicable to both programs. While different legal authorities and geographic coverage may apply to specific sources, States have the option to implement CZARA section 6217(g) management measures throughout the coastal zone, as long as NPDES requirements are met for those entities subject to NPDES requirements. States outside of the coastal zone may also voluntarily incorporate the management measures appropriate to particular sources or specific problems into the State's CWA section 319 program.

(c) Mandatory performance standards, guidelines, management practices and/or treatment requirements. An alternative option might also be to develop a set of mandatory national Phase II control guidelines that apply directly to Phase II storm water activities without a permit. The national pretreatment categorical effluent guidelines is an example of this approach. Permits by rule or general permits without application or reporting requirements are a similar concept. A variation on this approach might include the development of minimum categories or classes of BMP's or pollution prevention approaches with a requirement that elements from each class be chosen and implemented on a facility or system specific basis. At one level, this approach would appear to reduce the regulatory and administrative burden associated with submission of Phase II storm water applications. However, as a technical matter, it may be extremely difficult to develop one national rule that appropriately addresses all Phase II storm water activities. Developing such a rule may take a significant amount of time and may also entail substantial monitoring and data collection. A further issue upon which EPA solicits comment is whether a national rule would be the most effective approach given that many members of the Phase II universe may not be familiar with national regulations and may not even be aware that such requirements apply to them. EPA recognizes that implementation of control strategies other than NPDES permitting would probably require statutory change and requests comments on what changes would be appropriate.

(d) Rensselaerville focus groups. Focus groups identified several common themes with regard to controls that should be put in place for Phase II:

(i) Focus groups recommended that if a permitting process is to be continued for Phase II sources, NPDES general permits should be used, and the focus should be on the implementation of effective BMP's. Participants felt that permits should be simpler, less costly, and that EPA should make absolutely clear to applicants what information is required through the use of checklists of inclusion, a menu of potential BMP's, and other documents to assist permittees. The team members again stressed that exemptions from permitting should be available for sources not contributing to water quality problems.

(ii) The teams concluded that education is often overlooked and that it should be a primary component of any Phase II program. Team members felt that education is important for all audiences and that local level education

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for the public and affected industry is critical to the success of the program.

(iii) There was an agreement among teams that there should be more emphasis on voluntary programs, perhaps similar to those under the 319 nonpoint source program. Groups also suggested that for facilities that have contact with storm water, there should be limited additional governmental intervention, but rather an emphasis on pollution prevention incentives, BMP's, and specific pollution prevention techniques. Participants stressed that pollution prevention should be emphasized, particularly with new development. Some suggested prevention methods included: recycling storm water, good housekeeping practices, plantings to minimize runoff, street sweeping of work areas on a daily basis, storm water collection methods, coverage of storage areas, changing manufacturing processes to minimize pollutants and better controls of air emissions.

(iv) Groups felt that there should be correlation between the severity of the problem and the degree of controls required and that fines and fee structures could be used as "carrot-stick" measures to aid implementation.

3. Deadlines

Section 402(p) presently provides that the current prohibition against permitting Phase II sources expires on October 1, 1992. EPA solicits comment on the possible options for alternative deadlines for Phase II permit application requirements and statutory revisions of the CWA. One option is for Congress to extend the current October 1, 1992 deadline for Phase II sources. Under this option, EPA requests comment on what the new Phase II date should be and why one particular extension is more appropriate than another. For example, one possible date might be October 1, 1995, to allow one year for additional data gathering and public input on appropriate Phase II sources and control strategies and then two additional years to propose and finalize Phase II regulations.

Another strategy might be to adopt a phased set of Phase II deadlines with high priority storm water sources covered first and lower risk sources addressed at a later date.

A third approach follows option 1 under Targeting; that is, to eliminate the Phase II deadlines and follow option 1 or direct EPA to follow some other option.

Focus group recommendations from the Rensselaerville study suggested that a minimum of 2–3 years is needed to prepare for Phase II, with at least a year dedicated to looking at data gained from Phase I of the storm water program and other documents such as the first Report to Congress. Participants also felt that the effectiveness of presently used BMP's needs to be looked at to determine variations in effectiveness between different geographic locations and pollutants.

III. Request for Comments

EPA is requesting comments on all aspects of the Phase II storm water permitting program. EPA is soliciting general comments on environmental objectives and economic impacts, as well as specific recommendations and implementation advice on each of the options outlined above. Based on comments received and the results of the two studies required under CWA section 402(p)(5), EPA may propose a rule under section 402(p)(6) or solicit additional comments on options again when more data becomes available. In addition, EPA welcomes data or information from ongoing studies that support specific comments or recommendations.

A. General Issues for Comment

Based on the discussion above and the President's memorandum on reducing the burden of government regulation, EPA requests comment on the advantages and disadvantages of each option outlined above as well as any other potential approaches in terms of the following factors.

1. How well does the approach perform with respect to the environmental goals of protecting water quality, reducing pollutant loadings, and achieving designated uses in impaired waters? EPA requests comment on which of these approaches most lends itself to the documentation and establishment of environmental baselines and identification of appropriate environmental indicators against which to evaluate progress. EPA specifically solicits input on appropriate environmental indicators in connection with any of the approaches outlined above or identified by a commenter.

2. Does the option balance the need for regulation to protect/improve the environment with the desire to minimize the regulatory burden and maximize the cost effectiveness of the approach?

3. Does the option help to reduce the regulatory burden on potential permittee, while still maintaining environmental benefits?

4. Does the option help to reduce the administrative burden on Federal, State and local government, so that resources are used to address important environmental problems efficiently?

5. To what extent does the option support or provide an incentive or additional flexibility for implementing pollution prevention and other innovative permit approaches?

6. Does the option allow or encourage the use of market incentives or trading to promote greater or more effective loadings reductions and water quality improvements?

7. What is the impact of the proposed approach on small businesses [22] and communities?

8. does the option allow consideration of the issue of affordability as a factor in determining which Phase II sources should be controlled? For example, some data indicates that average per capita income in suburban fringe areas is substantially higher than in core cities. Does the option allow this to be factored in when identifying high priority groups or selecting appropriate control strategies?

EPA requests specific implementation recommendations based on the respondent's general evaluation of the options outlined above. EPA also seeks detailed comments on how the option will be implemented and ways to refine the respondent's preferred approach. For example, address issues of affordability, cost effectiveness and possible funding mechanisms and sources, in addition to providing case examples where available of successful State or local implementation of a preferred option. Respondents should also consider the need for statutory changes or rulemaking to implement recommended approaches.

B. Current Classification of Regulated Discharges

The current regulatory framework of Phase I is summarized in appendix A. This information may help respondents to understand which types of municipalities and commercial and light industrial activities are not currently regulated under Phase I of the program. Sources exempted from Phase II and some sources potentially covered under Phase II are summarized in appendix B.

IV. Review and Analysis Requirements

Various reviews and analyses are required to assess the economic or paperwork impact of new rulemaking activities under Executive Order 12291, the Paperwork Reduction Act (44 U.S.C. 3501, et. seq.), and the Regulatory Flexibility Act (5 U.S.C. 601, et. seq.).

[22] With respect to impacts on municipalities, the agency requests comments on options municipalities have for generating the revenue required to run such programs.

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These assessments are not necessary for this notice, which merely requests comments on ways to reduce the regulatory burden of potential future rulemaking.

Dated: September 1, 1992.

Martha G. Prothro,

Acting Assistant Administrator.

Appendix A. Facilities Covered in Phase 1

1. Industrial Facilities

EPA has defined the term "storm water discharge associated with industrial activity" in a comprehensive manner to address over 100,000 facilities. All storm water discharges associated with industrial activity that discharge directly to waters of the United States or through municipal separate storm sewer systems are required to obtain NPDES permits, including those which discharge through systems located in municipalities with populations of less than 100,000. Discharges of storm water to a combined sewer system or to a Publicly Owned Treatment Works (POTW) are excluded. Facilities with storm water discharges associated with industrial activity include: manufacturing/industrial facilities; construction operations disturbing five or more acres; hazardous waste treatment, storage, or disposal facilities; landfills; certain sewage treatment plants; recycling facilities; powerplants; mining operations; some oil and gas operations; airports; and certain other transportation facilities. Operators of industrial facilities that are Federally, State or municipally owned or operated (with the exception of certain facilities owned or operated by a municipality of less than 100,000 people [1] that meet the description of the facilities listed in 122.26(b)(14) (i)-(xi), described below, must also submit applications.

SUMMARY OF INDUSTRIAL ACTIVITIES COVERED UNDER PHASE I OF THE STORM WATER PROGRAM

40 CFR 122.26(b)(14) Subpart	
(i)	Facilities subject to storm water effluent limitations guidelines, new source performance standards, or toxic pollutants effluent standards under 40 CFR, Subchapter N [except facilities which are exempt under category (xi)].
(ii)	Facilities classified as: SIC 24 (except 2434)—Lumber and wood products. SIC 26 (except 265 and 267)—Paper and allied products. SIC 28 (except 283 and 285)—Chemicals and allied products. SIC 29—Petroleum and coal products. SIC 311—Leather tanning and finishing. SIC 32 (except 323)—Stone, clay and glass products. SIC 33—Primary metal industries. SIC 3441—Fabricated structural metal. SIC 373—Ship and boat building and repairing.
(iii)	Facilities classified as: SIC 10—Metal mining. SIC 11—Anthracite mining. SIC 12—Coal mining. SIC 13—Oil and gas extraction. SIC 14—Nonmetallic minerals, except fuels.
(iv)	Hazardous waste treatment, storage, or disposal facilities, including those that are operating under interim status or a permit under Subtitle C of the Resource Conservation and Recovery Act (RCRA).
(v)	Landfills, land application sites, and open dumps that receive or have received any industrial wastes including those that are subject to regulation under subtitle D or RCRA.
(vi)	Facilities involved in the recycling of material, including metal scrapyards, battery reclaimers, salvage yards, and automobile junkyards, including but limited to those classified as: SIC 5015—Motor vehicle parts, used. SIC 5093—Scrap and waste materials.
(vii)	Steam electric power generating facilities, including coal handling sites.
(viii)	Transportation facilities covered by the following SIC codes which have vehicle maintenance (including vehicle rehabilitation, mechanical repairs, painting, fueling, and lubrication), equipment cleaning operations, or airport de-icing operations, or which are otherwise listed in another category, are included. SIC 40—Railroad transportation. SIC 41—Local and suburban transit. SIC 42 (except 4221-25)—Motor freight and warehousing. SIC 43—U.S. Postal Service. SIC 44—Water transportation. SIC 45—Transportation by air. SIC 5171—Petroleum bulk stations and terminals.
(ix)	Treatment works treating domestic sewage or any other sewage sludge or wastewater treatment device or system, used in the storage, treatment, recycling, and reclamation of municipal or domestic sewage, including lands dedicated to the disposal of the sewage sludge that are located within the confines of the facility, with a design flow of 1.0 Million Gallons per Day (MGD) or more, or required to have an approved pretreatment program under 40 CFR Part 403. Not included are farm lands, domestic gardens, or lands used for sludge management where sludge is beneficially reused and which are not physically located in the confines of the facility, or areas that are in compliance with Section 405 of the CWA.
(x)	Construction activity including clearing, grading, and excavation activities except operations that result in the disturbance of less than 5 acres of total land area which are not part of a larger common plan of development or sale[1].
(xi)	Facilities under the following SICs [which are not otherwise included in categories (ii)-(x)], including only storm water discharges where material handling equipment or activities, raw materials, intermediate products, final products, waste materials, byproducts, or industrial machinery are exposed to storm water[1]. SIC 20—Food and kindred products. SIC 21—Tobacco products. SIC 22—Textile mill products.

[1] In the Intermodal Surface Transportation Efficiency Act of 1991, Congress provided that industrial activities owned or operated by municipalities with a population of less than 100,000 be placed into Phase II of the storm water program with the exception of airports, power plants and uncontrolled sanitary landfills.

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SUMMARY OF INDUSTRIAL ACTIVITIES COVERED UNDER PHASE I OF THE STORM WATER PROGRAM—Continued

40 CFR 122.26(b)(14) Subpart	
	SIC 23—Apparel and other textile products. SIC 2434—Wood kitchen cabinets. SIC 25—Furniture and fixtures. SIC 265—Paperboard containers and boxes. SIC 267—Converted paper and paper board products (except containers and boxes). SIC 27—Printing and publishing. SIC 283—Drugs. SIC 285—Paints, varnishes, lacquer, enamels. SIC 30—Rubber and misc. plastics products. SIC 31—(except 311)—Leather and leather products. SIC 323—Products of purchased glass. SIC 34 (except 3441)—Fabricated metal products. SIC 35—Industrial machinery and equipment, except electrical. SIC 36—Electronic and other electric equipment. SIC 37 (except 373)—Transportation equipment. SIC 38—Instruments and related products. SIC 39—Miscellaneous manufacturing industries. SIC 4221—Farm products warehousing and storage. SIC 4222—Refrigerated warehousing and storage. SIC 4225—General warehousing and storage.

[1] On June 4, 1992 the United States Court of Appeals for the Ninth Circuit found that EPA's rational for exempting construction sites of less than five acres and certain uncontaminated storm water discharges from category xi light industrial facilities from Phase I of the storm water program to be invalid and has remanded these exemptions for further proceedings (see *Natural Resources Defense Council* v. *EPA* No. 91-70176).

Source: FEDERAL REGISTER, Vol. 55, No. 222, p. 48065, November 16, 1990.

2. Municipal Facilities

"Municipal separate storm sewer" is defined as any conveyance or system of conveyances that is owned or operated by a State or local government entity designed for collecting and conveying storm water which is not part of a Publicly Owned Treatment Works. The application requirements do not apply to discharges from combined sewers (systems designed as both a sanitary sewer and a storm sewer). Municipal separate storm sewer systems that are addressed by the November 16, 1990 regulations include storm sewers located in one of 173 cities with a population of 100,000 or more; located in one of the 47 counties identified by EPA as having large populations in unincorporated, urbanized areas; and systems that are designated by the Director based on consideration of the location of the discharge with respect to waters of the United States, the size of the discharge, the quantity and nature of the pollutants discharged to waters of the United States, and other relevant factors. These are named in Appendices F–L of the November 16, 1990, regulation.

INDUSTRIAL AND MUNICIPAL PERMIT APPLICATION DEADLINES

Type of Application	Deadline	
● Individual	October 1, 1992	
● Group	Part 1	Part 2
All industrial activities except those owned or operated by a municipality with a population of less than 250,000.	September 30, 1991	October 1, 1992
Industrial activities owned or operated by a municipality with a population of 100,000 to 250,000.	May 18, 1992	May 17, 1993
● General Permit NOI	Deadline established in the general permit, but no later than October 1, 1992 for existing sources.	
	Part 1	Part 2
Large Municipalities	November 18, 1991	November 16, 1992
Medium Municipalities	May 18, 1992	May 17, 1993

Appendix B. Potential Universe of Phase II Dischargers

Phase II potentially includes all point source discharges of storm water to waters of the United States (including Municipal Separate Storm Sewer Systems) that are not regulated under Phase I of the storm water program (See Appendix A). The following table illustrates those types of operations which have been statutorily exempted from both Phase I and Phase II of the NPDES storm water program along with a general list of potential Phase II sources:

Statutory / Regulatory exemptions:	● Non Point Source Silviculture Activities. ● Agricultural Runoff and Irrigation Return Flows. ● Uncontaminated discharges from Mining, Oil and Gas Operations.
General categories of sources	● All municipalities with populations less than 100,000.

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	• All industrial activities not regulated under Phase I (including those owned/operated by municipalities under 100,000) (tank farms, "auxiliary facilities").
	• Commercial activities with industrial components (gas stations, dry cleaners).
	• Construction activities involving less than 5 acres [1].
	• Large parking lots (shopping malls, stadiums).
	• Residential property.
	• Recreational areas (ski areas, golf courses, amusement parks).
	• Livestock facilities (stables, feedlots not addressed by Phase I regulations [2], etc.).
	• Greenhouses, nurseries.

[1] On June 4, 1992 the United States Court of Appeals for the Ninth Circuit found that EPA's rational for exempting construction sites of less than five acres from Phase I of the storm water program to be invalid and has remanded the exemption for further proceedings (see *Natural Resources Defense Council* v. *EPA* No. 91-70176).

[2] Feedlots, as a class of facilities, have been associated with high loadings of pollutants such as suspended solids, BOD, and nutrients such as nitrogen and phosphorus, and could be an example of a targeting approach based on high loadings.

[FR Doc. 92-21653 Filed 9-8-92; 8:45 am]

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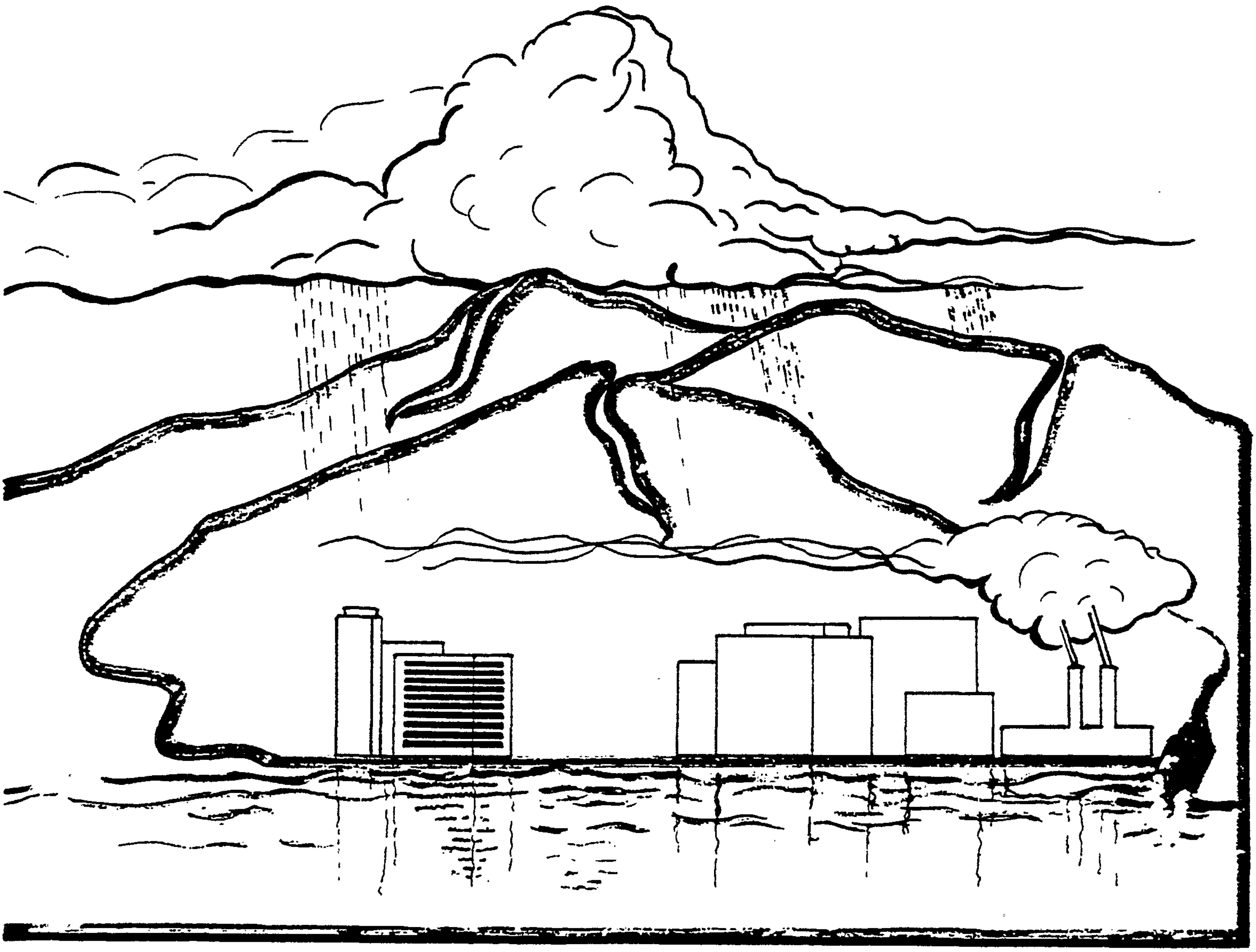
R0015498

APPENDIX I

REPORT ON THE EPA STORM WATER MANAGEMENT PROGRAM (RENSSELAERVILLE STUDY)

United States
Environmental Protection
Agency

EPA830-R-92-001
October 1992



Report on

The EPA Storm Water Management Program

Conducted for the U.S. EPA Office of Wastewater Enforcement and Compliance
by The Rensselaerville Institute

Volume 1

R0015500

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Volume I
Final Report Submitted: October 1992
EPA Report # 830-R-92-001

R0015502

ACKNOWLEDGEMENTS

We are most grateful for direction and guidance for this project provided by the Office of Wastewater Enforcement and Compliance, Michael B. Cook, Director; James Horne, Project Officer.

We also acknowledge the efforts of those persons who participated in the focus groups, the expert surveys, the public forums, and the "design team" session. The thoughtfulness of opinions and insights voiced is impressive.

We are encouraged by the willingness of people with very different perspectives to not only listen carefully to each other but to seek common ground. The prospects for collaborative work are strong.

Mary E. Marsters
Harold S. Williams
The Rensselaerville Institute

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EXECUTIVE SUMMARY

In December 1991, the Deputy Administrator of the U.S. Environmental Protection Agency (EPA) asked the Office of Water to undertake a research project with two objectives: 1) identify ways to improve and streamline the existing storm water regulatory program implemented by the agency under Section 402 (p) (2) of the Clean Water Act: and 2) define and annotate options for controlling sources of storm water runoff designed for Phase II of this same section.

In response to this request, the Office of Wastewater Enforcement and Compliance (OWEC) engaged The Rensselaerville Institute to develop a two-part project to gather and integrate diverse opinion and insight on ways to improve the efficiency and effectiveness of the existing Phase I program and the best possible response for the Phase II program designed to cover remaining storm water sources and problems.

Part I of the project was conducted during February and March, 1992 when six focus groups were held around the U.S. to gain user feedback on how the current regulations and implementation procedures could be improved and streamlined. These groups, which included representation by both public- and private-sector permittees as well as regulatory agencies, private consulting firms, industry, and environmental interests, identified numerous ways EPA and others could address permitting and compliance procedures seen as difficult or problematic.

Part II of the project began with an Expert Survey of 32 persons highly knowledgeable in storm water and its control who represented different perspectives (academic/research, state/local government, commercial development, environmental advocacy, and consultant/engineering) and different geographic areas. Experts were asked to respond to a set of options for targeting and controlling sources and to suggest additional alternatives as well. Insights on voluntary measures that have proven effective in storm water control were solicited through a separate survey of five experts in nonpoint program approaches.

Based on the results of these surveys, three public meetings were announced in the Federal Register and held in Denver, San Francisco and Washington, DC during June, 1992. Those attending were divided into teams and asked to define their own preferred strategies for a Phase II program response, including definition of sources to be regulated, the preferred method of control (permit-based or other) and their sense of both timetable and the role EPA should play.

Finally, a small group of insightful individuals representing diverse viewpoints from both point source and nonpoint source programs was convened for a strategy design meeting for the purpose of adding greater depth and breadth to one or more Phase II approaches identified in the public meetings. From this group, a ten-point strategy was created, as well as a series of recommendations to EPA on developing the second phase of the storm water program.

This Executive Summary presents the findings from each of these activities in summary form. More complete recommendations are contained in the body of Volume I. The project data base is contained in Volume II.

Summary of Findings on Improving Phase I of the Storm Water Program

Forty individuals participated in focus groups held in Atlanta, GA; Hartford, CT; Chicago, IL; Washington, DC; Seattle, WA; and Phoenix, AZ. Together, the participants included all identified viewpoints and separable interests--including EPA regional staff, state and local government officials, engineering consultants, environmental advocates, and representatives of corporations included in Phase I permitting.

Participants responded to a set of questions which probed for opinion and insight on such matters as the unclear aspects of the Phase I regulations, additional steps that should be taken to simplify the process and help permittees to achieve compliance, and the relative merits of individual and group permits. In addition to participant responses to core questions, the afternoon of each session was used to further elaborate problems and solutions of interest to participants in an informative format.

While many issues raised were location- or source-specific, some spanned geographic and demographic boundaries. Eight issues common across all focus groups were identified as key areas to be clarified and/or modified to improve program implementation:

1. EPA has not been clear about the intended goals of the regulations. A stronger sense of the relative importance of storm water in the framework of environmental risk is needed, as is clarity about short range and long term targets. There is a difference, for example between clean water standards and stream health standards. It is clear that there are storm water permits. It is not clear how the permits reflect a coherent program.

2. The expense of program implementation is significantly higher than EPA has estimated. There is great concern over what the program's <u>real</u> costs have been in terms of dollars and manpower costs of preparing a permit application, and the anticipated costs of achieving compliance. A broader concern: municipalities now beleaguered by resource shortfalls cannot reasonably afford the combined costs of compliance with all environmental regulations.

3. The administrative complexity of the program is enormous at the federal, state and local levels, and has quickly outpaced the availability of resources and manpower needed to carry it out. In some cases, field staff have been

pulled in simply to process the paperwork involved.

4. Clarification is needed on the roles and expectations EPA has for itself, states and permittees. What is clear to everyone is that EPA does not have the capacity to administer and enforce the program alone. This cannot be seen as an EPA program administered in a "command and control" style totally from Washington. It must involve active participation, not simply passive compliance, from all levels involved.

5. More technical support for the program is needed. Expanded information explaining the regulations and how to implement them is especially needed. Also, there should be less "national level" support and more focus on regional conditions. Much of the content of storm water workshops held at EPA headquarters is irrelevant to any given participant.

6. States need EPA to either clarify how to interpret unclear points of the regulations, or allow them the latitude to make the interpretations themselves. One unclear area is the inconsistencies and inequalities created by use of industrial SIC codes in such areas as transportation. Another murky area is the group application process.

7. EPA should consider consolidating programs in order to address water pollution in an efficient and cost-effective manner. A watershed approach is preferable to current practices of separating problems by media.

8. General permits are "the way to go" and EPA should continue to focus on and accelerate efforts in this direction.

Many focus group members made a point of indicating their pleasure with the focus group format used and the ways in which EPA had 1) encouraged interaction and customer insight and 2) listened carefully to their advice. A complete report on focus group responses and conclusions is contained in the body of this publication.

Summary of Findings on Designing Phase II of the Storm Water Program

Expert Survey

The second part of the Rensselaerville project began with a survey of a select group of 32 point source storm water program experts from across the country. The purpose was to solicit opinions on ways to implement the second phase of the storm water program. Five perspectives were represented: academic/research; commercial development; consultant engineering/legal; environmental advocacy; and state/local government. A first mail-back survey round gained opinion and consensus on relevant issues and options for addressing Phase II sources. Data from the first set of returned surveys were analyzed and given back to participants in a second survey round, which refined positions and created more options for Phase II consideration.

To ensure inclusion of all critical perspectives, five nonpoint source program experts were asked to provide feedback, with emphasis on potential voluntary approaches for addressing Phase II sources.

While approaches recommended differed by profession and geography, these common targeting themes emerged for identifying whom to include in Phase II:

- develop a geographically-based phasing plan by watershed impairment/severity of threat;
- determine selection criteria for pollution sources and use these to identify municipalities that should participate;
- do pilot projects first, evaluate, and then develop and implement a strategy;
- encourage and fund comprehensive basin research and planning to guide targeting;
- require Phase II industries to be covered under Phase I general permits;
- develop national guidelines, and leave selection of sites and methods to state discretion;
- require smaller communities (< 100,000) to apply for permits only when their storm water contributes a significant pollution problem;
- designate problem areas, establish permit requirements for municipals regardless of population, and allow municipals to exclusively regulate industries; and
- initiate a focused dialogue with key stakeholders (applies to both targeting and controls).

Common themes expressed for control strategies included:

- build a Best Management Practices (BMPs) menu that can be used by states to implement and verify progress;

- require localities to select from a list of BMPs the ones most appropriate for their needs and apply industry-specific BMPs nationwide with allowance for state/local officials to modify;

- provide nationwide public education and community-wide public education on the need for storm water control;

- establish national or industry-specific minimum practices for controlling storm water;

- implement good housekeeping and source reduction practices;

- require routine certification and audit of storm water pollution plans and practices;

- establish industry-specific and watershed-specific BMPs; and

- establish BMPs required nationwide and strictly enforce. Require facilities to further treat storm water discharges where BMPs are not effective.

The strongest additional factor in nonpoint survey responses was the degree of emphasis placed on education at all levels, including the general public, local and state officials, and local businesses and industry. Education was seen as the key to making voluntary approaches effective. Voluntary compliance, in turn, was then advanced as highly cost effective.

Respondents feel that EPA must be the "stick" that would fall--with permit requirements, fines, etc.--if a storm water source does not voluntarily take action and achieve certain minimum goals. But limited manpower and financial resources form a rationale for not addressing Phase II with the costly conventional federal mandates of Phase I.

Public Meetings

Three meetings were conducted to gain public responses to options for targeting and controlling Phase II sources. They were held in Denver, CO; San Francisco, CA; and Washington, DC during June, 1992. At each meeting, three experts selected from the Expert Survey process presented their ideas on a regulating strategy for the moratorium sources. Participants were then divided into small task teams, and given the charge of devising their own strategies for targeting and controlling Phase II sources. A strategy template was provided to guide group consideration of three key issues: 1) who should be covered under Phase II; 2) what controls are needed; 3) over what timeframe the program should be implemented. At the end of each public meeting, the task teams presented their options to other participants for discussion.

Common strategy characteristics emerged, in many cases paralleling those apparent in the expert survey. For targeting:

- Targeting should be done by watershed. Information gathered from Phase I should help identify sensitive watersheds. This may require intergovernmental agreements.

- The focus should be on "bad actors", i.e., those that are known problem sources. The ones most frequently identified were: gas/auto service industries, transportation, highway systems, land use development and agricultural sources. There needs to be the ability for facilities not contributing impairment of water to gain an exemption from permits, fees, implementation of BMPs. Categories are an ineffective way to designate covered sources - should be done by the degree of risk a given facility poses, because it may not be a whole industry, but rather individual facilities.

- Small municipalities should be included, but they should have a much simpler application process. Or, only small municipalities where a storm water problem is identified should there be required action.

- EPA should defer on selecting targeted sources until the agency has carefully looked at the data gathered during Phase I. Numerous sources of information are available which would help determine targeting priorities, e.g., information gathered through 305b reports, information from Phase I program sources, the NURP study.

For needed and desirable controls, these themes emerged:

- If a permitting process is to be continued for point sources, NPDES general permits should be used, and focus should be on implementing Best Management Practices (BMPs). Permits should be simpler, and much less costly. EPA should make clearer to the applicant what information is required, e.g. provide the permittee with a "checklist of inclusions" for the application, develop a menu of BMPs. Permit exemptions should be granted to those targeted sources who offer no contribution to the problem.

- Education should be seen not as an "add-on", but rather as a primary tool for effective control. Locally implemented education for public and industry is especially important; the premise is that information and conviction born of education will encourage many to take the needed preventive and remedial steps.

- More emphasis should be placed on voluntary programs, e.g., 319 nonpoint source-like programs. For facilities with contact with storm water, there should be little or no government intervention, but rather emphasis on pollution prevention incentives, BMPs, and measures of pollution prevention.

Pollution prevention programs should be emphasized, particularly with new development. Some suggested prevention methods included: recycling storm water, "good housekeeping" practices, plantings to minimize runoff, street sweeping of work areas on a daily basis, storm water collection methods, coverage of storage areas, changing manufacturing processes to minimize pollutants, and improvement of air emissions.

- ☐ Closer correlation should exist between the severity of the problem and the degree of controls required. Fines and fee structures could be used as "carrot-stick" measures.

- ☐ BMPs should be required based upon the specific pollutant problem. EPA should develop a menu of BMPs to assist businesses in determining the appropriate BMP for their problem.

In terms of a timetable for phasing in Phase II, two widespread opinions emerged:

- ◇ A minimum of two years is needed to prepare for Phase II, with at least a year dedicated to looking at data gained from Phase I of the storm water program. Effectiveness of presently used BMPs needs to be studied to determine differences in effectiveness between geographic locations and pollutants.

- ◇ Whatever the period established for phase-in, it should not begin until promulgation of the regulations.

A final question in the strategy template: **"For whatever strategy is chosen, what could EPA do to make the decision-making process for Phase II more responsive?"** generated responses focused on some common themes:

- ⌂ Coordinate information dissemination, e.g., set up regional clearinghouses offering such program information as general permit writing, effective applications of BMPs, and examples of successful efforts from programs around the country.

- ⌂ Provide funding not for program implementation but for needed research, e.g., on BMP effectiveness, and for demonstration projects.

- ⌂ Set broad guidelines for the program and establish minimum standards, and then allow state and local regulatory agencies determine how to achieve them.

- Develop and implement training programs for regulators, including regional and state, on the program. These people are the ones who will be the informational source for the regulated community, and need to know the details of the program.

As with the focus groups the participants in the public meetings felt positive about the format used. A mail-back survey returned by more than 30% of meeting participants showed that they strongly favored this interactive process over what they perceived as the conventional practice of a stream of public comments that encouraged adversarial positioning and boredom for those listening. Comments of attendees included:

- "The opportunity to formulate an entire strategy to deal with this issue was very useful;"

- "I obtained a better point of view of government's problems and felt that government representatives also obtained a better point of view of industry's problems;"

- "Result was a much less confrontational and much more problem-solving atmosphere;" and

- "It was a valuable way to address drafting of regulations, allowing the regulated community to feel a part of the process."

The body of this report contains a further elaboration of the process and the ways in which it might be used by the EPA in other communication and outreach efforts.

Design Team Meeting

A meeting of seven point and non-point storm water program experts, all of whom were survey respondents, and selected EPA staff was convened in Washington DC on September 17-18, 1992. The purpose was to gain the experts' varied insights on development of the Phase II storm water program and to build a strategy, or multiple strategies, for addressing Phase II sources.

Many discussions were specific to certain types of activity--not only municipal or industrial, but to specific kinds and levels of enterprise. Others focused on regional differences--for example the strong distinctions from places that are uniformly wet, uniformly dry, or highly volatile in hydrological terms. Still others found differentiation in scale--such as the difference in impact a regulation would have on a city as compared to a small town. These distinct findings are contained in the full report which follows in this volume.

A broader set of ten recommendations emerged for the major Phase II challenge which generally transcend such differences. They include:

1. **It is possible and desirable to identify priority target areas for which there is widespread consensus concerning their contribution to water pollution.** These areas begin with new development and redevelopment--both residential and commercial. They also include transportation corridors, dense existing development and automotive services.

2. **EPA needs to communicate more clearly and regularly with everyone impacted by the storm water regulations.** The priority focus should be less on the amount of communication and more on different kinds of communication.

3. **EPA could improve program effectiveness, efficiency and cost control in Phase II by "starting small".** The concept of regional and even local prototypes is a way of getting proposed new Phase II frameworks into the hands of users in prompt fashion to build and refine based on early use.

4. **Selectivity in data collection and monitoring is essential.** At present, some data collection frameworks consume tremendous time and money only to yield bad or useless data or murky or disputed conclusions. At other times, very simple actions taken with known consequences require simple verification, not extensive measuring.

5. **More customer differentiation is also needed.** At present the mind-set appears to be that one size fits all. While giving the appearance of equity, this concept actually creates strong inequalities. The same programs and regulations that befit a large corporation or municipality are simply not equitable for smaller enterprise and communities, for example.

6. **While the ultimate goal is water quality standards, this is very difficult to achieve and/or to measure in the short term.** Therefore, while retaining water quality standards as the ultimate goal, EPA should be focusing on best management practices, and in particular those that reflect preventive and non-structural solutions.

7. **The most functional unit of both analysis and intervention is the watershed.** Most people in our samples for opinion and recommendation strongly suggested the watershed approach--not only on the macro level (e.g., Chesapeake Bay) but the micro-level as well.

8. **EPA's role is to offer technical support and direction more than program funding or even full guidelines for state and local implementation.** In particular, building useful data bases and collection methodologies not only on water quality but on practices to achieve it is critical. Such practices should include education, given that prevention and voluntary compliance are much less costly than litigation.

9. **A collaborative approach to developing effective solutions is possible.** The interactive elements of this project are one reflection of the ability of those with strikingly different perspectives (ranging from strong environmental protection to a focus on economic development) to work cooperatively.

10. **Agriculture's absence from the storm water program is notable and regrettable.** In many regions, agriculture (which includes livestock as well as crops) is a primary contributor to surface water pollution. Permitting or in other ways controlling the transport of agricultural products introduces intervention too late.

The remainder of Volume I amplifies these findings and presents the rationales and key data points which underlie them. Volume II includes the complete data base, including all instruments used to collect and analyze information.

PART I: IMPROVING PHASE I OF THE STORM WATER PROGRAM

In December, 1991, the Deputy Administrator of the U.S. Environmental Protection Agency asked the Office of Water to undertake a project that would achieve two results: first, identify ways to improve and streamline the existing storm water regulatory program currently being implemented by the agency; and second, develop options for controlling sources of storm water runoff not currently required to be permitted under Section 402(p)(2) of the Clean Water Act.

In response to this request, the Office of Wastewater Enforcement and Compliance (OWEC), working with The Rensselaerville Institute, developed a two-part project. This section addresses the outcomes from Part I, which focused on identifying improvements to the existing regulatory program.

Description

As the first part of The Rensselaerville Institute's project to help EPA assess the effectiveness and efficiency of the existing Storm Water Program, focus groups were held in diverse regions of the country to gain feedback on how the regulations promulgated on November 16, 1990 could be streamlined and improved. Six such meetings comprising representatives from state, municipal, private industrial and environmental groups were conducted between February 24 - March 2, 1992.

A total of 40 individuals participated in the focus groups, which were held in Atlanta, GA; Hartford, CT; Chicago, IL; Washington, DC; Seattle, WA; and Phoenix, AZ. The format for each meeting was the same: participants provided feedback on eleven questions developed by EPA and Institute staff. The questions:

1. Which aspects of the storm water regulations are least clear?

2. What additional steps would be helpful in assisting permittees achieve compliance in the allotted timeframe? Who should take those steps?

3. Exactly what kinds of guidance and information are needed to help people implement the program? How would you prioritize these listed storm water program activities in terms of their usefulness?

4. Is there a need for EPA to do more national workshops on the storm water regulations? What about regional or local workshops? On which subjects?

5. What support should states, as opposed to EPA or other organizations, be expected to provide to their "universe" of permittees? What resources do they need in order to provide those supports?

6. If you had to name three ways to streamline the permitting process, what would they be?

7. What could EPA do to encourage those states without general permit authority to get it? What steps are needed to get general permits out? What simple, short-term grassroots efforts can associations and trade groups take to help this effort, and how could EPA support those efforts?

8. What outreach efforts to explain to permittees what they have to do to comply with the regulations have been most effective to date? Are there informational pieces that EPA could prepare that would best help these efforts?

9. What are the techniques, methods or strategies you would recommend to help permittees achieve water quality standards? In what timeframe should permittees be required to comply with WQS?

10. Given that construction activities are most often local in nature and temporary in duration, do you have suggestions about how EPA could more effectively regulate such activities?

11. What suggestions would you offer in terms of the most efficient way to enforce EPA existing regulation requirements, both application requirements and substantive permitting requirements?

Responses to question #6 were revisited in the afternoon of each session, when participants were asked to further define their recommendations, indicate who they felt should be responsible for initiating the changes, and list the initial steps they would take.

Response summaries were drafted following each meeting and sent to participants for additions and modifications. Their changes were incorporated into their respective reports. This overall report summarizes, interprets, and analyzes group discussions and conclusions.

Focus Group Findings

Despite the many issues surrounding implementation of the regulations, the consensus of all focus groups, including industrial representatives, was that storm water control is needed and appropriate. There was general agreement that storm water is a significant contributor to water pollution. Some felt that a regulatory program was appropriate to address the problem. A number of participants expressed that, overall, the storm water program is significantly more rational and easier to deal with than other EPA water programs, for example, the wetlands program.

Yet the storm water regulations still inspire much confusion and frustration. There is frustration with EPA, as well. Many felt there was a lack of consideration given to their inputs by the agency prior to promulgation of the regulations, and some thought that EPA had been unresponsive to questions and concerns voiced since the regulations went into effect. When pressed, however, most admitted that they perceived this to be an endemic or generic problem of government. For a few, this perception will not be changed. However, most were impressed that EPA was now willing to actually look at the storm water program and solicit input from those dealing with the regulations on how they could be improved or streamlined.

Reservation was voiced, however, that EPA would do nothing with the recommendations generated from these focus groups. Their concern was that the results would have as little impact on EPA's decision-making and responsiveness as had previous efforts to make their opinions known.

It is critical, therefore, that EPA identify those procedural changes made in response to the recommendations, and make them known both to focus group participants specifically and to the permitted and regulatory communities in general.

The range of concerns voiced was large, and differed between geographic regions and the representational make-up of the group. Each group raised issues that were quite specific to themselves or their region, e.g., New York City was concerned about the effects of tidal flow and backwater as they relate to water quality; Utah and other arid and semi-arid states were concerned about sampling procedures when there was scarce rainfall; Seattle felt that the regulations did not allow its storm water program to build on earlier work; general contractors do not understand why concrete mixing requires a separate permit even though it is done on the construction site, etc. The specificity of concerns for each group is reflected in the individual summary reports, which are included in Volume II.

Some issues and concerns identified, however, spanned geographic and demographic boundaries. They were raised across groups as key areas in need of clarification and/or modification. There were seven broad areas identified where members felt efforts should be made to improve and streamline the storm water regulations.

1. **Permittees and regulatory agencies feel that the EPA has not been clear about the intended goals of the regulations. A view of the "bigger picture" is wanted.**

   While group members agree that storm water is a contributory factor to water pollution, there does not seem to be an understanding of what EPA hopes to achieve with the regulations promulgated in November 1990. A frequently heard comment was that "the big picture" is missing. Participants felt that EPA has not been clear about how these regulations will accomplish the goal of achieving clean water, and in what timeframe. This has hampered efforts to comply because many do not understand what they should be setting as performance targets.

   One participant said, "What is a clean urban stream?" The point: participants were not sure what goals they need to attain to comply with the regulations and protect themselves from being sued or fined for non-attainment. Almost all participants felt that water quality standards were useful as the ultimate goal toward which to work, but were unachievable in a two- or three-year period. When asked what they felt would be a reasonable timeframe, estimates ranged from five to thirty years, with a few participants indicating that, given the large number of pollutant sources impacting on a given water body, achievement of water quality standards through the storm water program alone is a strong improbability. One participant stated that the scientific community's perspective is, "...there is no way water quality standards can be achieved with known storm water technologies"; it will take further research and development of BMPs before water quality standards could be achieved.

It was clear that members need more guidance about where the program is headed. Participants want EPA to be more explicit about what should be achieved in terms of improvement of water quality in the timeframes that have been given and with the technologies that are presently available.

Group members were aware that environmental advocacy groups will bring pressure on EPA to hold to established numerical water quality standards, and that reducing or replacing them is not likely a viable option. As one representative from an environmental advocacy organization stated regarding water quality standards, "...(they are) the heart of the Clean Water Act." Participants felt, however, that EPA needs to explicitly acknowledge that cleaning up the waters of the U.S. is a long-term effort that requires federal, state and local governments to work in partnership with permittees rather than through "command and control" relationships. Permittees fear being sued for non-compliance when in fact they are making the best efforts possible.

Permittees and regulatory agencies want EPA to provide them the time and support they need to design and implement storm water programs that make sense in terms of effectiveness and cost. They feel that EPA, by not clearly stating goals, has hampered efforts to deal with the problem; permittees are not sure which approaches to take because they don't know what they have to achieve. They want the guidance and information necessary to implement the most appropriate measures available for their discharges, and the time to evaluate those efforts. As one group member observed, "...What is needed is a longer period (than the permit period) to do BMPs - and then monitor their effectiveness. Where necessary, go back and change things. It's an evolutionary process. This is not a quick tech fix! EPA is creating more problems than answers. October 1 should not be 1992, it should be 1995."

If EPA is to achieve success with the program, it needs to address confusion over program goals and timeframes. The agency needs to be explicit about what it expects industrial and municipal permittees to accomplish in the first permit period, what they expect them to achieve in the longer term, and what they anticipate the impact of the storm water program to be on overall water quality.

2. **The cost of program implementation is significantly higher than EPA estimates. There is great concern over what the program's real costs have been in terms of dollars and manpower.**

A great concern of focus group members was the excessive cost of preparing a permit application, and the anticipated costs of achieving compliance. A number of state representatives indicated that implementation of their state program took, in terms of staff time alone, more than all other water programs combined - without the concomitant added federal dollars that those programs provided. That EPA has provided minimum federal dollars for the program is a major issue. Municipalities and industries were concerned with the significant additional costs of manpower and technology needed for both application and compliance. One focus group participant brought for discussion a study done by the School of Public and Environmental Affairs at Indiana University. The study has identified that the actual mean cost for Part 1 of the municipal application process for 59 cities exceeded by six times the EPA-estimated costs of the program [Gebhardt & Lindsey (1992), "NPDES Requirements for Municipal Separate Storm Sewer Systems: Costs and Concerns"].

That EPA has set aside some monies to assist in program development is not commonly known information. There was confusion among a number of focus group members about the availability and applicability of grant monies, e.g. 104(b) funds, that are dedicated to implementation of the program. For example, within the same focus group, one person said that they had applied for and received the funds to help prepare their application; another member replied that they were told that the monies could not be used for that purpose. Members of some groups were unaware that the funds were available at all. This indicates that communication from EPA has been inadequate in letting eligible groups know that there are some, albeit limited, dollars available to help them in setting up their programs, and that there has been inconsistent communication about the guidelines for use of those funds. Further, every person who indicated knowledge of the money also noted that the funds available were minuscule in comparison to what was needed to actually get their programs up and running.

Some states have developed the necessary revenue-gathering mechanisms to fund their storm water program. One state representative indicated that, by charging permit fees, they have been able to hire six staff people for the program. A few other state representatives indicated that storm water utilities had been successful in helping to raise the funds necessary for program operations. A significant number, however, contend that their state does not have the funds to implement the program, nor do they have a system devised to raise these funds. Therefore, wholehearted efforts are not being made to respond to the regulations. Further, some states have implied that they do not consider storm water a priority, and therefore are not willing to devote any portion of their budget to the program. This latter point creates a significant problem for the thousands of permittees in such a state that are then without a critical support system to provide them guidance and technical assistance.

The storm water field in general is perplexed that EPA could promulgate these regulations, without at least providing "seed monies" to assist the application process and help states set up their own revenue-generating systems. To some, the message EPA sent by not providing funds is that the agency itself is not invested in the program. If EPA plans to continue to regulate storm water without providing financial assistance, one way it could assist permittees is to provide guidance and examples of successful fund raising systems that some states have devised, e.g., storm water utilities.

3. **The administration of the program is enormous. Clarification is needed on the roles and expectations EPA has for itself, states and permittees.**

Much of the controversy surrounding the regulations arises from unclear delineation of the roles, responsibilities and authority of each level. What is clear to everyone is that EPA alone does not have the capacity to administer and enforce the program. Therefore, much responsibility must fall on state and municipal levels. However, the regulations do not delineate the responsibilities of each level. Group members were clear that they want EPA to be more decisive and explicit about what is expected of states and municipalities in terms of administration and enforcement, and the areas where they will be allowed authority and flexibility in decision-making.

Some state and local governments have not waited for EPA to define their roles. The regulatory deadlines were powerful motivators for them to move forward without such guidance. Thus, frequently heard was states' hesitancy to discuss with EPA what they were doing programmatically, because they were afraid they might not be doing it "right", i.e. in accord with what EPA wants done. They were concerned about asking EPA for clarity they feared the agency might take away their assumed authority since it had not been specifically assigned in the first place. A number of state representatives admitted that they interpret the regulations in their own way rather than wait for EPA to provide interpretation. As one state representative put it, "...we looked at the regs as guidance rather than rules. We do it our own way. We are not sure if it is appropriate, (so) I have concerns asking for guidance from EPA because they may take away our latitude to make our own judgments."

The vagueness in assignment of responsibility and authority has clearly hampered program implementation. It may have been the intention of EPA to be less specific so that other entities would make their own interpretations, but they clearly do not feel comfortable assuming responsibility or authority. Many have been frustrated by the agency's lack of response when trying to gain clarity of the regulations. For example, one trade association representative stated that, in order to inform his membership about the regulations, he wanted to publish in their trade newsletter an article that outlined their members' responsibilities under them. To ensure that his interpretation was in accord with EPA's, he submitted the article to

EPA for review. In his words, "I waited a month, and when EPA did not respond, I went ahead and printed it. They [EPA] didn't like that."

Some state representatives said that they were unwilling to help industrial people make decisions on whether they are covered by the regulations, because they do not want to be held accountable when EPA has not specifically given states the authority to make interpretations of the SIC codes. Participants felt that the states are more likely than EPA to know the specifics of the industries in their boundaries, and also to know which ones are high-risk pollutant sources. But states do not feel that EPA has given them the authority to use that knowledge to make their own judgments on whether an industry is covered or not.

Industries also feel unsure about their responsibilities under the regulations, and are turning to the states for guidance. The regulations are unclear, for example, about what level of program implementation is expected in a given timeframe. As one state representative put it, "...there needs to be some guidance from EPA to the states on what (industries) need to do!"

States feel they have more knowledge of the industrial risks within their boundaries, and know what is needed to bring those risks into compliance. A number of focus group members cited the uselessness of having EPA develop requirements and guidance for any given industry when it did not understand specific industries. They felt it far more effective for EPA to work with industrial representatives when developing materials to ensure clarity and correctness. This would likely create the added benefit of gaining industry's commitment to achieving certain results.

Given the magnitude of these regulations, the lack of funding available to support implementation, the fiscal constraints under which all levels of government are operating, and the limited staff at each level, working in partnership with states and permittees rather than through a "command and control" relationship could get the program in place more quickly and maximize its effectiveness. EPA needs to determine each government level's responsibilities, be explicit about what decisions and flexibility can be allowed, and be clear about what results are expected from each level of government if given the authority to interpret certain aspects of the regulations.

4. More supporting information for the program is needed, and dissemination of that information needs to be improved.

Information supplementary to the regulations, explaining them and providing explicit information on how to implement them, was cited as a critical need that had only partially been met. All focus group members gave feedback on those pieces of EPA-generated information they thought was useful, what they felt was not helpful, and what other information they desired or felt was needed. They also addressed the regulations themselves as a source of information.

a. Written Documents

Written information EPA has provided to supplement the regulations, such as guidance documents and supportive materials, received overall good reviews. Numerous participants stated that both the Industrial and Municipal Permit Application Guidances were helpful.

The primary problem with much of the written guidance and information is that it is coming out too late to be useful. A number of participants indicated that a model general permit would have been helpful, but that they were at the point of writing their own, so for them it was too late. Often group members' suggestions for specific informational documents were accompanied by the caveat that it was needed now, e.g., permit writers guidance; Model Permits for MS4s; a BMP manual; Construction Activity Guidance.

Not everyone wants to receive new information at this point in the program. A number of participants said, "Don't do anything...We have a track· anything that would confuse that would be a problem. Even clarification. We have an idea for what we want to do and if guidance comes out now, it might conflict with what we want to do."

One person commented that EPA should prepare guidance documents so that they can be released concurrently with promulgation of the regulations. This would avoid not having them ready in a useful timeframe. A number of participants felt that EPA should be more willing to release information in draft form if the final document is going to be late. EPA should make preparing information for Phase II of the program a priority; the timeliness of delivery is a reflection of the program's credibility and of EPA's commitment to the program. It is clear that those who have gone forth without the support of written guidance are going to be highly resistant to any input by EPA that would require them to modify what has already been done.

Dissemination of EPA documents has been inconsistent. Regions vary in their thoroughness of distribution. One group member said, "...EPA needs to be better at getting this stuff to us. I often have somebody walk into the office with something that has been out for three months that I have not seen." This frustration was echoed in a number of the focus groups. EPA needs to publish a list of available documents which people can request either in writing or through the Hotline.

b. Verbal Communications

The Storm Water Hotline received mixed reviews from group members. The primary response was that it effectively addressed very basic questions, but that the program had advanced quickly to the point where more technical information was needed. Trust in the ability of those answering the phones to address complex issues was low. However, this is not an unusual response to Hotlines; often callers complain that information given is inadequate, inconsistent, or not appropriate to the situation of the caller.

Some focus group members stated they were pleased with the response they had gotten from the Hotline. Some indicated that they were relieved just to have someone to call for program information. Others felt it was a good way to confirm their "hunches". Overall, given the size of the program and the number of phone calls that have been received, the perception of the Hotline is relatively positive.

Some alternative roles were suggested for the Hotline. Members stated that it could be used as an information clearinghouse, having available a list of sources that callers could turn to for more technical information. One person suggested that operators have lists of experts in categories to whom they could refer callers for more information.

One frustration voiced was that reaching EPA staff people was a problem. This has created for some the perception that EPA headquarters staff are unapproachable. On the practical side, however, responding to all the phone calls they receive would tie up all available staff for the duration of the program; headquarters staff would do nothing but answer phone calls. Yet it is important to recognize that this problem influences people's perception of EPA's commitment to the program. Perhaps with EPA's attention to the more substantive items listed in this report, e.g., getting documentation out in a more timely manner and with more thorough dissemination, etc., this perception will self-correct.

c. Workshops and Presentations

All groups felt that workshops of national scope were no longer needed, because the issues being dealt with were now more technically specific to certain industries or areas. The consensus was that state and local workshops, providing industry-specific guidance and information on water pollution control, were most needed. Most felt that such workshops should be sponsored and planned by trade associations and other membership associations like APWA, WEF, ASIWPCA, etc. rather than EPA. They did feel that EPA should be a speaker at the programs, and be willing to help address the federal perspectives in response to local concerns.

A main concern of group members, from coast to coast, is reaching those industries who are covered by the regulations; many businesses covered under the regulations do not know that they must apply for a permit. Trade associations were recommended as one of the best ways to get to the harder-to-reach permittees (usually referred to as "Mom-and-Pops"), but even they are limited to those businesses who are members. Group members mentioned other avenues through which they have tried to reach these businesses, such as direct mailings to municipalities and working through Chambers of Commerce. None have been completely effective. Most members said that this was not solely EPA's responsibility, but also one of states, local governments and trade associations as well. EPA could support this effort by suggesting methods for reaching these businesses, and contacts at the national level that could be helpful, e.g., Small Business Administration.

d. The Regulations as Information

The Federal Register notice of the regulations was considered by participants to be a key source of information about the program. Numerous comments were made about its inability to convey needed information clearly and concisely. Length, layout, language and accessibility were identified as deterrents for many "laypeople" to comprehend them.

One member said the length was approximately 127 pages too long; he felt it should have been three pages, with a focus on what the regulations will do to reduce water pollution. Many felt that the regulations were not user-friendly because of the language used, which they referred to as "legalese". One person remarked, "What is needed is an English version of the regs!" The citations were claimed to be confusing, and some felt substantive requirements were "buried" in the wrong section, e.g., important permitted industrial activities were in the Definitions section, and municipal requirements were scattered throughout rather than placed in a "Municipals" section. Another noted that the three-column format was difficult to read for most not used to the Federal Register format.

Many noted that the Federal Register is a publication that may be picked up by some large businesses, but would rarely find its way into the smaller ones. Given the widespread impact of the regulations, there is valid concern that EPA views the Federal Register as a primary method to "get the word out." They felt this was not a good assumption, since circulation of the Federal Register is very limited, leaving the vast majority of those industries covered by the regulations unaware that they are affected.

There is need for a more clearly stated version of the storm water regulations. Trade associations have done a great deal to try to reduce the regulations to laymen's terms for their members. But when supplemental guidance documents, which are more reader-friendly than the regulations, are not quickly forthcoming and the regulations provide the only source of information. confusion is inevitable.

5. **The regulations lack clarity on a number of key aspects. State authorities need EPA to either clarify these points of the regulations, or they need EPA to allow them the latitude to make the interpretations themselves.**

During each focus group, members discussed many particular points of the regulations that they had found unclear. These varied from group to group. depending on the perspectives represented. As one would guess, points that to a municipal person lacked clarity were often different than issues of concern to an industrial representative. For example, industrial representatives spoke of confusion with deadlines as a result of the Surface Transportation Act amendments. how to pick the appropriate permit to apply for, and how industries connected to municipal sewer systems should deal with the regulations. Municipal representatives, on the other hand, mentioned specific sampling and field screening methods, the definition of Maximum Extent Practicable, what to do about application sampling requirements in the face of drought conditions, and how to classify industrial parks as issues that lacked clarity. Further, participants felt there were some aspects where there was room for interpretation. Important to them was knowing where they would have latitude to make interpretations.

Presented here are the areas commonly identified as in need of clarification by EPA.

a. Who is covered under the industrial SIC codes:

Every group questioned EPA's use of the Standard Industrial Classification codes to determine which industries should be included under the regulations. The consensus was that these codes, which are economic indicators, are inappropriate for regulations that deal with environmental issues. Their use has caused a great deal of confusion as various industries try to apply them to their "primary" activities. Businesses don't know how to use them to determine if they are included under the regulations - and regulatory agencies are very reluctant to make that call for them given the "downside" of either decision. Group members indicated that the Transportation category (#8) and the category of Exposure (#11) were the most problematic and inconsistent.

One state representative said that trying to get businesses past this first decision point had consumed most of the manpower in their office. They were receiving 80-90 phone calls a day just on that question; they had to hire a "temp" to respond to these phone calls and refer callers either to an EPA field office or a consultant. Another group member said that they did one informational mailing to businesses in their county, and were flooded with 7,000 phone calls; they did not know how to respond to callers, so they ended up hiring a consultant to handle the questions.

One comment from a member in the Phoenix group accurately represents the feeling expressed across focus groups: "It is virtually impossible to determine who needs a permit...You are not looking at the runoff quality with the SIC codes. I do not know of an existing code that looks at runoff, and that ought to be the basis of the code (used for these regulations)."

EPA needs to clarify how these codes are to be used. As one member stated, "OMB decided to use the SIC codes for other than they were intended. EPA (therefore) must define how to use it; this needs research and an environmental interpretation done." EPA also needs to be explicit about states' liability if their interpretations of coverage are different from what EPA's would have been. One group member suggested that EPA put together a brief (1-2 page) guidance summary to help industries decide whether they are covered, and also to develop descriptive categories of industries covered. EPA needs to define the minimum criteria for coverage to help regulatory agencies and industries determine their status, and then give latitude to states to use Best Professional Judgment when making decisions to include or exclude a given industry.

b. Exposure:

The category of "exposure" was cited by all groups as one of the two most difficult to determine. Members requested that EPA allow regulatory agencies to use Best Professional Judgment in determining which industries should be covered. Examples were mentioned, included the artist doing metal sculptures (all his activities took place indoors), and the farmer trucking potatoes to the potato chip factory (he was advised to cover his load with a tarp). As one member stated, decisions on whether an industry falls under the exposure category need to be determined on a case-by-case basis, and may require a site visit for a final decision to be made. Members did feel this category was "good" because it is the only one that is risk-based, yet "bad" primarily because exposure is "fuzzy".

EPA needs to allow states to develop their own definition and criteria for exposure, reach agreement with them, and be comfortable with the possibility that states may be different. The enormous number of covered industries under the category would otherwise exhaust EPA's resources to deal with it.

c. **The group application process**:

Focus group members feel that the group application process has created significant confusion among permittees; there is no such thing as a group permit, yet there are large numbers of industries that participated in a group application still under the impression that they will be covered by a group permit. As a number of participants stated, "(those who applied for one) think group applications mean group permits. And that is not the case."

One industrial member voiced their frustration: "Industry feels that the group application was misrepresented. (We thought,) this looks good; we can band together, demonstrate our likeness, devise sampling techniques, and regulate accordingly. Then we heard that you don't get a group permit; you get sent to the next tier down - the state. And the state then decides what you get... This has discouraged us from being proactive, forward thinking, because the rules keep changing in mid-stream."

Some members thought the group application was a useful process. One stated, "The group application process will get the best information at the least cost. It is the best research process because you can control it. For example, the textile industry: consultants will get together with them to determine how sampling and BMPs will be done. It provides a source of comparison within industry."

EPA needs to let participating industries know what the process is about, what the next steps will be for them after application review, and where there will be extended timeframes for them to submit a NOI under a general permit or an individual permit application.

6. **EPA needs to consider consolidating programs in order to address water pollution in an efficient and cost-effective manner.**

All groups suggested that EPA look at consolidating the different water programs for greater cost-efficiency and effectiveness. Rather than looking at it by different water source, e.g., storm water, wastewater, wetlands, etc., limited federal resources could be applied on a prioritized basis by watershed. Group members felt that this approach would eliminate redundant efforts across programs, allow dollars to be spent by risk priority rather than through separate program allocation, and have a more profound effect on reducing water pollution.

The perception is that present programs are more interested in "bean counting"; that is, keeping their present funding levels at the expense of the environment. One group member said, "Avoid bean counting...Transfer the funds to where it makes sense. Some water bodies have five different funding streams. (EPA) should look at one water body, and look at point and non-point factors. See if we can pull the program together to yield an environmentally efficient program that brings all this together. This would form a prototype of pollution elimination by integration of programs." Another suggested the development of a "water pollution block grant."

In no group was there a concrete discussion on how EPA would accomplish this at a federal level, although many thought that a start would be to get people from each of the programs to "sit down together in the same room" to discuss ways of working together toward the same goals. State representatives were aware of program separation at their level, and cited the different funding streams - with some programs having far more than others - available for each one. It is clear that most would like to see a strategy in place that allows monies to be allocated based upon watershed priority. This ability to be able to shift funds between programs many felt would have eased the financial burden of getting their storm water programs up and running.

7. **EPA should continue to focus on general permits in order to get the program implemented as efficiently as possible.**

One of the most-mentioned ways of reducing regulatory burden was the use of general permits to cover as many industries as possible. Many state participants voiced frustration at EPA's slowness in getting a model general permit out, and some remarked on their slowness in reviewing state applications for general permit authority. One indicated that it had taken their state nine months for approval. Yet groups were unanimous that general permits are an excellent way to streamline the program.

Participants felt that states should **want** permit authority; as one member put it, "...they should want control over their own destiny." States that have not applied for general permit authority, such as New York, are seen by permit applicants as unhelpful. One voiced frustration that his state DEC office could not provide assistance when he needed it, because the state had chosen to "ignore" the regulations; he has looked to the regional EPA office for assistance, even though he was not sure that was the "right" route for him to go. Another state representative said that her state wants authority because "they could then issue more permits, cover more people. It's revenue-producing, and the dollars would come into (our) department."

Many participants predicted that states without general permit authority will be overwhelmed by the number of individual permits. They felt that EPA, as well as state and national trade associations, should make states aware of the consequences of not having general permit authority. One suggestion often heard was to get trade associations involved in lobbying state legislatures to put pressure on their state government. Some members recommended that EPA also put pressure on states to apply for permit authority by using a carrot-stick approach: assist them to apply, but withhold program monies from non-delegated states. Others suggested that the carrot be dollars, such as the 106 monies, used as an incentive. Participants felt that getting most industries into the program under a general permit umbrella would establish a baseline for the program so that a tiered approach could be used to identify and deal with pollutant sources.

It was evident from comments that some state representatives would like to see a model general permit. They are looking for guidance in developing their own, and models--either EPA-generated or state-generated--would obviously assist states in drafting their own. Critical to this effort is that this assistance be made available as quickly as possible.

There is a common thread across these seven issues. That thread is the need for more and clearer communication, from use of terminology and language more familiar to the "layperson", to explicit guidance on fund raising approaches to support program implementation.

In many organizations, "improved communication" is cited as a sought-after end, but it is often set forth without identification of the means by which to achieve it. With this project, EPA addressed the means by asking the "experts"--those people at the regional, state and local levels who have to ensure that the regulations are implemented--where communication has faltered and what is needed to address the problem. It will be the continued involvement of these people in working on solutions that will ensure successful achievement of the end.

PART II: DESIGNING PHASE II OF THE STORM WATER PROGRAM

The second part of The Rensselaerville Institute project was conducted during April-September 1992. It consisted of three distinct efforts: a survey of point source and nonpoint source program experts to gain their insights on the development of a strategy for Phase II of the storm water program; three public meetings to gain citizen advice on key elements that should be considered for the Phase II program; and facilitation of a "design team" effort with selected experts to generate a detailed strategy to guide EPA in planning and implementing Phase II of the storm water program.

For each effort, the focus was on three elements: **targeting** (which sources shall be included and by what categories); **control** (e.g., should permits be used or another strategy developed); and **timetable** (with what schedule and over what period of time should Phase II be implemented, particularly with regard to the October 1, 1992 deadline established in the Clean Water Act amendment).

This report profiles project activities, then summarizes the findings from each of them. The reader is referred to the supporting documentation in Volume II of this report for the database compiled during this project, including analysis and comments from the Expert Survey.

Expert Survey

Part II of the project began with survey input from a select group of 32 storm water experts from throughout the country. Five perspectives were represented: academic/research; commercial development; consultant engineering/legal; environmental advocacy; and state/local government. A Delphi-type survey approach was used to obtain initial opinion and consensus on relevant issues and options for addressing Phase II sources.

Two survey rounds were conducted with point source program experts. The instruments presented respondents with a series of potential targeting and control strategies along with timing options. Survey participants were asked to identify the strengths and weaknesses as well as steps and resources needed to implement each option and were also given the chance to suggest an alternative strategy to the ones presented.

Five nonpoint program experts received one survey designed to capture more specific information on voluntary approaches for achieving program success. They were asked to provide the same level of detail for their preferred strategy as point source experts. Please see Volume II of this report for survey transcripts and analyses.

Survey Findings

Respondents were asked to identify, from a list of 18 potential sources, which sources they felt to be the top five that "must be" regulated in Phase II. In descending order with frequency of response in parentheses, the sources identified were:

1. "Some industrial activities not covered under Phase I because of anomalies in the SIC codes." (24)

2. "Suburban areas of large metro areas outside city boundaries." (20)

3. "Some commercial activities with industrial components." (18)

4. "Large retail complexes." (15)

5. "State highway systems." (13)

The themes that characterized the designation of these sources as the top five included: 1) contribution to pollution load; 2) risk posed; 3) administrative efficiency of control; and 4) cost-effectiveness of control.

Respondents were presented with specific strategies for targeting and controlling Phase II storm water sources. They were asked to assign a level of desirability and feasibility to each. The scale used ranged from "1" (least desirable, least feasible) to "7" (most desirable, most feasible).

The three targeting strategies, and ratings and comments they received, are listed below.

Responses to Strategy I were spread across the scale; 39% of respondents felt it was "very desirable" and 36% rated it "not desirable". The same response pattern was given to feasibility: 21% rated it highly feasible while 29% rated it not feasible. That strategy was:

Strategy I: "Eliminate Phase II as a separate part of the storm water program and expand the current designation authority under Section 402 (p)(2)(e)."*

> *** 402(p)(2)(e): A discharge for which the Administrator or the State, as the case may be, determines that the storm water discharge contributes to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States.**

Some of the comments made by experts regarding this strategy included:

- "Gives the Administrator too much authority."
- "This approach provides the greatest flexibility and provides time so that we can learn from current programs."
- "Not feasible...unfortunately, the science is often not good enough to pinpoint culprits; the database...is weak; it is difficult to single out one of many candidate polluters."
- "Allows resources to be focused strictly on problem sources from the Phase II universe."
- "Arbitrary and capricious interpretation of intent of Congress."
- "Very desirable and feasible. It makes sense to target programs to areas that contribute to water quality standard violations and are significant contributors of pollutants."

Responses to Strategy I were the most mixed. While some saw it desirable because sources covered would be more selective and limited and therefore the program would require less resources and administration to implement, others did not support it because they were unsure what criteria would be used for targeting sources, and were concerned about the types of information used in decision-making as well as the experience of those making the decisions.

Most respondents felt that Strategy II would be costly, complex and unwieldy, and resemble Phase I in terms of its drain on resources and manpower. Some respondents felt it would expand the number of groups opposing storm water regulations.

Strategy II: "Cover all remaining point source storm water discharges under existing Phase I requirements."

This strategy received a mean rating for desirability of 2.25 and a mean rating of feasibility of 2.43.

Some of the comments regarding this strategy included:

- "Inadequate resources would pose a major implementation problem."
- "Ill advised and will be increasingly costly. There is no need to promulgate new regulations that we know will not be enforced."
- "Would be an administrative nightmare."
- "Too broad with respect to potential benefits."

Strategy III was seen by a majority of respondents to be the most equitable and rational of the three choices, as well as the most scientifically based. Concern that political pressures might sway the development of targeting criteria was expressed by some respondents. That strategy is:

Strategy III: "Apply Phase II controls selectively (e.g. on the basis of such factors as population density, pollutant loadings, or geographic targeting, or others you find to be appropriate)."

This strategy received a mean rating for desirability of 4.64 and a mean rating of feasibility of 3.75. It was rated the most desirable and feasible of the three suggested strategies.

Some expert comments on this strategy were:

- "Best of all worlds - reasonably objective."
- "Strategy III is the most desirable of the three strategies because it maximizes efficiency, effectiveness, and the flexibility to address water pollution problems based on site-specific factors, especially risk."
- "Sound on a technical basis, but probably requires too many resources, particularly information needed to do intelligent targeting."

- "Desirable - this focuses scarce resources on likely and easily identifiable problem areas. Feasible - the factors (e.g. population density) are easily identifiable."

In the second round of surveys, respondents were asked to recommend a fourth strategy if they did not support one of the three suggested by EPA. Most frequently mentioned was a strategy that was **a combination of Strategies I and III.**

Four control strategies were presented to respondents for similar ratings of desirability and feasibility. These strategies were:

1. **"Mandatory reliance on general permits."**

2. **"Direct regulation under a national Phase II guideline, which may well require a national rulemaking by EPA."**

3. **"Requiring direct regulation of Phase II municipalities under 100,000 and requiring them to develop necessary controls for priority sources discharging into the municipal storm water system."**

4. **"Control under the nonpoint source program authorized under Section 319 of the Clean Water Act."**

Desirability ratings for the first three strategies were approximately the same: respondents felt that they were "somewhat" desirable. The fourth strategy was rated as slightly less desirable. The greatest feasibility was assigned to Strategy 1. The least feasible strategy, in the respondents' opinions, was Strategy 4.

In the second survey round, respondents were asked to describe implementation of their preferred strategy. When asked what minimum control strategies they would use, the following methods were mentioned:

- a menu or roster of BMPs from which could be selected the most appropriate approaches for the industry or watershed;

- public education;

- erosion and sediment control methods;

- "good housekeeping" and source reduction/elimination methods;

- establishment of national minimum standards;

- elimination of illicit connections;

- emphasis on pollution prevention.

Few respondents saw the implementation of Phase II to be a short-term process. Most suggested a phase-in approach over a period of five to ten years. During this time, BMPs could be tested for effectiveness and cost-benefit in terms of reducing and eliminating storm water pollutant problems, and programs could establish solid components of education, training and technical assistance.

Nonpoint Source Perspectives

Nonpoint program experts also favored Strategy III: "Apply Phase II controls selectively..." for targeting Phase II sources, with a mean rating of 4.0 on Desirability. The ratings ranged, however, from "1" (not desirable) to "6" (very desirable). Some of the comments included:

- "Is inequitable. Establishes economic hardships for those required to participate. Only strength is less administrative burden."
- "Would be easy to identify sources that fall under criteria. Could be preventive since you are not waiting for a problem to happen."
- "Excellent in theory, but would require a lot of data for prioritization, and would create confusion for some period of time."

The survey instrument used for nonpoint program experts was a modified version of the point source expert survey that included a fourth EPA-suggestedtargeting strategy for consideration. It was:

Strategy IV: "Target and address problems and significant storm water sources and pollutant loadings by using Section 319 and CZARA programs."

Respondents' mean ratings of the strategy were 3.2 for desirability and 2.8 for feasibility. Comments included:

- "These programs lack real regulatory teeth. CZARA 6217 applies only to coastal regions. They just aren't aggressive enough."
- "Section 319 is broader than NPDES and has more technical experience with BMPs. CZARA 6217 results in specification by EPA of management measures, in effect setting standards and providing impetus to explore alternatives."
- "Since only limited 319 funds are available, it would be difficult to get much done."

- "This is an important piece of a multifaceted approach, but not adequate alone."

Respondents were given the same control strategies for consideration as the point source program experts. Of the four, #3: "Requiring direct regulation of Phase II municipalities under 100,000..." was most favored, with a mean rating of 5.2 for desirability and 3.8 for feasibility. This control strategy was the only one to receive ratings higher than "5" for either desirability or feasibility.

The majority of respondents were opposed to extending the October 1, 1992 deadline. The reasons given included:

- "The longer we wait to address the problem, the more costly, less technically capable and less environmentally effective the solution will be. There are more opportunities today, especially in less populated areas, than tomorrow to solve and prevent problems."

- "Storm water-related use impairment is a serious problem. Currently, there is little being done to remediate existing problems and no assurance that problems related to new development will be prevented. It is clear that the voluntary approach is not adequate."

- "Things aren't getting better. Forum and impetus are already in place - capitalize on it."

Many of the recommendations made by point source program experts for targeting and controlling storm water sources were echoed by nonpoint survey respondents. Some of the targeting similarities include:

- selection of Strategy III: "Apply Phase II controls selectively..." as the most desirable of EPA-suggested strategies. The most mentioned reasons for preference were ease of identifying targeted sources, and the more efficient use of resources;

- target by watershed impairment/threat severity;

- conduct pilot projects first, evaluate, and then develop and implement a strategy;

- develop minimum national guidelines, and leave selection of sites and methods to state discretion;

- initiate a focused dialogue with key stakeholders (for both targeting and controls).

Some of the similarities in preferred control strategies included:

- build a BMP menu that can be used to implement and verify progress; allow selection of most appropriate BMPs based on industry and watershed;
- provide public education on need for storm water control;
- provide national criteria with flexibility for local implementation of most appropriate controls;
- develop baseline control standards for all new development.

One primary difference between point and nonpoint respondents was the application of the "stick" by EPA, with the "stick" being the requirement of permits for those sources that did not achieve significant movement toward program goals via voluntary efforts within a reasonable timeframe. As one nonpoint respondent phrased it, EPA should keep permit requirements as the "gorilla in the closet" to be used as needed when voluntary efforts were not adequate for the problem.

A number of nonpoint respondents indicated that the 319 and CZARA 6217 programs do not have the "teeth" they need to ensure compliance. Most feel that a combination of programs is needed for successful achievement of water quality goals.

EPA STORM WATER PUBLIC MEETINGS

Description of the Meeting Format:

Three public meetings were conducted to gain citizen suggestions on options for targeting and controlling Phase II sources. These meetings were held in Denver, CO; San Francisco, CA; and Washington, DC. Approximately 200 people attended the three meetings.

At each meeting, three experts selected from the survey process presented their ideas on a regulating strategy for the moratorium sources. Following their presentations, attendees were divided into small task teams with an assigned facilitator, and given the charge of devising their own strategies for targeting and controlling Phase II sources. The strategy template provided to guide group consideration of key issues is presented below. During the latter half of the meeting, each task team presented their option to the other attendees for discussion.

Teams were asked to consider these issues:

1. Targeting (What light industrial, commercial, retail, residential, or other areas or other areas do you include in Phase II?)

2. Control (Do you use continued reliance on the existing NPDES permitting process or something else such as nonpoint source programs, selected permitting based on risk, geographic targeting, etc.?)

3. Timetable (How would you phase in the major components of the strategy and over what timeframe? Do you suggest full implementation on October 1, 1992 [as stated in CWA] or do you recommend a different set of deadlines and why?)

4. Key steps to implement (Please indicate up to five critical, major steps to take in implementing your strategy and the timetable for each.)

5. How will costs of your strategy be distributed over key players and how will costs be understood and controlled?

6. What measures of performance will you use and how will you verify the environmental results? (Do you rely on numerical measures and quantitative pollution indices or other factors?)

7. Strategy Strengths (Name four key strengths of your strategy which, in your judgement, make it preferable over alternative strategies.)

8. Strategy Vulnerabilities (Name four most critical points at which your strategy is most vulnerable to failure or shortfall in implementation.)

9. For whatever strategy is chosen, what could EPA do to make the decision-making process for Phase II more responsive?

Meeting Findings:

A total of sixteen task teams presented their strategies for Phase II of the storm water program. The individual task team strategy outlines offered a diversity of approaches for designing, implementing, monitoring, and funding Phase II of the storm water program. Individual strategies presented a large range of methods for targeting and controlling sources, and many different timeframes over which the program could be phased in.

Despite the different representations, experiences and expertise, there were points of congruence between many of the proposed strategies. Common strategy characteristics across task teams included the following:

1. **Targeting:**

   a. Targeting should be done by watershed. Information gathered from Phase I should help identify sensitive watersheds. May require intergovernmental agreements.

   b. The focus should be on "bad actors", i.e. those that are known problem sources. The ones most frequently identified were: gas/auto service industries, transportation, highway systems, land development and agricultural sources. There needs to be the ability for facilities not contributing impairment of water to gain an exemption from permits, fees, implementation of BMPs. Categories are an ineffective way to designate covered sources. Selection should be done by the degree of risk a given facility poses rather than categorical inclusion.

   c. Small municipalities should have a much simpler application process, or have the opportunity to be excluded if they do not contribute to the pollution problem. In addition to impact on a watershed, proximity to larger municipalities should be considered as well.

   d. EPA should defer on selecting targeted sources until the agency has carefully looked at the data gathered during Phase I. Numerous sources of information are available which would help determine targeting priorities, e.g. information gathered through 305b reports, information from Phase I program sources, NURP.

2. **Controls:**

   a. If a permitting process is to be continued for point sources, NPDES general permits should be used, and focus should be on BMPs. Permits should be simpler, and much less costly. EPA should make clearer to the applicant what information is required, e.g. checklist of inclusions, menu of BMPs. Exemptions should be available for non-contributors.

   b. Education should be a primary form of control. It is important at all levels and for all audiences, yet is often overlooked or underrated.

   c. There should be more emphasis on voluntary programs, e.g. the "319" nonpoint source program. For facilities with contact with storm water, there should be little or no more government intervention, but rather emphasis on pollution prevention incentives, BMPs, and practical measures of pollution prevention.

      Pollution prevention programs should be emphasized, particularly with new development. Some suggested prevention methods include: recycling storm water, good housekeeping practices, plantings to minimize runoff, street sweeping of work areas on a daily basis, storm water collection methods, coverage of storage areas, changing manufacturing processes to minimize pollutants, improvement of air emissions.

d. BMPs should be required based upon the specific pollutant problem and strategies known to be effective in its mitigation or elimination. The focus must be a known connection between solution and its effect on the problem. BMPs must also recognize financial constraints, providing actions that are relatively higher in terms of cost-effectiveness.

3. Timetable:

a. A minimum of two years is needed to prepare for Phase II, with at least a year dedicated to looking at data gained from Phase I of the storm water program. Effectiveness of presently used BMPs needs to be looked at to determine differences in effectiveness between geographic locations and pollutants.

b. Whatever the period established for phase-in, it should not begin until promulgation of the regulations.

4. Role of EPA Headquarters.

a. Research, information dissemination, technical assistance.
EPA should also provide focus within these areas. Also, the current efforts are too diffuse, and imply a complexity that makes applications seem difficult and formidable.

b. Funding, not for program implementation, but for research.
Two areas of research requested are water basin pollution control and determination of effectiveness of BMPs. The majority of participants recognize that EPA does not have the fiscal resources to fund programs. What they do want from EPA is guidance in establishing fund raising mechanisms, such as storm water utilities.

c. Establishing broad guidelines for the program within which local flexibility is allowed and encouraged.
Flexibility, at the same time, does not provide an excuse for inaction or postponement. Rather, it recognizes that different actions and action sequences are appropriate to different contexts and conditions.

d. Responsibility for training regulators in the storm water program.

Until those administering the program are well equipped to enable action, effective responses will be difficult.

Please see Volume II of this report for copies of the individual strategies developed at each of the public meetings.

Reflections on Meeting Format

A presumption shared by EPA and the contractor, The Rensselaerville Institute, was that the conventional format for public hearings and meetings is of limited value in engaging citizens or of making the critical transition from criticism to advice on how best to do things. Given this belief, a different format was devised that proved quite different from the typical approach of lectures by experts and/or testimonies read to the record by concerned citizens.

In the interactive approach used, participants were advised that they would be asked to form into task teams to first listen to experts offer their insights, then to develop, as a team, a preferred strategy for responding to Phase II of the storm water program. Each team comprised a cross-section of those attending--including where there are possible strong environmental, industrial, and local government perspectives.

In all three meetings, participants accepted the format and energetically engaged in the task of constructing a preferred solution. This included the session held in Washington, D.C. where participants from major interest groups were in the habit of providing critical feedback and criticism more than engaging in a positive design process.

To gauge participant responses to the different public meeting format, a mail-back questionnaire was used inviting comments by the some two hundred participants in the three public meetings. Approximately 35% of those attending completed the survey. They were first asked to comment on their assessment of the more traditional public hearing format. Most held a clear and consistent view of the traditional approach as focusing primarily on prepared statements. Where dialogue was included, it was seen as argumentative and contentious. The general conclusions:

- opinions are solicited for the record and to insure the perception of public participation but not to provide genuine input. The sense is not of active government listening.
- primary participants are those with strong convictions and often special interests; they are not a representative sampling of public opinion and tend to run the gamut of extreme perspectives on a given issue.
- sessions tend to become adversarial or at best argumentative. No mechanism for cooperation is available and differences tend to get

magnified, not resolved.

- the focus is on the problem much more than on ideas for resolving it. On the one hand this attracts critics more than implementors. On the other, it provides little guidance to people who full well know the problem and are looking for ways to deal with it.

Participants were much more positive about the format used. Among the sentiments voiced:

1. Participants had a full chance to participate--not only to be heard but to be directly engaged in finding solutions.

   "It was a valuable way to address the drafting of regulations--allowing the regulated community to feel part of the process";

   "Encouraged the regulated community to get involved and feel involved";

   "Participants felt that EPA was actually listening and dialoguing."

2. The process was genuinely two-way, allowing both EPA staff and those effected to better understand each other.

   "It made you appreciate the USEPA's tough job of satisfying the concerns of many people while protecting the environment";

   "Felt it draws out better data";

   "Actually got to interact one on one with industry and government and consultant representatives. Obtained a better point of view of government's problems and felt that government representatives also obtained a better point of view of industry's problems."

3. The format created an atmosphere for cooperation and even for collaboration among people with very different viewpoints.

   "The meeting went a long way towards promoting the creative thinking, open discussion, and presentation of ideas";

   "Group discussion is a fine vehicle to provide input as well as learning tool. It forces you to think through participation, rather than just simply sitting and trying to absorb by osmosis.";

"Small diverse groups allowed ideas to be evaluated fairly and fostered "brainstorming" and allowed ideas to be developed to better fit broad based objectives."

The positive elements of the meeting extended beyond the effective communication of opinion and position to EPA to broader understandings of issues, complexities, and solutions. Indeed, the sessions seemed as influential in creating new insights as in communicating old ones.

Respondents suggested two primary ways to improve the format for future uses. The first is the need for more detailed advance preparation--in part, needed to change the mind-set and expectations which people tend to have for a traditional public hearing or meeting. The second suggestion: minimize expert presentations, even when used in the "pump-priming" mode employed in this session. Trust the process and get right to the participants.

When asked if they would advise the EPA to use this kind of interactive task-focussed approach with other meetings designed to get public input, over 90% said "Yes." Two persons indicated that it depends on the issue and only two indicated that they preferred to remain more passive.

THE "DESIGN TEAM" MEETING

Meeting Description:

A meeting of seven point and non-point storm water program experts, all of whom were survey respondents, and selected EPA staff was convened in Washington, D.C. on September 17-18, 1992. The purpose was to gain the experts' insights on development of Phase II storm water regulations, and the intended outcome was to build a strategy, or multiple strategies, for regulating Phase II sources.

Participants included:

Mr. Gail Boyd
Woodward-Clyde Consultants, Portland, Oregon

Ms. Diane Cameron
Natural Resources Defense Council, Washington, D.C.

Mr. Dennis Dreher
Northeastern Illinois Planning Commission

Mr. Tom Mumley
San Francisco Bay Regional Water Quality Control Board

Mr. Earl Shaver
State of Delaware Department of Natural Resources and Environmental Control

Ms. Coleen Sullins
State of North Carolina Division of Environmental Management

The participants selected were deemed, by their peers nationwide and EPA, insightful and highly articulate exponents of all major viewpoints on the storm water program.

Also in attendance were these key people from U.S. EPA:

Mr. Michael Cook, Director
U.S. EPA, Office of Wastewater Enforcement and Compliance

Mr. Geoffrey Grubbs, Director
Assessment and Watershed Protection Div.
U.S. EPA, Office of Wetlands, Oceans and Watersheds

Mr. James Horne, Special Assistant to the Director
U.S. EPA, Office of Wastewater Enforcement and Compliance

Mr. Ephraim King, Chief
NPDES Program Branch, Permits Div.
U.S. EPA, Office of Wastewater Enforcement and Compliance

Mr. Jack Lehman, Deputy Director
U.S. EPA, Office of Wastewater Enforcement and Compliance

Session Findings:

1. Development of a ten-point outline describing a potential strategy for Phase II of the storm water program.

Consistent with the overall purpose of the meeting, participants identified ten core elements that they feel constitute a potential strategy for Phase II of the storm water program. These elements are:

A. Objective: To get certain BMPs, ordinances and education programs into place over a 10-15 year period. Progress would be measured by getting these elements into place, with direction toward water quality standards and beneficial uses over a longer period of time. EPA would work with all states to help them develop Phase II programs.

B. Priorities: EPA would set these. They would include: the sources listed by the group, using a watershed approach where feasible, focusing first on those local governments with the size and capability to get going.

C. Education/outreach/technical assistance: these are all critical components of a successful program.

E. Mandatory Interim Milestones: EPA needs to determine interim milestones state programs need to meet which would show they are on track.

F. Financial Plan: states/local governments need to develop plans for financing the program.

G. Guidance: guidance is needed on BMPs and local ordinances. These would be generated at the federal level, and states could adapt/modify as needed.

H. "Default" system: local governments would take the lead with their programs, but there would be a built-in default system where the states or EPA would take over with more stringent controls if the locals fail to meet requirements.

I. Permit issuance: for high priority categories, could issue permits that allow flexibility or some alternative mechanism at state's option. Permits might be just for high priority categories; would include site design performance standards.

J. Phasing: there would be a schedule for issuing permits to key municipalities: high priority to low (e.g. coordinate by watershed); high flexibility to "getting tough" with recalcitrant localities. These would be based on inspections, on-site reviews.

K. Monitoring: this would be the difficult part of the program because of cost. Need is to be able to design something useful. The system might be "tiered" - highest to lowest priority; or "strategic" - focused only on gathering what we really need to know.

2. Sources to be targeted in Phase II.

The participants identified a number of specific unregulated pollutant sources that need to be targeted in Phase II of the storm water program. An approach recommended by some of the participants for controlling these sources is a "whole basin approach", which would focus attention and resources on activities impacting the water quality of a given watershed.

The group identified approximately 40 pollutant sources that they believe need to be included in Phase II of the storm water program. The sources identified include the following:

New Development/Redevelopment (commercial and residential)
Transportation Corridors
Dense Existing Development (commercial and residential)
Automotive Services
Federal facilities/military facilities
Feedlots (including dairy)
Failing septic systems
All incorporated places with less than 100,000
Non-urbanized watersheds yet to be determined
Parts of watersheds where land use is in a state of flux
Dry cleaning shops
Parking lots
Some forest operations
Nurseries/orchards
Recreational areas (e.g., stadiums, golf courses)
Landfills
Office parks
Grain elevators
Concrete cutting sites
Commercial pesticides
Landscaping industry
Car washes
Mobile washing units
Equipment maintenance
Boat yards
Tank farms
Shopping malls
Restaurants
Airports
Janitorial services
On-site solid waste (collection, hauling, transfer stations)
Atmospheric deposition
Cemeteries
Commercial strips
Wood stoves
Marine ports
Animal waste
Warehouses/storage facilities
Exterior building maintenance
Bridge maintenance

Members of the group suggested that rather than use the Phase I approach of including sources by category into the regulations, regulatory staff time and resources should be allocated on a water basin approach, i.e., target a watershed, identify impacting activities and their location within the watershed, and determine a set of criteria to deal with the problems impairing the watershed. This would allow limited resources to have maximum impact.

3. Source priorities.

After listing the range of sources that they felt should be included in the Phase II program, participants voted for what they considered to be the top priority sources, i.e. those sources that EPA should address immediately and diligently. The top sources selected are listed below, in order of decreasing number of votes received. All sources were selected by at least 50% of the participants. The sources identified as top priority for addressing in this order:

A. New Development/Redevelopment (commercial and residential)

B. Transportation Corridors

C. Dense Existing Development (commercial and residential)

D. Automotive Services

E. Federal facilities/military facilities

F. Feedlots (including dairy)

G. Failing septic systems

4. Lessons from a case study.

One participant presented an outline of the basic components of the Puget Sound Water Quality Management program. The program is a multifaceted approach toward the achievement of improved water quality which heavily emphasizes voluntary measures in its implementation strategy.

The program includes minimum BMP standards for all jurisdictions with additional water quality treatment BMPs, guidance and requirements for higher risk storm water dischargers. Key facets include: vigorous technical assistance, education, state financial support, education and support for storm water utility development, highway runoff regulations, a full nonpoint watershed management program, storm water operation and maintenance requirements, source controls, and local control and flexibility.

The program is being phased in over several years. It is a combination of mandatory requirements, technical guidance and voluntary compliance. There are specialized focus areas, such as shellfish protection districts and conservation districts. There is a coordination effort with individual and general permittees in the Puget Sound area.

The program views its strengths to be greater local flexibility and acceptance of requirements, a strong sense of teamwork between all levels, better water quality results, and better targeting and use of limited resources than if they were regulated by NPDES. They view the NPDES program as the "gorilla in the closet" that can be brought to bear if and when a source does not meet minimum standards and requirements.

5. Principles for Phase II.

Participants discussed the basic principles they believed should drive the Phase II program at the national level. For the program to be successful, it would require that the following pieces be put into place:

A. Require that people gather documentation of information regarding dischargers' activities and accomplishments and provide outsiders with that documentation;

B. Formally define gaps where additional information and understanding is needed. There needs to be an incentive to close these gaps;

C. Support (with encouragement and incentives) efforts that will close these gaps, and advance the state of the art and/or provide a technically sound basis for the programs' requirements;

D. Actively encourage a broad spectrum of understanding and involvement (the general public, community leaders, service groups, environmental groups) via educational programs and materials;

E. Strategically identify "good" guys and "bad" guys in the regulated community;

F. Provide clear guidance regarding programmatic and physical actions that are required/expected. Actively seek out evidence that people know <u>what</u> to do, and provide technical training to be sure that people know <u>how to do</u> what is required (technical transfer);

G. Require relevant/credible/useful monitoring only. Don't waste people's time/money/energy running data collection programs that yield bad or irrelevant data.

6. State suggestions of what EPA needs to consider in developing the Phase II program.

A sub-group of participants from state regulatory agencies met, and set forth a list of suggestions for EPA to consider in developing Phase II. The following recommendations were made:

A. EPA needs to provide states with the minimum program requirements they must achieve, and then allow states flexibility on how they will do it. The components must include:

- requirements/BMP standards for new development
- education/technical assistance
- control requirements for illicit connections/dumping
- developing state-specific priorities

B. EPA should require states to adopt regulations that specify program components that must be included;

C. To assure program funding, EPA needs to require that state and local governments set up funding mechanisms, e.g. storm water utilities, permit fees, etc.;

D. EPA needs to compile and disseminate technical information that would support programs, e.g. set up a national or regional clearinghouse of information on storm water plans being implemented, BMP-specific information and materials, etc.;

E. EPA needs to compile a national BMP manual that would assist members of the regulated community in determining and implementing appropriate BMPs to address their storm water problems. EPA needs to recognize, however, that BMP application will differ between regions, e.g. climatic differences will require different approaches;

F. EPA needs to require that states develop and implement education, technical assistance, and training programs; EPA also needs to hold the states responsible for effectiveness of these programs, and require permitting in the event that these measures do not work;

G. EPA needs to maintain the right to require permits in a reasonable amount of time (e.g. 2-3 years) if a state's program is not meeting federally determined requirements;

H. EPA needs to determine what short and long term goals they wish the storm water program to achieve.

7. Identification of problem areas and needs of the regulated community in dealing with the storm water program.

Participants were asked to identify what their "hot buttons" were, i.e. elements or considerations that EPA might include in the Phase II program which would cause major problems for them, or those which if not considered by EPA would create needs for the regulated community.

The list of "hot buttons" include the following:

A. Penalizing those who have already solved their problems by requiring permits.

B. Liability for water quality standards, sediment standards, and resource damage clean-up in the first round.

C. Failure to provide technical transfer - permittees need to know what to do and how to do it.

D. Failure to promulgate revised and simplified NPDES regulations that get around the complicated approval process.

E. Possible backlash from local governments if they are held responsible for instances of independent commercial activity that they cannot address or control when they don't know about it.

F. Lack of research on BMP effectiveness from a watershed perspective. There is inadequate federal/state money to look at BMPs because monitoring is so expensive.

G. Possibility of EPA not basing the program on permits (except in cases where the state can show that it can reach goals alternatively).

H. The inherent substantial risk of tremendous backlash that would affect people's livelihoods, i.e. failure to try to sell the program to regulators and public, including the NPDES permit process.

I. Prevention v. wetlands - determining how to prevent storm water problems while protecting wetlands.

J. Not addressing the roadblocks created by the regulations themselves. The system is so complicated, it now takes two generations for permits to get to goals.

K. Lack of federal monetary assistance. Some states may be reluctant to develop adequate programs without it.

L. Not getting rid of the acronyms in the regulatory language. No one understands what EPA is saying.

M. Concern that mainstream design is end-of-pipe treatment. This is not prevention! CZARA is on a better track.

N. Allowing states to cut monitoring activities first. They need to be encouraged to not eliminate that element disproportionately from their budget.

O. Need to figure out how to sell the program - to get through to OMB and top levels of state governments exactly what it is going to take to get the program into place.

P. Not identifying funding incentives and disincentives.

Q. Not giving praise for progress.

Additional Advice

Additional suggestions for development of the Phase II program were generated by the group during the two-day meeting. Included in those recommendations are the following:

1. **EPA needs to revisit and revise the terminology used in the regulations.**

   - the problems are often with the common words, e.g. runoff, storm water, nonpoint source, point source. EPA staff have attached certain meanings to words that are not conveyed to the regulated community, so there is inherent danger that people are not talking about the same thing. Words need to have clear and referenced meanings.

   - the enormous number of acronyms used by EPA creates significant comprehension problems for regulatees. The regulations need to be written with fewer acronyms, and all communications need to be sensitive to the level of use.

2. **EPA needs to clearly define the goals of the program.**

- all levels of feedback (focus group, survey, and meeting results) generated during The Rensselaerville Institute project have pointed out that the regulated community does not understand what EPA is trying to achieve with the storm water program. Assumption of what the goal is ranges from achievement of set water quality numerical limits to returning a water body to its original uses.

Confusion over the goals causes confusion for regulatees in terms of selecting the tools that need to be used to reach them. EPA needs to determine what the federal purpose is with regard to the storm water regulations given the reality of limitations of presently available methods and resources for preventing and treating storm water pollution.

3. **Citizen involvement can play an important role in achieving program goals. EPA, states and local governments need to promote citizen education and enforcement authority.**

Participants gave numerous examples of how citizens could play an active role in implementing and monitoring pollution reduction efforts. Given the limited resources of federal, state and local governments, voluntary citizen involvement can support successful program outcomes, including enforcement. Education of citizens at different levels, e.g. qualitative vs. quantitative monitoring, stream health vs. compliance monitoring, etc. would be needed. Guidance manuals can be developed to guide public education.

General Recommendations

The ten summary recommendations stated at the conclusion of the Executive Summary are here amplified to reflect the discussions and insights generated in this project. While not all persons involved agree with each observation and recommendation, these are advanced as having widespread support.

1. **It is possible and desirable to identify priority target areas for which there is widespread consensus concerning their contribution to water pollution.**

   These areas begin with new development and redevelopment--both residential and commercial. They also include transportation corridors, dense existing development and automotive services. Further, the priority of these target sources is relative to the watershed upon which they are impacting.

   Strategically, approaches that focus on a small number of priorities based on relative risk will show stronger results than one that initially targets a broad set of sources in Phase II. Also, it much more cost-effective to identify and pursue the "bad actors" (eg, those contributing toxicity as opposed to sediments or turbidity) as a priority, then get to those adding incremental pollution through routine activity.

2. **EPA needs to communicate more clearly and regularly with everyone impacted by the storm water regulations.**

The priority focus should be less on the amount of communication and more on different kinds of communication. Specifically, communications should be:

- more interactive--the examples of the focus groups and public meetings used in this project are often cited as productive formats for future citizen input;

- more localized to contexts--as in more regional workshops and fewer national ones. This means communications less inclined to reflect the national complexity of the program and more inclined toward addressing the specific information and guidance needs of the local person involved in a specific and delimited way. It also means less "canned" content and more consultative dialogue;

- less laden with acronyms and technical language that confuse and irritate many of the people who are the true "customers" of the program, and who are required to carry out the federal mandate. Along with this, more attention should be paid to finding and marketing simplicities rather than complexities.

3. **EPA could improve program effectiveness, efficiency and cost control in Phase II by "starting small".**

The concept of regional and even local prototypes was advanced by many people as a way of getting proposed new Phase II frameworks into the hands of users in prompt fashion to build and refine based on early use. This was generally seen as preferable to the comprehensive approach in which new programs are developed fully and then introduced comprehensively at a point when modification is difficult and expensive.

Related to prototypes is the case study--in which an analytical eye is turned to current programs that demonstrate one or more strategies or best practices for storm water implementation. An example is the Puget Sound model, with its focus on the tangible and cost-saving values of voluntary compliance by small businesses (a summary of this approach is contained in Volume 2).

The use of a small scale plays to the strength of regional differences as well as the reality that an equal stress on comprehensive large programs may so paralyze states and localities that nothing is done expeditiously.

4. **Selectivity in data collection and monitoring is essential.**

At present, some data collection frameworks consume tremendous time and money only to yield bad or useless data or murky or disputed conclusions. More attention should be paid as to what constitutes "good science" and activities that may show the appearance of effective activity but in reality be consuming scarce resources to no clear gain. This also relates to the adage, "what you measure is what you will get." While the tendency is to see monitoring and assessment as questions of methodology, they must first be viewed as questions of substance. What are we trying to measure and at what level of detail and accuracy?

Not all measuring and assessment need be arcane. In development projects, for example, the use of hay bales is known to contain overflows. No great study of cause or effect is needed. And if there is floating oil on a body of water, we can start by verifying that it is there--a useful step even if we do not "measure" its amount. At the same time, other kinds of assessment are meaningless without extensive (and expensive) levels of detail and analysis.

A related point is that documentation of discharger activity and accomplishment is as critical as scientific study of water conditions.

5. **More customer differentiation is also needed.**

At present the mind-set appears to be that one size fits all. While giving the appearance of equity, this concept actually creates strong inequalities. The same programs and regulations that befit a large corporation or municipality are simply not equitable for smaller enterprise and communities, for example. More broadly, some specific operations within a given source category contribute significant pollution; others contribute none. Some way to either make the initial process much less costly or to more quickly separate out those who do not need continuing attention must be found.

One form of general differentiation is between those who are causing a problem by clearly inappropriate activity (the "bad actors") and those contributing to storm water pollution by standard and at times inadvertent practice.

6. **While the ultimate goal is water quality standards, this is very difficult to achieve and/or to measure in the short term.**

While retaining water quality standards as the ultimate goal, EPA should be focusing on best management practices, and in particular those that reflect preventive and non-structural solutions. An example is stronger standards and technologies for storm water control in new residential and commercial construction. In many instances, the correlation is clear between the management practice and the consequences for cleaner water.

The codification and communication of best management practices applies not only to those targeted and controlled but to state and local actors implementing storm water programs. For example, a set of "carrots and sticks" known to promote voluntary compliance is just as critical to disseminate as a new approach to storm retention ponds in a sub-division.

While BMPs are set in place, interim milestones for water quality are also critical--and feasible--as a way of measuring progress. The transition from progress by practice to achievement by water quality measure must begin now.

7. **The most functional unit of both analysis and intervention is the watershed.** Most people in our samples for opinion and recommendation strongly suggested the watershed approach--not only on the macro level (e.g., Chesapeake Bay) but the micro-level as well. In particular, this means looking at stream quality issues beginning at the headwaters for early contributions and alterations. Most felt that functional differentiation of pollutant sources is not really meaningful in terms of either regulation or effective change at the watershed level.

8. **EPA's role is to offer technical support and direction more than program funding or even full guidelines for state and local implementation.** In particular, building useful data bases and collection methodologies not only on water quality but on practices to achieve it is critical. Also key are training and support programs and development of effective dissemination networks. In all EPA roles, the need is to recognize both regional differences and the need for a multi-faceted set of strategies, tools, approaches, solutions.

   Another EPA function is to focus on the connection between best management practices and long term consequences for water quality. While those who introduce them are in the best position to refine BMP's, they often do not have the tools to verify a correlation (let alone a causal connection) to water quality. This is an important EPA function.

9. **A collaborative approach to developing effective solutions is possible.** The interactive elements of this project are one reflection of the ability of those with strikingly different perspectives (ranging from strong environmental protection to a focus on economic development) to work cooperatively. If adversarial and polemical dynamics can be set aside, the gains are far greater.

   Collaboration must begin within EPA itself, where there is a tendency for those focussing on permits and "harder" tools of compliance and those focussing on education and "softer" elements of prevention to not fully connect with each other. In reality, there is a strong common theme from the need to see the storm water program as a way of enabling local communities and industries to change their behaviors to help the environment in ways that will directly benefit them as well as all other citizens.

10. **Agriculture activities should be included more directly in the storm water program.**

In many regions, agriculture (which includes livestock as well as crops) is a primary contributor to surface water pollution. While the present NPDES program requires permitting of the transport of agricultural products, this brings intervention too late. The critical first steps of agricultural activities, e.g. soil preparation, growing, and harvesting, must be included.

Beyond this reality is the signal sent that for whatever set of reasons, some interests are exempt from a program in which they clearly belong.

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R0015558

THE U.S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF WATER

EPA GROUP INVOLVEMENT PROJECT

CONDUCTED BY: THE RENSSELAERVILLE INSTITUTE

REPORT SUBMITTED: SEPTEMBER 14, 1993

R0015559

EPA GROUP INVOLVEMENT PROJECT

Introduction

In early 1993, The Rensselaerville Institute undertook a project designed to gain various groups' involvement in development of Phase II of the Storm Water program. Working with the U.S. EPA Office of Wastewater Enforcement and Compliance, The Institute implemented an approach whereby groups and people with interest in the Storm Water program became actively involved in identifying and discussing a series of program design options.

A series of meetings were held in Dallas, TX; Washington, DC; Chicago, IL; and Falls Church, VA. Approximately 150 people participated in the meetings.

This report describes project implementation and the method utilized, highlights the results of the project, and provides a set of recommendations for program development.

Project Implementation

One of the first steps of the project was to craft a number of options to describe how the Phase II program could be organized and implemented. At a Phase II Options Identification Meeting held in January 1993, 14 different options for target and control of Phase II storm water discharges were outlined. From the original 14, seven options were developed; each designated certain program responsibilities and authority between federal, state and local entities.

These seven options were used as the basis for focusing team work at each of the meetings. Briefly, the presented options were:

1. State Target Selection - Non-NPDES Control.

Phase II sources would be targeted by the states, using information from 305(b), 303(d) and 304(l) reports to target sources in watersheds where storm water is a significant source of impairment. Individual States would be able to select from a mix of controls to attain water quality standards. There would be no provision for Federal oversight of State control options.

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2. Eliminate Phase II; Expand Phase I Designation Authority.

This option would eliminate Phase II of the storm water program. NPDES permitting authorities would retain designation authority to target and control any high risk sources of concern under Phase I of the program. The remainder of Phase II sources would be prioritized and controlled by States through existing non-NPDES control strategies.

3. NPDES Permits for Federally Selected Municipalities Not Covered Under Phase I.

Under this option, EPA would target urbanized areas and emerging growth area portions of municipalities and counties. NPDES permits would be issued to selected municipalities/counties and would require the implementation of a storm water management program through which the municipality would control commercial/industrial/residential sources within their jurisdiction.

4. Tiered Federal and State Target Selection - Tiered NPDES and Non-NPDES Control.

The first tier of high risk sources would be selected on a national basis with this option. Potential targets would include categories of facilities or activities, and urbanized and associated developing area portions of municipalities and counties. Additional sources may be selected by individual States based on information available to the State, including watershed data generated through 305(b) reports as well as 303(d) and 304(l) information. First tier high risk sources would be controlled through NPDES permits (State/EPA). Second tier sources would be controlled through a range of control measures under State discretion.

5. Federal Target Selection - Non-NPDES Control.

With this option, high risk sources would be Federally selected. Potential targets include categories of facilities or activities and municipalities located in urbanized and associated developing areas. Individual States would select their own control mechanisms for all Federally selected sources. There would be no provision for Federal oversight of State control mechanisms.

6. State Target Selection Consistent with Federal Criteria - State NPDES or non-NPDES Control.

EPA would develop selection criteria for sources (criteria would include watershed targeting and reliance on 305(b) reports as well as 303(d) and 304(1) lists as appropriate). States would identify high risk activities using these criteria. Potential targets would include categories of facilities or activities, urbanized and associated developing area portions of municipalities and counties, and sources located in affected watersheds. The State may implement either point or non-point source control measures as they see fit. Federal oversight would be exercised; sub-options would provide for different oversight schemes.

7. Federal Target Selection - NPDES Control.

With this option, high risk sources would be selected at the Federal level. Potential targets would include categories of facilities or activities, and urbanized and associated developing are portions of municipalities and counties. All sources identified would be controlled through NPDES permits.

At each of the three public meetings held, participants were presented the above list of options, and were provided the opportunity to ask clarifying questions about each one. For their first task, they were asked to identify strengths and weaknesses of each option in terms of targeting, control and timing strategies, and decide what changes if any they would make in the option to improve it. Participants were also given the opportunity to create their own option(s) for consideration.

The second task for participants at each public meeting was to list the key components that they felt should be included in a Phase II program for it to be successful, and to identify actions that EPA should avoid taking because the actions would have major detrimental effects on program success.

Participants were divided into small working teams of 6-8 people. Each team appointed one person to record group responses to each of the tasks. Following each task, teams reported out to the rest of the group.

Individual meeting reports of team responses to the options are appended to this Executive Summary. The list of options for the first meeting was slightly different than the list used for the remaining meetings in both order of option presentation and wording. The list was modified for two reasons: 1) there was a sense that, because the options were presented from most to least Federal control, people in the first two meetings may have been unintentionally drawn to "middle of the road" options; and 2) initially, one option explicitly included a watershed approach, and therefore people may have felt that it was the only option that could incorporate it, even though the other options in no way excluded using the approach. Thus, participants in the second two meetings received the options in a different order and with explicit reference to the watershed approach given in a number of option descriptions.

Two final "expert meetings" was held in Chicago, IL and Falls Church, VA, where national storm water experts convened to review the options and suggest overall criteria for selecting a Phase II option.

Project Results

Task I: Identifying Strengths and Weaknesses of Options

At each public meeting, individual teams presented their responses to each of the options listed above. The responses of all teams for all meetings were compiled for this report. The responses of any individual team can be found, by meeting, in the appendix. Below, in discussion of various favored options, a sampling of responses across teams and meetings is presented.

Option Responses:

Across the board, meeting participants identified Option #6, "State Target Selection Consistent with Federal Criteria - State NPDES or non-NPDES Control" and Option #4. "Tiered Federal and State Target Selection - Tiered NPDES and Non-NPDES Control" as their most favored options.

Option #6, which would have States target high risk sources based upon Federally established criteria for selection and would include Federal oversight of State programs, was seen to provide the consistency needed nationwide for target selection while still allowing states the flexibility needed to control sources and identify high-risk polluters. This option was seen as easily incorporating a watershed approach, and including both point and non-point sources. Some of the strengths identified for Option #6 included:

- uniformity of selection criteria of sources among States;
- removal of the burden on States to develop selection criteria of their own;
- the flexibility to allow non-point source controls;
- giving States, who are closer to the problems and issues, more input into the decision-making process;

- giving States more latitude to develop programs which meet their own needs and high risks;
- establishing a partnership model between EPA and States, not a command-and-control model.

Some of the weaknesses that participants associated with Option #6 included:

- the probability that there would be inconsistencies between States on requirements;
- that it does not protect unimpaired waters, because the focus is on remediation not prevention;
- the potential for disagreement between State and Federal levels on the criteria established. The State may differ in the prioritization of pollutant sources;
- that Federal criteria may not be applicable to the State because of geographic, industrial, or other unique characteristics;
- a State may not have the resources to handle the program;
- the potential for State and local disagreement over controls used;
- that it could penalize progressive States that have already taken the initiative to develop a program, only to have EPA set criteria that don't "mesh" with their progress;
- the possibility that industries with multiple facilities in different States would have to deal with differences in requirements, timing, etc.

Option #4 was identified by participants as the next most favored option. According to that option, EPA would identify the first tier of high risk sources, and then the States would target additional sources as appropriate. The EPA-targeted sources would be permitted by EPA or delegated States, and then the States would have the latitude to use a range of control strategies for additional identified sources. Some of the strengths that teams listed for Option #4 included:

- would allow for quickly addressing severe problems, so the State would have more time to deal effectively with other problem sources they identified;
- provides more options for compliance in its latitude for control strategies;
- allows States more discretion and time to identify and prioritize sources;
- provides a potential advantage for industries to keep themselves clean enough so that they are not targeted for (State-selected) Tier II. This option might act as an incentive to get industries to focus on pollution prevention;

- offers the ability to incorporate less resource-intensive controls to lesser risk sources such as 404-type permits;
- Tier I allows non-contributors out of the system (since EPA would be targeting only determined high risk sources);
- seems to be more equitable than Phase I targeting and control strategies.
- permitting provides a clear point of control, i.e. the "gorilla in the closet".

Some of the weaknesses that teams associated with Option #4 included:

- the time and expense of performing risk assessments, which the States would need to do in order to target Tier II sources;
- promotes 'buck-passing' of responsibility between Federal and State levels;
- the possibility that it would create inconsistencies among States for targeting and controlling industrial categories (high risk sources);
- EPA/State coordination could be difficult, which could prolong the time it would take to implement this option;
- the potential inconsistencies that could occur for States regulating interstate waters, e.g. Chesapeake Bay.
- EPA may not have adequate information to screen and identify high risk sources on a national basis.

There did not seem to be a consistent "worst choice" option among meetings. However, among teams at the Dallas meeting, one option - Option #7, in which high risk sources would be selected at the Federal level and controlled through NPDES permits - stood out as unfavorable for six out of eight teams. Their common reason was that the Federal level would be the primary decision-maker in this option. Across all meetings, teams favored options that promoted a system of shared decision-making and responsibility reflecting the need for a partnership between Federal and State entities.

In one of the Washington public meetings, two options - option #5, in which high-risk sources would be Federally selected, with no provision for Federal oversight of control mechanisms; and Option #1, in which States would select sources and controls, with no provision for Federal oversight - were deemed the <u>least</u> favorable. In terms of Option #5, participants did not see the federal "teeth" that they felt would be needed to enforce the program. Many people across meetings felt that if there was not "the gorilla in the closet", i.e. the threat of EPA enforcement of the regulations after incentives were tried and failed, the program would not work.

Sentiment was similar regarding Option #1, and again centered around the sense that some States would do very little if the Federal government were not driving them.

It was quite apparent that, while involved groups do not want a standard command and control situation with every aspect of the program dictated at the Federal level, they still see a need and role for Federal regulatory enforcement as a motivator to get States and the regulated community to implement effective storm water programs.

Task II: Contributors to Program Success

The purpose of Task II was to have participants identify the critical factors that would help to ensure a successful storm water program, no matter which option or combination of options was selected. Teams were asked to identify the essential and basic components of a program that they believed would be required for the program to be successful. Further, they were asked to advise EPA on what the agency needed to avoid doing in order to further ensure successful program outcomes.

A summary of team responses to each of these tasks is presented below.

Task II a: Key Components for Program Success

Teams were asked to identify and list what they believed to be the key components of a successful storm water program. Responses to this task differed between group representation (e.g. State government, local government, etc.) and geographic region. There were, however, common components listed by teams across meetings. The first four items were mentioned by more than half of all work teams; the remainder were mentioned by 25-50% of the teams. The items teams identified as key to a successful program included: (in parentheses are comments made by some of the individual teams re: the item)

1. Public education and awareness programs (e.g. through trade associations, at schools, use of various media - everybody needs to be educated);

2. Training for regulators and the regulated community (e.g. for States, regions, permit writers, permittees; periodic regional/national meetings; hands-on training for municipalities and industry; dialogue and feedback between EPA, States and locals; technical assistance);

3. Timely guidances (get guidances out ahead of time as regulations are passed; provide guidance on technology transfer and innovative technology; include case studies and a data clearinghouse);

4. Determination of what lessons were learned from Phase I of the program, and mechanisms for Phase II that will allow tracking and assessment of the program within reasonable timeframes. A key factor is to allow enough time for an adequate review process of Phase I to see how Phase II could build on and expand those efforts;

5. Clear regulations (e.g. straightforward as possible; user friendly, clarity of coverage/applicability; clarity in criteria; be more specific in naming industrial activities covered under the regulations);

6. Use of a Watershed approach to implement the program;

7. National guidelines for the program (e.g. identify measurable goals for regulated sources, standards, designated use impairments, mechanisms for oversight, long range planning; recognize cost and implementation of compliance; provide realistic measures of success);

8. A phased-in approach for the Phase II program (e.g. reasonable time schedule, long-term phase-in). The most common timeframe mentioned by teams was 3-5 years for program implementation;

9. Pollution prevention incentives (send out guidance on pollution prevention to potentially regulated facilities now; offer exemptions; reduce requirements as an incentive for successful use; possibly provide a menu of programs on pollution prevention plans from which entities can pick and choose);

10. Program flexibility (e.g. to change deadlines based on hydrological flow; to implement and use elements of a watershed approach to bring in stakeholders and implement a program).

Approximately half the teams noted that there need to be some dedicated funding sources available to States, local government and permittees to assist in successful implementation of these program components. Teams felt that EPA should either provide funds or provide guidance on how States and local governments could implement fund-generating systems, e.g. storm water utilities. Team suggestions included: funding could first be made available through congressional appropriation to EPA to help programs start, and then programs could generate on-going funds through permit fees; EPA should make available federal grants and loans to States, locals and permittees.

Task II b: EPA Actions that would be a Barrier to Program Success

Teams were asked to identify and list those actions that EPA should avoid taking lest those actions prevent programs from being successful. The actions most frequently mentioned include:

1. Unnecessary/unusable program requirements, including excessive monitoring, unrealistic BMPs and compliance criteria, cost-prohibitive Best Management Practices;

2. Fully developing requirements before pilot testing various proposed components of the program to catch inconsistencies, problems, etc. In other words, do small scale testing of program elements and use knowledge gained from those pilot tests to refine the regulations before they are put into effect;

3. Unrealistic deadlines and goals;

4. Implementing program regulations without providing dedicated program funding;

5. Promulgating the requirements without providing written guidances and technical assistance concurrent to doing so.

Criteria for Selecting A Phase II Option

The final meetings brought together storm water experts from across the country to develop an option in detail for the Phase II program. One of the products from those meetings was a developed set of criteria on which to base option selection.

Those criteria are that the program:

1. Does not rely solely on the actions of just one player. The program needs to include multiple levels: EPA, States, targeted municipalities and industries. For example, the Federal government should not be designer and decision-maker, educator, enforcer and funder. The program needs a balance of players across levels, each with a clearly defined role. Also, there needs to be a clear avenue for intervention at the Federal level if States or municipalities fail to implement the program, i.e. "the gorilla in the closet".

2. Provides clear guidance and unambiguous targeting categories and words (e.g., words like "sufficient" should be avoided, at least if there is no way to define what they mean in a given context). Simplicity and clarity should be favored; words that are ambiguous or hazy should be avoided. The regulations must be clear to the regulated community in terms of goals, objectives and implementation if EPA is to gain "buy-in" from them.

3. Provides the resources (not only dollars, but people as well) or suggests how they can be obtained for that option. The program needs to be clear on who pays for what, e.g. Federal, State, local, permittee.

4. Is flexible, especially in recognizing regional and local differences, not only in terms of storm water pollutant loadings but also in terms of their environmental impact. For example, even if all gas stations put out an equal volume of pollution, the environmental impact may vary depending on location. Or as another example, recognition of the vast differences between States, such as mid-Atlantic compared to Southwest, which would mean a vast difference in what they need in terms of a storm water program.

5. Needs to be nationally consistent in the underlying methodology used, i.e. consistent national guidelines, identified goals, measures of success, etc. while at the same time recognizing regional differences and allowing flexibility to implement a program that best addresses the particular characteristics of local problems.

6. Emphasizes the need for program responsibility and authority that is "pushed" down to a local level. The sense of some of the participants in this meeting was that the best understanding of the problem and how to deal with it is the people closest to the problem who have to deal with it, i.e. local problem/local government and groups. Note: People representing local government at the meetings were extremely concerned about the lack of resources and technical expertise that might be found at the local level in many situations. The need for adequate funding was again identified as a critical issue, and some suggested that utility districts would be the only real way to fund the program unless the cost is low enough that it could be covered in a regular budget. The group agreed as a whole that resources and technical expertise not withstanding, this program must be accepted and supported at the local level if it is to be successful.

7. Provides the opportunity to integrate other water issues and concerns--e.g., groundwater. For example, restriction on certain BMPs affects groundwater impacts. The methodology used should allow integration with groundwater, habitat, and other water programs. It needs to integrate or be compatible with other sections of the Clean Water Act, e.g. right now 402 causes 401 and 404 compliance problems.

8. Needs to build on and tie to Phase I, where much work was done and where momentum has been established. A lull now means the need for a new start up - right now the energy level is high and awareness of the storm water program has been growing, so EPA needs to tap into that forward movement. If EPA waits too long in getting Phase II out, inertia will set in, and it will take much more energy and effort to get it in place. And the talented people will go on to something else (208 was given as an example).

Other key areas of expert discussion around Phase II program considerations included:

1. **EPA needs to recognize the potential gaps between "best efforts" and performance standards.** On the one hand, we have a variety of ways of characterizing best efforts: Best Management Practices (BMP's) and Maximum Extent Practicable (MEP) are examples. These are inputs, presumed to influence water quality. On the other hand, we have water quality standards that are outcomes. One question: what do we do if people follow BMP's and water quality does not improve to the standards we set? What if the "maximum extent practicable" is deemed in place and we still have an outcome shortfall?

2. **Two distinct structural premises are in play.** One is of a national program which is administered by the States. In this view, EPA provides mandates, and supports state and local efforts to reach them. The other premise is more decentralized. It is seen as a set of State programs and initiatives which share a national performance target. In at least some respects, the structural premise held suggests different programmatic approaches in such areas as desired and allowable variability among states and localities.

3. **Much wisdom about storm water controls are not readily generalizable.** BMP's in the residential development field, for example, were said, by some experts, to hold true for a scale of 5 - 50 acres. And many watersheds for which solutions are designed are actually very small. It is hard to "scale up" answers.

4. Program "champions" are often a factor in program success. One expert observed, and others agreed, that the individuals involved in storm water programs were as much a reason for high program performance as was the program plan. We should be careful to allow for this factor in the emphasis on rules, procedures, and even workplans.

5. Pollution prevention should be emphasized. While often anecdotal, a variety of examples were offered of situations in which preventive steps solved a water quality problem. These examples, like the Puget Sound program discussed in our earlier report, were generally focused and interactive. They did not rely on the spread of information alone to prompt changes in behavior.

6. EPA needs to allow State and local flexibility to address priorities as they have identified them. The theme of selectivity combined often with local flexibility. e.g., in some areas, a little more grease has a tremendous negative impact on the environment. In others, it does not. Selectivity on targeting is also clear, e.g., that BMP's on new land development (commercial as well as residential) would pay high dividends vs. other generalized targets.

7. Several equity or fairness issues emerge and persist. One concerns those sources targeted. If a discharger has done everything in their permit -- all the BMP's are in place -- and the water is still dirty, is he or she liable? Another is the distinction between larger organizations (corporate or municipal) with resources to handle permits and processes and much smaller ones which lack that capacity. To what extent is the same rule as "fair" for the small town as for the big city?

8. The Federal role in the program to establish a partnership with States, and be an enabler rather than an enforcer. Participants felt that EPA's responsibilities would be to develop national goals and guidelines, set national selection criteria, establish a selection methodology, and develop a universal methodology for selecting controls that would allow programs to choose alternatives based upon their needs, e.g. regional and local differences. Participants felt strongly that Federal oversight is a necessary component to ensure that States do implement programs, i.e. be the "gorilla in the closet". However, in a partnership capacity, participants felt EPA should first be ready to provide support and technical assistance rather than punitive measures to programs that were not meeting standards despite best efforts.

APPENDIX J

SUMMARY OF PHASE II COMMENTS

Organization of Phase II Comments

I. Targeting

A. General Targeting Approaches for Both Municipalities and Industries

	Yes	No
■ Examine Phase I data before selecting Phase II sources. **[1.g.iv]**	52	0
■ Amend CWA and eliminate Phase II/ cover additional sources under Phase I **[1.a]**	28	7
■ Establish requirements for State storm water programs to identify additional sources. **[1.f]**	18	5

■ **Examine Phase I data before selecting Phase II sources. [1.g.iv]**

The majority of the commenters (52 commenters) agree that a close examination of Phase I is essential before launching into Phase II. Many of these commenters also stressed that EPA should complete the Reports to Congress, as specified under section 402(p)(2)(5) of the CWA. Such an examination would allow EPA to evaluate whether the current approach is achieving the intended goals, or whether another approach to storm water permitting would be more effective. As discussed in detail later, commenters expressed a number of concerns about the storm water program, including 1) the high cost associated permit compliance and program administration; 2) the ineffectiveness and inequity of "blanket coverage" of particular industrial activities that do not pollute while other "bad polluters" remain unregulated; and 3) a general uncertainty about the goals of the storm water program and whether, in fact, these goals are being achieved under current program.

■ **Amend CWA and eliminate Phase II by covering additional sources under Phase I; administer through NPDES or section 319 (NPS) or section 6217 (CZARA). [1.a]**

To address these problems associated with Phase I, commenters indicate that a change in how facilities are targeted is necessary. Of the 91 commenters, approximately a third (28) favor amending the CWA to eliminate Phase II of the storm water program and to bring additional sources under Phase I. As far as regulating these Phase II sources under Phase I, the majority of commenters prefer a continued reliance on the NPDES program as opposed to State non-point source programs (funded under Section 319 of the CWA and/or section 6217 of the CZARA). While commenters support continued reliance on NPDES, they overwhelmingly agreed that Phase II sources should not be targeted by EPA headquarters but rather by State and/or local entities.

These commenters argue that by eliminating Phase II and bringing additional sources under Phase I, the problems associated with Phase I storm water permitting will be most effectively addressed. In particular, by designating facilities under section 402(p)(2)(E), States can target those industrial activities that are impacting sensitive watersheds and/or posing the greatest environmental risk. One State agency notes EPA should "maintain national data for determining environmental risk, establish priorities for additional activities to be covered under a storm water permit, and coordinate compliance, enforcement and educational information among the States."

The majority of commenters believe that designation authority in the hands of the State would be the most cost-effective targeting approach. However, other commenters express concern over shrinking State budgets and indicate that additional funding would be needed, particularly if the program were administered under section 319.

Those commenters opposing the elimination of Phase II (7 commenters) argue that for reasons of equity Phase II sources should be subject to the same requirements as Phase I. The concern is that State designation of Phase II sources may result in inconsistencies throughout the country. One municipality argues that in order to effectively protect water quality, smaller municipalities should be required to develop the same storm water management programs as the medium and large municipalities were required to under Phase I.

- **Establish requirements for State storm water programs to identify additional sources. [1.f]**

18 commenters out of 91 commenters favor the targeting option whereby EPA would establish Phase II requirements for State NPDES storm water programs to identify additional sources. 5 oppose this option.

Those supporting this option believe that States and local entities (not EPA) should be identifying additional sources for Phase II permitting, adding that EPA should somehow direct the States and municipalities to develop programs appropriate to their unique requirements and monitor the progress of these programs. As far as EPA's exact role in this process, some commenters assert that EPA should establish baseline effluent limitations for particular industries and then establish control measures for these industries. Other commenters believe that such determinations should be made by the State, with EPA maintaining its important role as an information and guidance clearinghouse. One State agency writes that "minimum criteria in the area of funding levels and educational requirements seems appropriate." These commenters indicate that this approach is preferable as it establishes consistent criteria for the development of State storm water programs.

B. Options for Targeting Phase II Industrial Sources

		Yes	No
■	Geographic Targeting: Designate additional individual sources in watersheds of concern (those not meeting designated water uses) and in specific rainfall zones **[1.e/1.g.i]**	48	5
■	Focus on high-risk polluters and exempt facilities that don't pollute. **[1.d/1.g.ii]**	39	3
■	Rely on Phase I MS4s to target industrial sources that discharge through their system. **[1.c]**	9	11

■ **Geographic Targeting: Designate additional individual sources in watersheds of concern (those not meeting designated water uses) and in specific rainfall zones. [1.e./1.g.i]**

Almost half of the 91 commenters (45 commenters) support targeting sensitive watersheds, i.e., those that have high pollutant loadings and/or those not meeting designated uses. These commenters argue that such an approach is the most cost-effective way to improve the quality of the Nation's water. (Please note that within this category, more commenters support permitting watersheds under the NPDES program than under State nonpoint source programs). Commenters suggested that this approach should be coupled with identifying the industry "bad actors" within watersheds of concern. (Identification of "bad actors" is discussed in the following section).

A number of commenters believe that watersheds should be prioritized based on criteria such as threats to high quality resources or significant degradation. One industry offered the following suggestions for a watershed strategy: "1) Conduct a survey of receiving watersheds and rank them based upon their designated uses and level of contamination; 2) Identify and prioritize major sources of pollutant loadings; 3) Analyze the control measures to control these pollutant sources and prioritize them based on cost effectiveness." Some commenters stress the importance of developing national criteria for evaluating watersheds so as to avoid inconsistencies among different regions.

In terms of evaluating watersheds, commenters suggest using the following CWA mechanisms: Section 303(d) which prioritizes a ranking of waters, section 305(b) which describes water quality of all navigable waters in the State, section 319 watershed listings, and section 304(l) which lists waters not expected to meet water quality standards. Some commenters suggest that sampling data from Phase I cities be used to generate regionalized watershed loading criteria.

Regarding costs, a number of commenters agree that targeting watersheds would be more cost-effective for both industries and States than current targeting strategies. However, some States express concern over the cost of gathering watershed-specific information in a timely manner. One State argues that "entirely too much effort would need to be invested to determine what waters have been negatively impacted by storm water runoff. Using the lists from 305(b) reports is not sufficient nor acceptable."

As far as designating specific sources by rainfall zone, there was some scattered support for this measure. However, most commenters agreed that it could be difficult and costly to generate timely, meaningful data that could justify variances or special conditions between regions.

- **Focus on high-risk polluters and exempt facilities that don't pollute. [1.d/1.g.ii]**

Nearly half of the commenters (39 commenters) supported targeting high-risk industrial polluters. Only three commenters opposed the option. As discussed above, many commenters believe that targeting of "bad actors" should be linked to the targeting of sensitive watersheds.

In general, commenters feel that the Phase I targeting of industries based on SIC codes was not cost-effective. In addition, many commenters believe that a number of the big industrial polluters were not included under Phase I of the storm water program. Commenters unanimously agree that bad actors who are contributing to water quality degradation should be targeted for Phase II permitting, while those "good actors" who don't pollute should be exempted. This approach, commenters say, would reduce the regulatory burden on all those facilities that are not contributing to water quality problems.

One State agency stressed that determinations of "bad actors" must be done on a State or local basis, not by EPA. "Controlling activities that are specifically designated by EPA could be a significant waste of time and resources if a particular jurisdiction has other activities that contribute to higher pollutant loads." This commenter suggested using data gleaned from municipal applications to determine Regional water quality information.

As far a which particular "bad actors" should be targeted under Phase II, commenters suggested the following industries: gas/auto service, State highways, large parking lots (malls), tank farms, commercial activities with industrial components, and construction activities of less than five acres. Please note, however, that a number of trade organizations representing the above industries submitted lengthy comments outlining why their industries do not pose environmental risks.

Those commenters opposing the option (3 commenters) claim that focusing on "bad actors" is a reactive strategy rather than a preventative one. Further, one commenter argues that using impairment would be imprudent as States (after more than a decade) still have not completed inventories of their waters. The commenter further states that agricultural runoff and irrigation return flows, which are exempted under the CWA, constitute some of the worst pollution in the country. One commenter suggests the continued use of SIC codes but with exemptions provided for those who have proven that they don't pollute.

- **Rely on Phase I MS4s to target industrial sources that discharge through their system. [1.c]**

11 commenters opposed the targeting option whereby Phase I MS4s would target industrial sources discharging through their systems; 9 commenters supported the option.

Those commenters opposing this option feel that the burden of regulating Phase II industrial dischargers would be too great, and that this role rightfully belongs to the State. Further, commenters believe that water quality problems are not confined to individual municipalities, but rather they span entire watersheds. These commenters argue that standards would not be uniform--or efforts might not be coordinated--between different municipalities and, therefore, regulation through State or EPA would be more equitable. Municipalities indicate a willingness to assist States in targeting Phase II sources, for example, by providing a list of potentially high-risk industries. Commenters supporting this option believe that because Phase I municipalities already have their storm water management plans in place, they are the most appropriate entity to identify additional sources under Phase II.

C. Options for Targeting Phase II Municipalities

	Yes	No
■ Identify MS4s based on population, population density, and/or population growth. **[1.b]**	20	20
■ Geographic Targeting: Designate additional municipal sources impacting watersheds of concern (those not meeting designated water uses) and in specific rainfall zones **[1.e/1.g.i]**	48	5
■ Permit small municipalities but establish simplified application requirements. **[1.g.iii]**	15	1

- **Identify MS4s based on population, population density, and/or population growth. [1.b]**

Commenters are split evenly (20 in favor, 20 against) Phase II MS4s being targeted on the basis of population, population density and/or population growth.

Commenters in support of this approach argue that municipalities having particularly dense populations and those experiencing intense population growth due to new development should be of primary concern under Phase II of the storm water program. One commenter also notes that MS4s could be targeted on the basis of watershed population. At any rate, numerous commenters agree that effective Phase II storm water programs must be coordinated on a regional basis [perhaps in conjunction with those already established under Phase I]. This would allow for the development/implementation of regional policies and regional BMPs, and would facilitate addressing specific issues such as land use, structural controls and construction activities. As discussed later, the majority of commenters supporting this approach also advocate the establishment of simplified permit application requirements.

The majority of the comments opposing this option are from small municipalities. Approximately half of these commenters believe that municipal storm water management should be conducted on a watershed basis rather than by determining population density and/or growth. The other half opposes Phase II regulation of small municipalities altogether. "Phase II regulations will have a very significant impact on municipal budgets if implemented similar to Phase I," 11 municipalities wrote. "These will entail increased staff levels, testing, consulting fees and other costs which are unduly burdensome, particularly where there is no Phase I documentation to show that environmental quality is enhanced." Of primary concern among municipal commenters is the astronomical cost associated with completing municipal storm water permit applications. They argue that funds do not exist to implement the storm water program and that political pressures would prevent them from securing storm water utilities.

- **Geographic Targeting: Designate municipalities impacting watersheds of concern (those not meeting designated water uses) and in specific rainfall zones. [1.e./1.g.i]**

As discussed under the "Industrial Targeting" section, nearly half of the 91 commenters (45 commenters) support targeting sensitive watersheds, i.e., those that have high pollutant loadings and/or those not meeting designated uses. While targeting these watersheds can help identify significant industrial polluters, many commenters also believe that this approach is useful in identifying MS4s for storm water permitting.

These commenters argue that since watersheds are oftentimes a patchwork of rural, suburban and urban lands comprised of incorporated and unincorporated areas, storm water permits should apply to the jurisdiction as a whole, not just to individual municipalities within the watershed. Commenters note that in watersheds of concern, all Phase II municipalities could become co-permittees with Phase I municipalities. Where it is determined that watersheds are not polluted, Phase II municipalities would not be required to obtain a storm water permit. This option provides opportunities for municipalities to reduce administrative burdens, consolidate efforts to study or evaluate approaches, and greatly reduce costs of program development and implementation. Although a great deal of regional coordination would be required, commenters believe that such an approach would yield the greatest environmental benefit.

(Please refer to the "Industrial Targeting" section for a summary of options for targeting on a watershed basis).

- **Permit small municipalities but establish simplified application requirements. [1.g.iii]**

15 commenters support the idea of permitting small municipalities but establishing simplified application requirements. Arguing that Phase I municipal permit application requirements (particularly Part 2 requirements) were burdensome and overly costly, these commenters suggest that Phase II municipalities be covered under a simplified general permit that requires a storm water management plan and flexible watershed-specific monitoring requirements. One commenter suggests the following components of a Phase II municipal program: 1) *Sediment and Erosion Control*:

Applicants incorporate erosion control into the development review and local permitting process; 2) *Storm Water Quality Control*: Applicants incorporate storm water BMPs into the municipal development review and approval process and into municipal operations; and 3) *Illicit Discharges*: Applicant prohibits illicit connections and improper dumping, he/she develops a spill prevention and response plan.

II. Control Strategies

A. General Control Strategies for Both Municipalities and Industries

	Yes	No
■ Continue to rely on NPDES programs; use NPDES general permits that focus on BMPs. **[2.a/2.d.i]**	32	4
■ Rely on nonpoint source programs administered under section 319 of the CWA and section 6217 of CZARA. **[2.b]**	20	3
■ Establish mandatory national Phase II performance standards without a permit. **[2.c]**	14	10

■ **Continue to rely on NPDES programs; use NPDES general permits that focus on BMPs [2.a.]**

Approximately 32 commenters favor the continued use of NPDES programs to regulate storm water discharges. 19 commenters prefer reliance on State nonpoint source programs under section 319. Most commenters state that it would be inefficient to discontinue the current program, and, as one commenter notes, displacing the NPDES program would "create a significant amount of confusion among authorized NPDES States and the regulated community." Additionally, the NPDES storm water permit program is in the initial stages of development and results may not be realized for at least two years. The majority of the commenters who support reliance on the NPDES program encourage use of general permits, for an "emphasis on the development of effective programs, not on lengthy and expensive application processes." Most commenters believe that BMPs are a more effective control strategy and a better allocation of resources than monitoring and numeric effluent limitations. BMPs utilized should be those which proved cost effective for Phase I sources.

- **Rely on nonpoint source programs administered under section 319 of the CWA and section 6217 of CZARA. [2.b.]**

Approximately 21 commenters favor the use of State nonpoint source programs and/or section 6127 of CZARA to regulate Phase II storm water discharges. Many of these commenters assert that storm water runoff is a nonpoint source rather than a point source and therefore should be regulated under section 319. Moreover, State nonpoint source programs are already developed and utilizing them would lessen the repetition of water quality programs. Several commenters emphasize, however, that if State nonpoint source programs were expanded to include storm water runoff, additional funding would be essential. Those commenters that supported the use of section 319 see it beneficial in that the program encourages flexibility through voluntary control measures, pollution prevention, and watershed planning. Several commenters express some trepidation that nonpoint sources may be moved under the NPDES program, and assert that nonpoint sources should continue to be covered under section 319, not NPDES.

- **Establish mandatory national Phase II control strategies without requiring a permit. [2.c.]**

Commenters are fairly divided on whether EPA should establish national control strategies for Phase II sources. Various statements from the 12 commenters who support mandatory guidelines indicate that this approach would be cost-effective and would alleviate the administrative burdens of permit applications. A few commenters also state that, in order to be most effective, the guidelines and management practices should be industry-specific. A model that is mentioned by several commenters is the Puget Sound Water Quality Management Plan and the Washington State Department of Ecology's Stormwater manual for the Puget Sound Basin. These commenters suggest that all States adopt a similar storm water management plan which would be required to at least meet a national standard; all municipalities within the State would have to adhere to the plan.

11 of the commenters who address this control strategy oppose mandatory national control guidelines for Phase II activities. Several commenters believe it would be difficult to effectively notify and educate the general population concerning the details of such a program. Other commenters express concern that the diversity in climate and topography throughout the country requires more flexibility than national standards would provide.

B. Key Elements of a Control Strategy

	Yes	No
■ Focus on education for public and affected industry. **[2.d.ii]**	18	0
■ Emphasize pollution prevention incentives and BMPs, particularly for new development. **[2.d.iii]**	17	0
■ Establish correlation between severity of pollution and controls required, using fines to aid implementation. **[2.d.iv]**	3	0

- **Focus on education for public and affected industry. [2.d.ii]**

14 commenters state that education needs to be a primary focus of the Phase II program. One commenter notes that EPA should "keep it simple," particularly on issues on coverage, since Phase II dischargers may be smaller and less familiar with environmental regulations than Phase I dischargers. Commenters unanimously stress the importance of public education and outreach. They urge that EPA/States 1) distribute guidance documents and fact sheets prior to implementing the rule, 2) provide examples of pollution prevention programs, 3) conduct workshops, 4) prepare video presentations for distribution, and 5) launch public education campaigns geared towards explaining water quality problems associated with storm water.

- **Emphasize pollution prevention incentives and BMPs, particularly for new development. [2.d.iii]**

14 commenters support an emphasis on voluntary pollution prevention programs. This approach is favored because of its cost-effectiveness, flexibility, and reduction in regulatory burden. Additionally, several commenters indicate that it would establish a 'partnership' between the regulated community and regulatory agencies by encouraging dialogue and guidance concerning pollution prevention techniques. One State notes that the voluntary measures in its nonpoint source program have proven very successful in improving water quality, and that similar practices could be implemented for storm water runoff. The State recommends, however, that voluntary approaches be used in conjunction with mandatory approaches and that "provisions be included for requirements placed on 'bad actors' if cooperation is not attained through the voluntary programs." Numerous commenters point out that education would need to be far-reaching if the voluntary programs were implemented.

- **Establish correlation between severity of pollution and controls required, using fines to aid implementation. [2.d.iv.]**

Only 3 commenters address this control strategy, and all 3 support a correlation between severity of pollution and controls required. One commenter writes that, "market based incentives structured to incorporate true economic externalities associated with pollution can be a valuable tool in helping society balance economic growth and levels of pollution." Another commenter notes that State agencies should administer the fine/implementation system, as States can adjust their controls based on the types of pollutant sources and sensitivity of the watersheds in a particular region.

III. Deadlines

A. Options for Program Deadlines [3]

	Yes	No
■ October 1, 1995 or later	12	
■ Prioritize sources; establish phased deadlines	3	
■ Eliminate Phase II; no deadlines	1	
■ Pending thorough review of Phase I	20	
■ H.R. 6167 deadlines satisfactory	3	
■ Before October 1, 1994	3	

Commenters unanimously feel that Phase II should not be implemented until a thorough review of Phase I has been completed. A number of these commenters indicated that Phase II regulations should not be published before October 1, 1995.

IV. Costs/Regulatory Burden

A. Issues associated with costs and regulatory burden

■	Balancing the need to protect the environment with the cost-effectiveness of the program [III.A.2]
■	Examining the impacts of the storm water program on small businesses and communities [III.A.7]
■	Assessing the regulatory burden on permittees and regulators [III.A.3/III.A.4]

General Cost/Benefit Concerns

Nearly a third of the commenters (26 commenters) express concern over the costs associated with implementing the storm water program, and whether these costs justify the need to protect the environment.

Municipalities, in particular, voice concern over the costs associated with completing municipal permit applications and implementing storm water management programs. One commenter argues that while cities across the nation have spent over $1 trillion dollars to implementing the program, water quality is not significantly improving because of upstream discharges not regulated under the CWA. This commenter further states that since urban runoff affects only 11% of river impairment and 29% of lake impairment, the price tag of implementing storm water management programs is not justified. (Please note that a number of commenters question EPA's methodology in 305(b) reports as it pertains to assessing "designated uses" for waterbodies).

Comments indicate that across the board--among cities, small business owners, and trade associations--the storm water program is viewed as a major financial burden on communities and industries. Of particular concern for cities (and especially small cities) is the number of growing number of projects/regulations that need to be supported by shrinking municipal budgets. Generating a storm water utility to support the program has proven politically difficult in a number of cities. On the industrial side of the program, there are equally as many concerns over costs and benefits. In particular, commenters argue that a number of small industries which pose little risk to the environment were required to apply for a storm water permit under Phase I, while "higher risk" industries such as oil and gas, agriculture, and retail gasoline facilities were not covered by the rule. A number of small industries claim that sampling is cost-prohibitive and that the quantitative data generated are oftentimes inaccurate/meaningless. Regarding Phase II, one construction operator argues that inclusion of construction operations under 5 acres would render these small-scale activities cost-prohibitive.

Strategies for Phase II

In closing, commenters offer the following suggestions for maximizing cost-effectiveness and environmental benefit under Phase II:

- Phase I of the storm water program must be thoroughly assessed in terms of dollars spent and environmental benefits gained before launching into Phase II.

- EPA and/or States must incorporate a more realistic benefit/cost analysis of Phase II, particularly for the municipal side of the program.

- Under Phase II, emphasize storm water management and pollution prevention rather than sample gathering and analysis. (A number of the quantitative requirements under Part 2 of the municipal permit application were viewed as unnecessary and overly costly)

- EPA and States should use data generated from Phase I of the program so as to make Phase II more cost-effective and environmentally beneficial.

- Rely more heavily on State or local entities for storm water program administration.

V. General Concerns/Issues Related to the Storm Water Program [4]

■ Lack of adequate outreach/public education/timely guidance during Phase I resulted in confusion about: * Which facilities are subject to regulation (use of SIC codes viewed as confusing, inappropriate) * The types of permit application options available * Deadlines * The relationship between the industrial and municipal programs * The overall relevance of the program
■ Confusion resulted from different requirements in different States (i.e., those with approved NPDES programs and those without) particularly in regards to the group application process.

■ **Lack of adequate outreach/public education/timely guidance during Phase I resulted in confusion over a number of issues, including:**

Use of SIC codes. A number of commenters indicated that there was widespread confusion during Phase I over which facilities were subject to regulation. In particular, the use of SIC codes to determine regulatory status was viewed as confusing. Multiple activities commonly occur at a single facility and people were frequently unclear as to how they are classified under the SIC code system. Due to this excessive confusion, commenters generally feel that SIC codes are an ineffective way of targeting facilities for regulation under the storm water program.

Application Options. Commenters complained that the storm water permit application options were not spelled out clearly in the beginning of the program. In particular, some expressed anger over the group application process. One commenter notes that while the group application option seemed preferable a year ago, it became clear that this option was problematic given that certain States are not accepting group applications as legal coverage. In addition, a number of group applicants would have opted for coverage under the general permit had that option been available in the first place. Commenters resented that it was oftentimes necessary to hire expensive consultants simply to understand the regulations and stay informed of their application options.

Deadlines. Commenters indicate that there was confusion surrounding permit application deadlines. In the future, this could be alleviated by improved outreach and public education.

The relationship between the industrial and municipal programs. One commenter recommends separating municipalities and industries into two distinct rules so as to avoid confusion over the differences between the two programs.

The "Big Picture" of the storm water program. As discussed throughout this report, commenters seem frustrated over the fact that huge costs are being incurred to implement the storm water program without a clear indication that environmental benefits are being achieved. Commenters write that it essential for EPA to step up public education and outreach efforts in the future.

- **Confusion resulted from different requirements in different States (i.e., those with approved NPDES programs and those without) particularly in regards to the group application process.**

Numerous commenters state that the conflicting time frames between States and EPA in developing and issuing the permits created enormous confusion for the regulated community. As discussed above, this situation was particularly frustrating members of group applications.

APPENDIX K

SELECTED MANAGEMENT MEASURES DEVELOPED UNDER SECTION 6217 OF CZARA

SELECTED MANAGEMENT MEASURES DEVELOPED UNDER SECTION 6217 OF CZARA[1]

MANAGEMENT MEASURES FOR URBAN AREAS (Chapter 4 of CZARA guidance)

I. INTRODUCTION

II. URBAN RUNOFF

A. New Development Management Measure

(1) By design or performance:

(a) After construction has been completed and the site is permanently stabilized, reduce the average annual total suspended solid (TSS) loadings by 80 percent. For the purposes of this measure, an 80 percent TSS reduction is to be determined on an average annual basis,[2] or

(b) Reduce the postdevelopment loadings of TSS so that the average annual TSS loadings are no greater than predevelopment loadings, and

(2) To the extent practicable, maintain postdevelopment peak runoff rate and average volume at levels that are similar to predevelopment levels.

Sound watershed management requires that both structural and nonstructural measures be employed to mitigate the adverse impacts of storm water. Nonstructural Management Measures for new development (B&C) can be effectively used in conjunction with this Management Measure reduce both the short-and long-term costs of meeting the treatment goals of this management measure.

B. Watershed Protection Management Measure

Develop a watershed protection program to:

(1) Avoid conversion, to the extent practicable, of areas that are particularly susceptible to erosion and sediment loss;

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[1] See "Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters," January 1993, U.S. EPA, 840-B-92-002.

[2] Based on the average annual TSS loadings from all storms less than or equal to the 2-year/24-hour storm. TSS loadings from storms greater than the 2-year/24-hour storm are not expected to be included in the calculation of the average annual TSS loadings.

(2) Preserve areas that provide important water quality benefits and/or are necessary to maintain riparian and aquatic biota; and

(3) Site development, including roads, highways, and bridges, to protect to the extent practicable the natural integrity of waterbodies and natural drainage systems.

C. Site Development Management Measure

Plan, design, and develop sites to:

(1) Protect areas that provide important water quality benefits and/or are particularly susceptible to erosion and sediment loss;

(2) Limit increases of impervious areas, except where necessary;

(3) Limit land disturbance activities such as clearing and grading, and cut and fill to reduce erosion and sediment loss; and

(4) Limit disturbance of natural drainage features and vegetation.

III. CONSTRUCTION ACTIVITIES

A. Construction Site Erosion and Sediment Control Management Measure

(1) Reduce erosion and, to the extent practicable, retain sediment onsite during and after construction, and

(2) Prior to land disturbance, prepare and implement an approved erosion and sediment control plan or similar administrative document that contains erosion and sediment control provisions.

B. Construction Site Chemical Control Management Measure

(1) Limit application, generation, and migration of toxic substances;

(2) Ensure the proper storage and disposal of toxic materials; and

(3) Apply nutrients at rates necessary to establish and maintain vegetation without causing significant nutrient runoff to surface waters.

IV. EXISTING DEVELOPMENT

A. Existing Development Management Measure

Develop and implement watershed management programs to reduce runoff pollutant concentrations and volumes from existing development:

(1) Identify priority local and/or regional watershed pollutant reduction opportunities, e.g., improvements to existing urban runoff control structures;

(2) Contain a schedule for implementing appropriate controls;

(3) Limit destruction of natural conveyance systems; and

(4) Where appropriate, preserve, enhance, or establish buffers along surface waterbodies and their tributaries.

V. ONSITE DISPOSAL SYSTEMS

A. New Onsite Disposal Systems Management Measures

(1) Ensure that new Onsite Disposal Systems (OSDS) are located, designed, installed, operated, inspected, and maintained to prevent the discharge of pollutants to the surface of the ground and to the extent practicable reduce the discharge of pollutants into ground waters that are closely hydrologically connected to surface waters. Where necessary to meet these objectives: (a) discourage the installation of garbage disposals to reduce hydraulic and nutrient loadings; and (b) where low-volume plumbing fixtures have not bee installed in new developments or redevelopments, reduce total hydraulic loadings to the OSDS by 25 percent. Implement OSDS inspection schedules for preconstruction, construction, and postconstruction.

(2) Direct placement of OSDS away from unsuitable areas. Where OSDS placement is unsuitable areas is not practicable, ensure that the OSDS is designed or sited at a density so as not to adversely affect surface waters or ground water that is closely hydrologically connected to surface water. Unsuitable areas include, but are not limited to, areas with poorly or excessively drained soils; areas with shallow water tables or areas with high seasonal water table; areas overlaying fractured bedrock that drain directly to ground water; areas within floodplains; or areas where nutrient and/or pathogen concentrations in the effluent cannot be sufficiently treated or reduced before the effluent reaches sensitive waterbodies;

(3) Establish protective setbacks from surface waters, wetlands, and floodplains for conventional as well as alternative OSDS. The lateral setbacks should be based on soil type, slope, hydrologic factors, and type of OSDS. Where uniform protective

setbacks cannot be achieved, site development with OSDS so as not to adversely affect waterbodies and/or contribute to a public health nuisance;

(4) Establish protective separation distances between OSDS system components and groundwater which is closely hydrologically connected to surface waters. The separation distances should be based on soil type, distance to ground water, hydrologic factors, and type of OSDS;

(5) Where conditions indicate that nitrogen-limited surface waters may be adversely affected by excess nitrogen loadings from ground water, require the installation of OSDS that reduce total nitrogen loadings by 50 percent to ground water that is closely hydrologically connected to surface water.

B. Operating Onsite Disposal Systems Management Measure

(1) Establish and implement policies and systems to ensure that existing OSDS are operated and maintained to prevent the discharge of pollutants to the surface of the ground and to the extent practicable reduce the discharge of pollutants into ground waters that are closely hydrologically connected to surface waters. Where necessary to meet these objectives encourage the reduced use of garbage disposals, encourage the use of low-volume plumbing fixtures, and reduce total phosphorus loadings to the OSDS by 15 percent (if the use of low-level phosphate detergents has not been required or widely adopted by OSDS users). Establish and implement policies that require an OSDS to be repaired, replace, or modified where the OSDS fails, or threatens or impairs surface waters;

(2) Inspect OSDS at a frequency adequate to ascertain whether OSDS are failing;

(3) Consider replacing or upgrading OSDS to treat influent so that total nitrogen loadings in the effluent are reduced by 50 percent. This provision applies only:

(a) where conditions indicate that nitrogen-limited surface waters may be adversely affected by significant ground water nitrogen loadings from OSDS, and

(b) where nitrogen loadings from OSDS are delivered to ground water that is closely hydrologically connected to surface water.

VI. POLLUTION PREVENTION

A. Pollution Prevention Management Measure

Implement pollution prevention and education programs to reduce nonpoint source pollutants generated from the following activities, where applicable:

- The improper storage, use, and disposal of household hazardous chemicals, including automobile fluids, pesticides, paints, solvents, etc.;
- Lawn and garden activities, including the application and disposal of lawn and garden care products, and the improper disposal of leaves and yard trimmings;
- Turf management on golf courses, parks, and recreational areas;
- Improper operation and maintenance of onsite disposal systems;
- Discharge of pollutants into storm drains including floatable, waste oil, and litter;
- Commercial activities including parking lots, gas stations, and other entities not under NPDES purview, and
- Improper disposal of pet excrement.

VII. ROADS, HIGHWAYS, AND BRIDGES

A. Management Measure for Planning, Siting, and Developing Roads and Highways

Plan, site, and develop roads and highways to:

(1) Protect areas that provide important water quality benefits or are particularly susceptible to erosion or sediment loss;

(2) Limit land disturbance such as clearing and grading and cut and fill to reduce erosion and sediment loss; and

(3) Limit disturbance of natural drainage features and vegetation.

B. Management Measure for Bridges

Site, design, and maintain bridge structures so that sensitive and valuable aquatic ecosystems and areas providing important water quality benefits are protected from adverse effects.

C. Management Measure for Construction Projects

(1) Reduce erosion and, to the extent practicable, retain sediment onsite during and after construction and

(2) Prior to land disturbance, prepare and implement an approved erosion control plan or similar administrative document that contains erosion and sediment control provisions.

D. Management Measure for Construction Site Chemical Control

(1) Limit the application, generation, and migration of toxic substance;

(2) Ensure the proper storage and disposal of toxic materials; and

(3) Apply nutrients at rates necessary to establish and maintain vegetation without causing significant nutrient runoff to surface water.

E. Management Measure for Operation and Maintenance

Incorporate pollution prevention procedures into the operation and maintenance of roads, highways, and bridges to reduce pollutant loadings to surface waters.

F. Management Measure for Road, Highway, and Bridge Runoff Systems

Develop and implement runoff management systems for existing roads, highways, and bridges to reduce runoff pollutant concentrations and volumes entering surface waters.

(1) Identify priority and watershed pollutant reduction opportunities (e.g., improvements to existing urban runoff control structures; and

(2) Establish schedules for implementing appropriate controls.

MANAGEMENT MEASURES FOR ANIMAL FEEDLOTS (Chapter 2.II.B of CZARA guidance)

B1. Management Measures for Facility Wastewater and Runoff from Confined Animal Facility Management (Large Units not subject to NPDES permit requirements)

Limit the discharge from the confined animal facility to surface waters by:

(1) Storing both the facility wastewater and the runoff from confined animal facilities that is caused by storms up to and including a 25-year, 24-hour frequency storm. Storage structures should:

(a) Have an earthen lining or plastic membrane lining, or
(b) Be constructed with concrete, or
(c) Be a storage tank;

and

(2) Managing stored runoff and accumulated solids from the facility through an appropriate waste utilization system.

B2. Management Measures for Facility Wastewater and Runoff from Confined Animal Facility Management (Small Units not subject to NPDES permit requirements)

Design and implement systems that collect solids, reduce contaminant concentrations, and reduce runoff to minimize the discharge of contaminants in both facility wastewater and in runoff that is caused by storms up to and including a 25-year, 24-hour frequency storm. Implement these systems to substantially reduce significant increases in pollutant loadings to ground water.

Manage stored runoff and accumulated solids from the facility through an appropriate waste utilization system.

APPENDIX L

PRESIDENT CLINTON'S CLEAN WATER INITIATIVE (PORTIONS RELATED TO STORM WATER PROGRAM)

United States
Environmental Protection
Agency

Office of Water
Washington, D.C.

EPA 800-R-94-001
February 1994

PRESIDENT CLINTON'S CLEAN WATER INITIATIVE

R0015597

STORM WATER PROGRAMS

ISSUE:

How should CWA storm water requirements be revised to strengthen and facilitate implementation of storm water controls?

BACKGROUND:

States report that approximately 30 percent of remaining surface water quality impairment is attributable to storm water discharges. Significant sources of storm water discharges include urban runoff, industrial activity, construction, and resource extraction (mining). For example, in urban areas, loadings from storm water runoff for heavy metals, sediment, bacteria, polycyclic aromatic hydrocarbons (PAHs), acidity, and floatables are higher than those from POTWs.

To address these environmental risks, Congress established in 1987 a two-phased storm water program under CWA §402(p). Phase I applies to municipal storm sewer systems serving a population over 100,000, as well as storm water discharges associated with industrial activity.

In November of 1990, EPA issued regulations that identified 220 municipalities whose separate storm sewer systems are subject to Phase I of the NPDES program. States and EPA have designated an additional 550 municipalities as part of the Phase I program. The Agency estimates that the Phase I municipalities have a population of over 90 million people (about 36 percent of the total U.S. population). EPA and authorized States have received comprehensive permit applications from many of the municipalities, and are in the process of developing and issuing permits for these dischargers.

In addition, the Phase I regulations established regulation of over 100,000 industrial facilities in eleven categories, including manufacturing, mining, waste management, construction, and transportation. Permits for storm water discharges from Phase I industries generally were required to be issued by October 1, 1993. The Ninth Circuit struck down EPA's exemption from Phase I regulations of construction sites under 5 acres and light industrial activities "with no exposure" to rain water.

Phase II applies to all remaining light industrial, commercial, retail, and residential facilities with storm water discharges that are not in Phase I. Preliminary estimates indicate that millions of facilities are not addressed by Phase I. Phase II is potentially ten times larger in scope than Phase I, and could address a large number of municipalities without significant urban populations. EPA was required to issue Phase II regulations by October 1, 1993, which would designate classes of Phase II storm water discharges to be regulated to protect water quality. Phase II sources are required to obtain a permit by October 1, 1994. EPA did not meet the October 1993 deadline for Phase II regulations.

Municipal Compliance with Standards

Municipal separate storm sewer systems (or "MS4"--those municipal systems that are covered by the storm water program) have stated that it is both technologically and financially impossible to establish treatment or management practices that can ensure that urban storm water runoff complies with water quality standards. They have indicated that it is highly uncertain whether feasible storm water control measures (source controls, traditional structural controls, and best management practices) will ensure that storm water discharges will meet water quality standards. They further argue that the only other alternative, collecting and treating essentially all of the storm water from widespread urbanized areas, would be infeasible and result in significant destruction of urban streams and wetlands.

Under the existing CWA, §402(p)(3)(B)(iii), a statutory standard exists that NPDES storm water discharge permits issued to municipal separate storm sewer systems require controls to reduce the discharge of pollutants in storm water to the "maximum extent practicable" (MEP). The statutory standard can include management practices, control techniques, and system design and engineering methods and other such provisions that the Administrator or State determines are necessary for the control of such pollutants. Because of the lack of a more specific definition of the statutory standard of MEP, municipalities, permitting authorities, and members of the public are uncertain as to the extent of storm water control requirements a municipality must implement in its storm water management program.

Provisions for Facilities with No Exposure

EPA attempted to exempt from storm water control requirements certain industrial facilities that had no exposure of materials, equipment, or wastes to storm water. However, this exemption of facilities without storm water exposure was overturned by the Ninth Circuit. Such an exemption, if reinstated through legislation, would create a strong incentive for facilities to implement pollution prevention. It would simultaneously accomplish environmental objectives (reducing pollutants in storm water) and greatly reduce administrative burdens for EPA, States, and industries.

Deadline Extensions for Phase II

EPA is presently required to issue Phase II regulations designating sources for permitting and establishing deadlines by October 1, 1993. In the absence of new regulations, Phase II sources are required to have permits after October 1, 1994. Given the scope and complexity of Phase II, EPA was unable to meet the October 1, 1993 regulatory deadline. Furthermore, EPA and authorized States will not be able to issue permits to all Phase II sources by October 1, 1994. This may expose unpermitted dischargers, including many small municipalities or commercial enterprises posing small risks, to litigation for discharging without a permit. In addition, potential Phase II municipalities need additional time to develop the financial capabilities and institutional frameworks needed to comply with storm water requirements.

Phase II Storm Water Requirements

Phase II regulations must be reasonable in scope and establish a workable program that will focus on sources of storm water discharges that pose the highest risk. The Bureau of Census has designated 396 urbanized areas which represent the most widespread and dense urban development. These urbanized areas occupy less than 2 percent of the total land area of the United States but contain 165 million people, or about 65 percent of the total population of the United States. In addition, most new development occurs in or adjacent to these urbanized areas. Between 1980 and 1990, over 75 percent of the national increase in population occurred in these urbanized areas. However, over 5,000 municipal entities in urbanized areas are not in Phase I of the NPDES storm water program.

Authorize Municipalities to Directly Regulate Storm Water Facilities Within Their Jurisdiction

Under current CWA provisions, the storm water program requires permits for industrial activities even if they are discharging to municipal separate storm sewer systems which also must obtain storm water permits. Municipalities argue that this is redundant and inefficient, and also undercuts their effectiveness in directly dealing with an industrial facility.

Inactive and Abandoned Mines

It is estimated that there are in the range of 400,000 or more inactive and abandoned mine sites (IAMs) on Federal lands. The environmental damages posed by these sites can vary significantly. While many sites are relatively benign, releases from other sites result in significant environmental degradation, even decades after active operations have ceased. A major administrative challenge is to (1) prioritize these sites that cause environmental problems so that the United States can address them in a rational environmentally protective manner, and (2) effectively protect water resource quality by addressing these sites according to the prioritized order. Another major challenge is to target control measures so as to achieve the greatest improvement in environmental quality for the limited Federal resources that may be available. Although the estimates of total costs of mitigating water resource quality impacts from IAMs vary significantly, they range into the many tens of billions of dollars without such cost-effective, risk-based prioritization.

A significant number of IAMs on Federal lands are believed to have point source discharges of pollutants, as defined under current statute and regulation, to waters of the United States subject to regulation under the NPDES permit program. Given the large number of IAMs and the costs of mitigating sites causing environmental impacts, there is a need for a phased, cost-effective, risk-based prioritized approach to mitigating these sources.

RECOMMENDATIONS:

The Administration recommends that the CWA be amended to do the following--

Municipal Compliance with Standards

- Establish a phased permit compliance approach that requires best management practices in first-round municipal storm water permits, and through improved best management practices in second-round permits, where necessary, to move towards compliance with water quality standards. In later permits, compliance with water quality standards will occur using water quality based effluent limits, where necessary. This would give EPA and municipalities additional time to evaluate the technical feasibility of establishing numeric effluent limits to meet water quality standards and give States time to develop specific water quality standards appropriate for storm water discharges, if necessary.

- The Administration supports clarifying authority under section 402(p)(3)(B) concerning "maximum extent practicable" (MEP). In contrast to best available technology economically achievable (BAT) and best conventional pollutant control technology (BCT) that are applicable for storm water discharges associated with industrial activities, under MEP, storm water management programs can be implemented in a site-specific and flexible manner to address the storm water management concerns in the municipality. It should be made clear that MEP allows for the consideration of different factors including: (1) the severity of the impairment caused by the source, (2) the effectiveness of alternative approaches at reducing storm water discharges, and (3) the cost of control measures. Under MEP, a storm water management program can target controls based on differences in the type and size of sources, climate, geography, and water quality concerns. Based on a statutory clarification, EPA will then issue guidance on the best methods by which to implement MEP in NPDES permits.

- The Administration supports encouraging States to review and revise their designated uses and water quality standards implementation procedures, as they develop water quality-based permits, to reflect the episodic nature of storm water runoff, the varying loadings during storm water events, and the potential resilience of natural ecosystems to some infrequent, temporary incremental loadings.

Provisions for Facilities with No Exposure

- Authorize EPA to exempt from individual storm water permitting requirements facilities that can certify that there is no nor will be exposure of industrial or other activities or significant materials to rain water and snow melt. This change would ensure that several hundred thousand low-risk facilities are not subject to NPDES requirements, allowing allocation of resources to more critical areas. This would also effectively create incentives for facilities to eliminate contamination of storm water.

Deadline Extensions for Phase II

- Extend the Phase II deadline for EPA issue to regulations to October 1, 1997. Also, extend the deadline to obtain a permit to October 1, 1999. These extensions are necessary to allow EPA to work with States and municipalities in developing workable, effective regulations. Extending the deadline for permits would give municipalities an opportunity to begin to build institutional frameworks and provide the funding necessary to implement storm water management programs. It would also allow permits to be issued to Phase II municipalities at the same time Phase I permits are expiring. This will promote regional and watershed-wide permitting by allowing different municipalities to be co-applicants and coordinate their storm water programs.

Phase II Storm Water Requirements

- Focus Phase II requirements on system-wide permits for municipal separate storm sewer systems in Census-designated urbanized areas with a population of 50,000 or more.

- Target storm water management programs for municipal separate storm water systems (MS4) in the 138 Phase II urbanized areas associated with a Phase I permitted MS4 to address, at a minimum, non-storm water discharges into storm sewers and storm water runoff from growth and development and significant redevelopment. The CWA should encourage NPDES permitting authorities as part of a watershed approach to implement a more comprehensive municipal storm water management program where appropriate based on water quality impairments or other factors for the MS4s in these urbanized areas. In the remaining 258 Phase II urbanized areas, storm water management programs would be required which focus only on controlling non-storm water discharges into storm sewers and storm water runoff from growth and development and significant redevelopment activities.

- Under Phase II for those MS4s required to implement a storm water management program targeted to growth, development and significant redevelopment and illicit connections, the municipal program will control those Phase II storm water sources, including discharges from construction of less than 5 acres, which are part of growth, development, and significant redevelopment activities and may address, where appropriate, subject to the MEP standard, those Phase II sources causing water quality impairment. For those municipal separate storm sewer systems required by the NPDES permitting authority to implement a more comprehensive storm water management program, Phase II light industrial, commercial, retail, and institutional storm water sources would be addressed through the program under the municipality's NPDES storm water permit, which meets the MEP standard. Phase II sources not addressed through a municipal program would not be covered by the NDPES program.

- Do not directly regulate Phase II light industrial, commercial, retail, and institutional storm water discharges, and municipalities outside of Census-designated urbanized areas under the NPDES program, unless otherwise designated by the permitting authority for inclusion in the NPDES program under §402(p)(2)(E) of the CWA. (EPA does not expect that this designation process would be used, except in highly-unusual circumstances, to require an NPDES permit for a typical homeowner.) Rather, such discharges could be addressed by NPS program, if they were a targeted source.

<u>Authorize Municipalities to Directly Phase I Industrial Regulate Storm Water Facilities Within Their Jurisdiction Under the NPDES Program</u>

- Allow EPA and authorized States to authorize municipalities to establish programs for Phase I industrial storm water permit issuance and controls, where it has the appropriate authority, and is willing to commit to implement Federal requirements. EPA does not envision Federal funding to be available to municipalities to perform this function. This recommendation is similar to the industrial pretreatment program currently authorized under the CWA. As in the industrial pretreatment program, storm water permits and controls that are issued by municipalities in an EPA-approved program would be Federally enforceable.

<u>Inactive and Abandoned Mines</u>

- The Administration recommends that the CWA be amended to make the following changes to the NPDES permitting program to target control measures so as to achieve the greatest improvement in environmental quality for the limited Federal resources available for inactive and abandoned mine sites (IAMs) without an operator present:

- The Administration supports clarifying authority to issue NPDES permits on a State-wide basis for IAMs within resource management units (e.g., one permit per State for the National Forest Service, National Park System, Bureau of Land Management, or Fish and Wildlife Service resource areas). This would allow Federal land managers to establish State-wide priorities based on impairment or threats to water resource quality and the most effective use of the available resources. Such priorities could allow some sites not to be controlled or be subject to relatively less stringent controls.

- The Administration supports an amendment to substitute, for existing technology-based requirements under the NPDES program for IAMs on Federal lands, the authority for Federal land managers to identify water resource quality that is threatened or impaired by IAMs and to implement targeted controls for such sites, similar to existing authority for permits for municipal separate storm sewer systems contained in section 402(p)(3)(B).

- The Administration further supports allowing, in general, no more than up to ten years to meet appropriate water quality standards within a resource management unit, as defined in the language above, from the date of issuance of an NPDES permit to the Federal land manager. The Federal land manager would be expected during this period to 1) strive to achieve water quality standards as expeditiously as possible, 2) continue to assess the water resource quality impacts of IAMs where they are currently unknown, and 3) continue to implement targeted controls for those sites causing impairments or threats once identified. This provision should not apply to IAMs which were permitted under the NPDES program prior to the date of enactment.

- The Administration supports encouraging States to review and revise their designated uses and water quality standards implementation procedures, as they develop water quality-based permits, to reflect the episodic nature of storm water runoff, the varying loadings during storm water events, and the potential resilience of natural ecosystems to some infrequent, temporary incremental loadings.

United States
Environmental Protection
Agency

Office of Water
Washington, D.C

EPA 800-R-94-002
March 1994

PRESIDENT CLINTON'S CLEAN WATER INITIATIVE:

Analysis of Benefits and Costs

R0015605

Recycled/Recyclable
Printed with Soy/Canola Ink on paper that contains at least 50% recycled fiber

4.0 Storm Water

EPA's current Phase I storm water program requires NPDES permits of cities and counties with municipal separate storm sewer systems (MS4s) serving populations of 100,000 or more and "storm water discharges associated with significant industrial activity." The Phase II program, currently suspended due to a Congressional moratorium, could require permits for all private sources of storm water (commercial, industrial, retail, and institutional) and all MS4s serving all populations that have the potential to affect water quality. In the Initiative, EPA has addressed the potentially high costs of the Phase II program while still providing protection from private sources and additional MS4s.

The "worse case" scenario for storm water permitting reflects the most inclusive option of all potential options that EPA would consider in proposing rules for the types of facilities covered under Phase II. If EPA were to propose regulations for permitting Phase II facilities, EPA may propose to cover only a portion of these facilities, based on consideration of costs incurred and environmental benefits gained. EPA could propose regulations covering the same facilities to the same extent as suggested in the Initiative.

The Initiative's Phase II program will focus on system-wide permits for MS4s in Census-designated urbanized areas--i.e., areas with a population of 50,000 or more and a population density of 1,000 persons per square mile. The Census Bureau has identified 396 such urbanized areas nationwide. Phase II MS4s will be required to implement storm water management programs that are subject to a "maximum extent practicable" (MEP) standard. These programs will, at a minimum, address: (1) nonstorm water discharges to their systems (i.e., illicit connections) and (2) storm water runoff from growth and development and significant redevelopment activities (including discharges from construction of less than 5 acres) and, where appropriate, those Phase II sources causing water quality impairment.

Where the NPDES authority deems it necessary, MS4s in the 138 urbanized areas associated with a Phase I permitted MS4 may be required to have a more comprehensive storm water management program (consistent with the Phase I storm water requirements). The comprehensive storm water management programs would cover Phase II light industrial, commercial, retail, and institutional storm water sources under a municipality's storm water permit. The NPDES program would not cover Phase II sources not addressed through a municipal program. Such discharges could be addressed by the NPS program if they were a targeted source.

4.1 Private Sources

Under a stringent interpretation of the CWA, the current Phase I program is estimated to cost industrial permittees $3.99 billion per year, while Phase II under a similarly stringent interpretation could cost as much as $16.23 billion in annual costs.

To account for the uncertainty in estimating the potential costs, EPA has developed ranges. These ranges account for variations in both the number of sources affected and the costs incurred. The Initiative's Phase II plan would reduce these impacts on commercial, service, and institutional facilities considerably, imposing costs of between $0.34 billion and $1.67 billion per year, as follows:

	Low	High
10,000 facilities x $22,340/facility	$0.22 billion	
28,000 facilities x $34,700/facility		$0.97 billion
96,000 facilities x $630/facility	$0.06 billion	
269,000 facilities x $1,885/facility		$0.51 billion
100,000 sites x $630/site	$0.06 billion	
100,000 sites x $1,885/site		$0.19 billion
TOTAL	**$0.34 billion**	**$1.67 billion**

From a universe of 1.1 million significant sources, EPA has identified 100,000 that are similar to Phase I industrial sources while the remaining 1.0 million are retail, commercial, and institutional. Of the 100,000 industrial sources, approximately 60 percent or 60,000 have no storm water exposure. Of the remaining 40,000 sources, EPA has assumed that municipalities will require between 25 and 70 percent of the facilities to install storm water controls. To further account for the uncertainty inherent in projecting costs, EPA has used $22,340 per facility at the low end and $34,700 per facility at the high end of the estimated cost to comply (EPA, 1994c). The total cost for industrial look-a-likes is estimated to be between $0.22 billion and $0.97 billion per year.

Of the remaining 1.0 million sources, 60 percent are located in urbanized areas and may be addressed under storm water management programs for the urbanized areas. As above, 36 percent, or 216,000 sources, are estimated to have no storm water exposure. Of the remaining 384,000 sources, or 64 percent, the low-end number of facilities (96,000 sources or 25 percent) could incur costs as low as $630 per facility, while the high-end number of facilities (269,000 sources or 70 percent) could incur costs as high as $1,884 per facility.

In addition, 40 percent of the private sources that are not covered by a municipal program would be covered by the NPS program. Under the NPS program, only the sites located in impaired watersheds would need controls. EPA believes roughly 25 percent of these sites are in impaired watersheds. At a range of $630 and $1,885 per site and 100,000 sites, the annual costs will be between $0.06 billion and $0.19 billion.

Based on these estimates, the Initiative's total cost on private sources is between $0.34 billion and $1.67 billion. Compared to EPA's best interpretation of current law and assuming that the moratorium will expire, the Initiative will avoid costs (or yield a cost savings) of between $14.6 billion and $15.9 billion.

The Initiative may also result in potential cost savings for those facilities currently or soon to be permitted under the existing storm water Phase I regulations. About 60 percent of existing permitted industrial sources and 100 percent of potentially permitted light industrial sources will not require NPDES permits under the Initiative's provisions. In addition, small (less than 5 acre) construction sites will be considered Phase II sources, and this would result in additional cost savings of $70 million per year. As a result, additional cost savings to private sources from Phase I requirements will be between $1.1 billion and $1.6 billion.

The above estimates are derived in EPA, 1994c, and are summarized here. Based on a stringent interpretation of the current law, the overall cost savings (or costs avoided) to private sources from these provisions would be in the range of $15.7 billion and $17.5 billion, as shown in Table 21.

4.2 Municipalities

Costs for the current Phase I program for municipal sources are estimated at between $1.6 billion and $2.6 billion annually, based on a covered population of 69.3 million people and per person costs of between $23.91 and $37.00 per person.[8]

If the Phase II moratorium expires, EPA could be required to promulgate regulations covering an additional population of at least 74.1 million people (25.3 million in 138 urbanized areas associated with Phase I MS4s, 29 million in 258 additional urbanized areas between the population of 50,000 and 100,000, and potentially 19.8 million in other MS4s). EPA's best interpretation of the current law is that it would not include these additional 28 million in other MS4s. Using the same unit costs ($23.91 to $37.00), the existing Phase II program could cost between $1.8 and $2.7 billion per year.

To account for the uncertainty of the impact in terms of the number of municipalities affected and the costs incurred, EPA has estimated a range of costs for the Phase II provision in the Initiative. The following estimates are derived in EPA, 1994c, and are summarized here. About 25.3 million people live in 138 urbanized areas (UAs) with growth and development and illicit discharge. Costs range from a low of $15.33 per capita to a high of $23.72 per capita. The range of total costs for these urbanized areas is between $0.39 billion and $0.60 billion. Next, EPA assumed that between 25 and 70 percent of the population in these UAs will be covered by a comprehensive program based in part on the percentage of impaired urban waters. The population affected will be between 6.33 million and 17.7 million. The additional cost of

[8] Population estimates for the municipal storm water costs are from the draft "Report to Congress on Storm Water Dischargers Not Regulated Under Phase I of the NPDES Storm Water Program" (EPA, 1993d). Average costs are from the draft EPA report "Review of Program Costs in Part 2 NPDES Municipal Storm Water Permit Applications" (EPA, 1993c).

a comprehensive plan above the cost of addressing growth and development and illicit discharges will be in the range of $8.58 and $13.28 per capita. The total cost of the comprehensive coverage will vary from a low of $0.05 billion to a high of $0.24 billion.

EPA identified 29 million people in another 258 UAs who will be affected by the Phase II provisions. The cost of compliance will vary from $15.33 per capita to $23.72 per capita. The total cost of this coverage will be in the range of $0.44 billion and $0.69 billion. The final element of this cost on municipalities is the cost of addressing private sources and industrial look-a-likes that impact water quality in areas without the comprehensive program and in areas with combine sewers. At a per capita cost of $2.00, EPA estimates that about 75.7 million people will incur $0.15 billion. At a per capita cost of $5.00, the upper-end cost would be $0.38 billion.

	Low	High
25.3 million population x $15.33 per capita	$0.39 billion	
25.3 million population x $23.72 per capita		$0.60 billion
6.33 million population x $8.58 per capita	$0.05 billion	
17.7 million population x $13.28 per capita		$0.24 billion
29.0 million population x $15.33 per capita	$0.44 billion	
29.0 million population x $23.72 per capita		$0.69 billion
75.7 million population x $2.00 per capita	$0.15 billion	
75.7 million population x $5.00 per capita		$0.38 billion
TOTAL	**$1.03 billion**	**$1.91 billion**

The total cost to the municipalities of the proposed Phase II requirements is between $1.03 billion and $1.91 billion, as shown in Table 20.

Compared with the cost of Phase II requirements under a stringent interpretation of the current law, total savings to municipalities will be between $755 million and $850 million per year.

4.3 State Water Programs

The impacts of the Phase II storm water provisions on states have not been estimated but are expected to be minimal.

4.4 Federal Agencies

Additional costs of the storm water provisions on federal agencies will total $19 million per year. EPA will account for $2 million per year of this cost, and DOI will account for $17 million per year.

4.5 Benefits[9]

The benefits of storm water control as proposed in the Initiative are based on numerous case studies and are summarized as follows:

- 75 to 80 percent reduced loadings in urbanized areas prior to and during development,
- 15 to 25 percent reduced loadings in areas already developed,
- Greater environmental protection at lower cost,
- Improved water resource quality, habitat, and aquatic life; reduced flooding; improved recreational opportunities; increased commercial fishing; improved human health; and increased employment.

(Note that more cost-effective and institutionally feasible prevention and management methods are available for new development than for areas that have already been developed.)

Case Studies[10]

Bellevue, Washington (see longer summary in Appendix B)

Bellevue has a population of nearly 87,000 and covers a 30-square mile area that contains five lakes and over 50 miles of open streams. The city established a storm water utility in 1974 to maintain a hydrologic balance, prevent property damage, and protect water quality.

The city requires newly developing areas to include on-site storm water management that provides protection for 24-hour, 100-year storm events.

Examples of program benefits:

-- Flood control. One of the most successful aspects of the program is flood control, which relies on eight remote-controlled regional detention basins along major stream corridors to monitor rainfall, stream flow, and water levels. This helps ensure that flood gates control peak flows. Small detention basins reduce peak flow rates up to 60 percent, providing flood and stream-bank erosion control and protecting stream-side property.

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[9] See also the EPA (1994e) background paper "CWA Benefits of Storm Water Controls," January 1994.

[10] Costs for these case studies were not available and hence are not included here.

-- Reduced property damage. As a result of storm water controls over the previous 10 years, property damages were avoided during a 100-year storm in January 1986.

-- Reduced pollutant loadings. Runoff concentrations of lead and total solids were reduced by 10 to 25 percent through biannual cleaning of storm drainage inlet pumps and catch basins; oxygen demanding substances, nutrients, and zinc concentrations were reduced by 5 to 10 percent. Conventional street-sweeping operations reduced toxic loadings by 5 to 10 percent. Installation and maintenance of oil/water separators reduced floatables in the drainage system.

-- Reduced illegal dumping. Dumping of motor oil and debris in storm drains was significantly reduced through increasing public awareness of storm water issues and volunteer stenciling of storm drains. A recent survey indicates that 85 percent of area residents dispose of used oil at a recycling facility.

-- Increased recreational opportunities. Clean-up of Mercer Slough (a 325-acre wetland) along with stream and wildlife enhancement of the park resulted in increased canoeing on the slough and increased visitation to the park's trails.

Murray City, Utah

Murray City (population 31,000) worked with the Utah Department of Transportation (DOT) to develop a storm water control system for runoff from a 4.5-mile stretch of highway in conjunction with the construction of an 18-hole, 135-acre municipal golf course.

Storm water runoff from the highway and subsurface waters is collected and routed through a series of streams and wetlands into four ponds on the golf course.

Examples of program benefits:

-- Reduction in pollutant loadings. The pond system removes approximately 90 percent of the sediment, oil and grease, and dissolved materials from the highway runoff.

-- Flood control. The system successfully handled the runoff from two 25-year storms.

-- Savings in irrigation water costs. The detention ponds provide 7 acres of flood retention area and created nearly 11 acres of wetlands. The ponds also provide water to irrigate the golf course, which saves nearly $80,000 per year in watering costs.

-- Savings in highway construction costs. Because runoff was diverted to irrigate the golf course, DOT saved $300,000 in land acquisition and storm water piping costs by eliminating the need to construct a separate storm water discharge system for the highway.

Orlando, Florida

The city of Orlando (population 160,000) receives over 50 inches of rain annually, over half of which converts to storm water runoff and flows into the city's 83 lakes. One example of a project to manage storm water is the creation of the Greenwood Urban Wetland, which consists of several ponds in a series.

Examples of program benefits:

-- Increased property values. Overall, whenever Orlando constructs a storm water control lake, property values in that area increase.

-- A savings was realized in construction of the Greenwood Urban Storm Water Control Wetland with the sale of fill dirt that was excavated ($5/cubic yard).

-- Creation of a natural park. The Greenwood Urban Wetland created a natural park atmosphere (with footbridges, walking paths, picnic areas, and opportunities for observing wetland wildlife) in an urbanized area.

-- Irrigation and drinking water supply. Cleansed storm water is used to irrigate the upland areas of the park, which conserves the drinking water supply.

Santa Clara Valley, California

Santa Clara Valley has a municipal storm water permit covering 15 co-permittees (14 municipal entities and one water control district). Three of the municipalities have populations over 100,000, four are between 50,000 and 100,000, and seven are less than 50,000.

Transportation activities have been identified as potentially the most significant source of storm water pollutants. Copper and zinc have been identified as significant contaminants in the storm water runoff into south San Francisco Bay. These metal are carried by suspended particles. Brake pad dust is believed to be a major source of the copper.

Examples of program benefits:

-- Significant reduction in copper loadings. Street sweeping activities clean 19,000 miles per month and have prevented 2,500 pounds of copper and 46,000 cubic yards of material throughout the area from entering storm sewers.

-- Reduction in floatables. Cleaning 34,000 catch basins has removed 1,000 cubic yards of material. Inspection and cleaning of 160 miles of conveyances has removed 400 cubic yards of material.

-- Identification of illegal dumping activities. The co-permittees identified 867 cases of illegal dumping, of which 700 have been resolved.

Tulsa, Oklahoma

The city of Tulsa (population 367,000) has been recognized as having an effective storm water management program. EPA recently issued a draft municipal storm water permit for Tulsa.

Discharges from Tulsa's storm sewer collection system were identified as a source of pollutant loadings in the Zinc Lake portion of the Arkansas River. The storm sewer's discharges showed a high concentration of bacteria.

Examples of program benefits:

-- Removal of suspended solids. Tulsa estimates that its construction site storm water controls average 70 percent effectiveness in removing total suspended solids from storm water runoff. In addition, the city estimates that its street sweeping and structural operation and maintenance reduce suspended solids by up to 50 percent; metals by up to 10 percent; total solids and lead by 10 to 25 percent; and oxygen demanding substances, nutrients, and zinc by 5 to 10 percent.

-- Improved Water Quality in the Arkansas River. The city identified 35 illicit storm sewer connections drained into Zinc Lake and the Arkansas River. Tulsa removed these discharges from the storm sewer system and states that water resource quality has improved as a result.

STORM AND SURFACE WATER UTILITY
BELLEVUE, WASHINGTON

Bellevue, Washington, is a suburban community located in the Puget Sound area east of Lake Washington in the Seattle metropolitan area. The city experienced substantial population growth during the last 30 years and particularly rapid growth over the last 20 years. When Bellevue incorporated as a city in 1953, the population was approximately 6,000 and the city limits covered five square miles. By 1990, Bellevue had grown to a population of 86,000 and an area that covered 30 square miles, making it the fourth largest city in Washington State. Recent estimates indicate that the watershed is over 90 percent developed, primarily with residential units and commercial and light industrial uses.

Rapid growth and development created storm water runoff problems in most of the natural streams draining the area. The city's 30-square mile area contains over 50 miles of open streams and five lakes. Much of the average annual rainfall of 42 inches is carried by existing streams into the following receiving waters: Kelsey Creek, Meydenbauer Bay and the Lake Washington East Channel, Yarrow Bay on Lake Washington, Lake Sammamish, and Coal Creek. Of these, Lake Washington is considered the primary receiving water body. The types of storm water runoff problems documented in the Bellevue area include increased flooding and streambank erosion; property damage; stream sedimentation/siltation; diminished salmon runs; water quality degradation by discharges of nutrients, heavy metals, pesticides, and oil; and illicit connections.

In response to citizen concerns about environmental degradation caused by storm water runoff, the city of Bellevue established a storm water utility in 1974. The mission of Bellevue's Storm and Surface Water Utility (SSWU) is to manage the storm and surface water system in Bellevue, to maintain a hydrologic balance, to prevent property damage, and to protect water quality for the safety and enjoyment of citizens and the preservation and enhancement of wildlife habitat.

STORM AND SURFACE WATER UTILITY PROGRAMS

When first established, Bellevue's utility focused on examining various solutions to control flooding and preserve waterways. The utility selected an "open stream concept" using streams as the main conveyance system for storm water runoff. This system uses regional, in-stream flood control facilities to attenuate peak flows for older development. The utility also manages the municipal storm drainage system. In addition, regulations require developers to provide erosion and sedimentation controls at all construction sites and on-site storm water controls for new development. With successful flood control systems in place, the focus has recently shifted to water quality controls, including requirements mandated by the federal Clean Water Act. For the most part, SSWU's comprehensive effort to solve storm water quality problems is preventive in nature, but the utility also recognizes the need for retrofitting and new capital improvements for treatment.

Management of Bellevue's storm drainage system and open streams involves five major programs: a capital improvement program, operations and maintenance, water quality control, public education, and administration. Activities conducted under each of the major programs are summarized below.

- **Capital improvement program.** SSWU's capital improvement program (CIP) involves planning, design, property acquisition, flood control construction, water quality treatment, and stream enhancement projects. The utility constructed a series of 11 in-stream flood control facilities (detention basins) within the Bellevue stream system to provide protection for the 24-hour, 100-year storm event. SSWU also improves stream passages for carrying capacity, stability, wildlife habitat, and migratory fish passage.

- **Operations and maintenance.** The operations and maintenance (O&M) program involves those functions typically associated with urban drainage, such as repair and minor replacement of SSWU's structural facilities. Bellevue's O&M program also includes operation of structures for flood control, including a telemetry control system for structures and an emergency storm response program, a drainage system inventory, and advice to private citizens on private drainage concerns.

- **Water quality control.** Activities conducted for water control include drainage system cleaning, routine monitoring of receiving waters, investigative monitoring of pollution events and sources, emergency response for water pollution events, coordination with other water quality control agencies, participation in lake restoration studies and projects, a private maintenance inspection program, and a streams enhancement program.

- **Public education.** SSWU's public education efforts focus on available services and the environment. Specific activities include articles in local publications about SSWU services and the effects of human practices on the environment, the Stream Team Program (includes a water quality newsletter, workshops, and citizen activities), City Hall's "Mini Salmon Hatchery" and annual salmon release, storm drain stenciling projects, and a business water quality program.

- **Administration.** Administrative programs for SSWU include financial management, rate administration, comprehensive drainage planning, general administration, and support for the City Council and Storm and Surface Water Advisory Commission. SSWU assures quality control of utility services by tracking all service requests through an automated Customer Action Request system.

UTILITY FINANCING

The city decided that the most equitable system of drainage service charges entails basing changes on the estimated amount of runoff that individual properties contribute to the surface water system. All properties are classified according to their intensity of development. Each classification is assigned a rate (per 2,000 square feet of property area), with current rates set as follows: undeveloped ($0.17), light development ($0.99), moderate development ($1.23), heavy development ($1.83), and very heavy development ($2.46). Wetlands are also a class; however, wetlands are not charged due to their value in water quantity and quality control. The classification combined with the total square footage of the property determines the service charge, which is billed every two months.

Revenues grew slowly until rates were raised to fund the adopted Capital Improvement Program, which was initiated by issuance of $10 million in revenue bonds. Three major rate increases occurred in 1980 (70 percent), 1982 (90 percent), and 1986 (35 percent), and subsequent rate increases have remained in the single-digit category largely to cover inflation. Although the majority of SSWU revenue is from service charges, other revenue sources include clearing and grading permit fees, general facilities charges, and interest on fund accounts. Revenues from the utility service charges and these other sources cover the full costs of Bellevue's storm and surface water management program.

Single-family customers make up 92 percent of the 24,000 accounts and contribute 45 percent of the revenue. An average single-family household pays $16.44 every two months ($98 per year) for 10,000 to 12,000 square feet of property with a typical home. Tax-exempt properties are not exempt from the utility charges. (Washington State highways and Bellevue streets are the SSWU's two biggest ratepayers.)

BENEFITS OF THE STORM AND SURFACE WATER PROGRAM

One of the most successful of SSWU's programs is flood control, and several different approaches to managing storm water discharges are achieving water quality improvements. In addition, Bellevue's reputation as a well-planned, environmentally sensitive city is enhanced through SSWU programs that preserve the city's numerous streams.

Reductions in Peak Flows

- Bellevue's use of the natural stream system to manage storm water preserves the environment and reduces costs. Bellevue's storm water management activities to address flooding and stream erosion problems range from four to ten times less costly than traditional storm sewer improvements.

- Small detention basins (detention times of 30 minutes or less) reduced peak flow rates by up to 60 percent, providing flood and streambank erosion control that protects streamside property.

- With a computerized remote control system, maximum flood protection along major stream corridors is achieved through eight regional detention basins. The remote control system monitors rainfall, stream flow, and water levels to ensure optimal operation of flood gates to control peak flows.

- During a 100-year storm experienced by the Bellevue area in January 1986, property damages occurred only where planned improvements were not yet constructed. Capital improvements totalling $15 million and constructed over the previous 10 years reduced flooding and streambank erosion, thereby avoiding property damages.

- Calls for emergency service during storm events continue to decrease, indicating that SSWU's flood control system has significantly reduced hazards to life and property.

Reductions in Pollutant Loadings/Discharges

- Runoff concentrations of lead and total solids were reduced by between 10 to 25 percent over a two-year period through biannual cleaning of storm drainage inlet sumps and catch basins. Chemical oxygen demand (COD), nutrient, and zinc concentrations were reduced by between 5 to 10 percent over a two-year period.

- Toxic loadings were reduced by between 5 and 10 percent by conventional street-sweeping operations.

- Introduction of floatables to the drainage system was reduced by the installation and maintenance of oil/water separators, some of which have the capability of reducing oil and grease during oil spill events to levels generally associated with background levels in urban storm water.

- Dumping of motor oil and debris in storm drains was significantly reduced by increasing public awareness of storm water issues through SSWU's Stream Team Program and volunteer stenciling of storm drains. A recent survey indicates that 85 percent of area residents dispose of used oil at a recycling facility.

- Dumping of motor oil and household chemicals was also reduced through SSWU's Oil Recycling and Hazardous Waste Program. SSWU collected 2,100 gallons of petroleum products at a recycling event in October 1993.

- Total solids in urban runoff originating from residential yards were reduced by increasing public awareness of practices such as pet waste and litter control.

- A wide variety of local businesses work with SSWU water quality staff to prevent storm water pollution at the source through an innovative program called Business

Partners for Clean Water.

Protection or Restoration of Ecological Resources

- Volunteers have planted thousands of native trees and shrubs along 10 miles of Bellevue's open streams to shade stream waters and enhance fish habitat. Other stream enhancement projects conducted through the Stream Team Program have reduced streambank erosion which also lowered water temperatures and provided shade to enhance fish habitat.

- Kelsey Creek's salmon fishery was enhanced through installation of regional detention basins that help mitigate peak flows and habitat improvements from streambank revegetation projects. Previously, this salmon fishery was limited and unhealthy because of high peak flows from urban runoff that altered the stream channel and carried pollutants.

- Anadramous fish populations are enhanced because SSWU's flood control system is designed to provide maximum flood protection with minimum impact on fisheries and fish migration. During salmon spawning season, flood control gates remain open until significant heavy rainfall occurs.

- Sensitive areas (floodplains, wetlands, and steep slopes) are protected through the city's Natural Determinants Regulations, which prohibit development of designated areas, including 740 acres of wetlands.

- The city is restoring Phantom and Larsen Lakes in partnership with the Washington Department of Ecology. Restoration measures for Phantom Lake over a two-year period reduced annual internal phosphorus loading to the lake by approximately 75 percent and reduced annual external phosphorus loading by 39 to 54 percent. The trophic status of Phantom Lake improved substantially after implementation of restoration measures, although it remains a eutrophic lake.

- Ecological and aesthetic features of the natural environment are preserved through regulation of new development under city codes and a Comprehensive Plan to reflect the philosophy that development should be integrated naturally with the environment and preserve rather than overcome natural features.

Recreation Activity

- Kelsey Creek, a natural water channel that was developed to convey storm water from the city of Bellevue to Lake Washington, provides recreational opportunities such as canoeing, birdwatching, and hiking.

- Cleanup of Mercer Slough (a 325-acre wetland), along with stream and wildlife enhancement in Mercer Slough Nature Park, resulted in increased canoeing on the slough and increased visitation to the park's interpretive trail.

- Phantom and Larsen Lakes furnish recreational opportunities such as fishing and educational opportunities for school children, who visit the lakes for environmental education projects.

Economic Activity

- Clean water in Bellevue and the surrounding Puget Sound area is important for drinking, food sources, recreation, and industry.

References

"Bellevue Washington: A Leader in Surface Water Management." Storm and Surface Water Utility Department, City of Bellevue, Washington.

Diessner, D. "The Bellevue Storm and Surface Water Utility: A Case History of a Successful Urban Surface Water Management Program." prepared for Storm and Surface Water Utility Department, City of Bellevue, Washington.

"The Metro Monitor," Municipality of Metropolitan Seattle, October 1993.

Personal communication with Wendy Skony, Program Coordinator, Bellevue Storm and Surface Water Utility, December 8, 1993.

Personal communication with John Frodge, Municipality of Metropolitan Seattle, December 9, 1993.

"Phantom/Larsen Lake Phase IIB Restoration Project." Final report prepared by KCM, October 1993.

"Storm Water Utilities: Innovative Financing for Storm Water Management." Prepared by Apogee Research, Inc., for the Water Policy Branch, Office of Policy Analysis, Office of Policy, Planning and Evaluation, U.S. Environmental Protection Agency. Draft final report, March 1992.

EPA. 1992. "Environmental Impacts of Storm Water Discharges: A National Profile." EPA 841-R-92-001. Office of Water. June 1992.

EPA. 1990. "Storm Water Guidance Impact Analysis: Volume II: Case Studies." Draft. Office of Water. May 15, 1990.

United States
Environmental Protection
Agency

Center for Environmental
Research Information
Cincinnati, OH 45268

EPA/625/R-95/003
April 1995

DR

EPA

Seminar Publication

National Conference on Urban Runoff Management: Enhancing Urban Watershed Management at the Local, County, and State Levels

March 30 to April 2, 1993

The Westin Hotel

Chicago, Illinois

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Printed on Recycled Paper

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Acknowledgments

This document is the product of the efforts of many individuals. Gratitude goes to each person involved in the preparation and review of this document.

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A special thanks goes to the many authors of the papers presented in this document. Their efforts in preparing papers made this document possible and led to the overall success of the conference.

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Special Thanks

A special thanks goes to Bob Kirschner, Northeast Illinois Planning Commission, Chicago, IL, for his efforts in producing a high quality, technically sound conference. Without his efforts, the conference and this document would not have been possible. His talent and efforts are truly appreciated.

Background

As stormwater and snowmelt flow across the urban landscape, countless contaminants are carried into our rivers, lakes, and estuaries. The effects of these contaminant discharges on the environment can be severe. Water quality and sediment characteristics can be degraded, threatening the biological integrity of our urban water bodies. In addition to urban runoff quality, the quantity of urban stormwater and snowmelt that reaches urban streams can cause severe physical harm to sensitive ecosystems, including those well beyond urbanized areas.

The proper management of urban watersheds is a challenging and complex task. As urban watersheds are developed, they produce a site-specific mix of pollutants that can adversely affect water and sediment quality. Also, with increased urbanization comes increased impermeability, resulting in higher stormwater flows to streams that can cause streambed and streambank erosion. Urban runoff management is particularly difficult because government jurisdictions rarely coincide with watershed boundaries. So, to overcome these institutional obstacles and implement effective urban watershed management programs, comprehensive and coordinated management strategies are needed.

The National Conference on Urban Runoff Management was held in Chicago, Illinois, from March 30 to April 2, 1993. The purpose of this conference was to bring together national experts in the field of urban watershed management to discuss and share ideas and approaches for effective urban watershed management. This 4-day conference addressed a wide variety of institutional and technical issues, from watershed planning and public information programs to the design and application of best management practices.

Purpose

The purpose of this seminar publication is to make available to a much wider audience the valuable information presented at the National Conference on Urban Runoff Management. This publication comprises 53 papers that were presented at the conference. The papers address a broad spectrum of programmatic and technical topics relating to urban watershed management, including:

- Watershed planning
- Stormwater management programs
- Regulatory issues
- Monitoring, modeling, and environmental assessment
- Design and application of best management practices and controls
- Education and information programs

The papers in this publication represent the collective knowledge and experience of many talented individuals who have developed and are implementing and supporting watershed management programs at the federal, state, county, and local level. As a result, this document will be a valuable resource to regulators, watershed management program personnel, and others interested in developing and implementing a successful urban watershed management program.

Watershed Planning and Program Integration

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Abstract

Since passage of the Clean Water Act, federal, state, and local governments together with the private sector have spent billions of dollars attempting to meet the act's goals of restoring and maintaining the chemical, physical, and biological integrity of the nation's waters. While great progress has been made, especially with respect to reducing traditional point sources of pollution, we are faced with a much more complex and difficult challenge: reducing the pollution associated with our everyday activities. Facing the environmental challenges presented by nonpoint sources and stormwater discharges requires a more comprehensive and integrated approach, especially if we are to maximize the environmental benefits in a cost-effective manner. This approach is known as watershed management—the integration, on a watershed basis, of the management of land resources, water resources, social-cultural resources, financial resources, and infrastructure. Implementation of this approach requires a cooperative Watershed Management Team effort involving all levels of government, the private sector, and each citizen.

Besides addressing the need for watershed management, this paper discusses briefly the many components of a comprehensive watershed management program. Key program elements include growth management, land preservation/purchase, wetlands/floodplains protection, erosion and sediment control, stormwater management, wastewater management, watershed prioritization and targeting, inspections and maintenance, research, public education, and dedicated funding sources. Other papers in this publication review the evolution of Florida's watershed management program, with emphasis on successes and failures together with recommendations to improve the environmental effectiveness of the program (e.g., "The Evolution of Florida's Stormwater/Watershed Management Program").

Introduction

When land within a watershed is changed from its natural state to agricultural land and then to urban land, many complex interconnected changes occur to the natural systems within the watershed. These changes can and do have profound effects on the health of these systems as well as their inhabitants. As Earl Shaver describes in his paper, one of the greatest changes is the alteration of the watershed's hydrology, especially the infiltrative capacity of the land. Additionally, the everyday activities of humans within the watershed add many potential environmental contaminants to the watershed that can be easily transported by precipitation and runoff.

Managing stormwater and nonpoint sources of pollution presents many complex challenges to the water resources manager that are somewhat unique and quite different from those encountered when managing traditional point sources of pollution. These challenges include:

- Integrating land-use management, because change in land use creates the stormwater problems.
- Educating the public about how everyday activities contribute to the stormwater/nonpoint source problem and how they must be part of the solution.
- Developing a management framework that is based on the fact that "we all live downstream" and that stormwater flows are not constrained by political boundary lines.
- Obtaining the cooperation and coordination of neighboring political entities that exist within a watershed.
- Not only managing stormwater from new development but retrofitting existing "drainage systems" that were built solely to convey runoff away from developed lands to the nearest water body as quickly as possible.

Secondly, constraints imposed by current stormwater treatment technology, such as treatment efficiency, land needs, and maintenance needs, and by the costs of assessing and solving existing stormwater/nonpoint source pollution problems call for a cooperative and regional framework. Additionally, the proliferation of federal programs and requirements imposed by federal legislation, such as the Federal Clean Water Act and the Coastal Zone Management Act, has caused fragmentation of efforts and created program "turf wars" and even conflicts between programs within the U.S. Environmental Protection Agency (EPA). Other federal programs such as the National Flood Insurance Program, the Section 205 flood control program, and even agricultural crop subsidy programs directly conflict with achieving the goals set forth in various environmental laws and programs. Finally, current environmental management approaches rely on regulatory efforts that attempt to compensate for adverse effects caused by land alteration activities on a particular site. Implementing a watershed management approach helps to overcome all of these challenges and, just as importantly, allows inclusion of planning efforts that can prevent problems. This allows for more extensive use of less expensive nonstructural management practices.

Watershed Management

"Watershed management" is a flexible framework for integrating the management of all resources (land, biological, water, infrastructure, human, economic) within a watershed. Basically, it is the managing of human activities so as to cause the least disruption to natural systems and native flora and fauna. With respect to the management of stormwater and nonpoint sources, the crucial factor is the integration of the management of land use, water/stormwater, and infrastructure. Watershed management has numerous facets, including planning, education, regulation, monitoring, and enforcement, that are performed on a watershed basis.

The watershed management approach discussed in this paper must be flexible. The size of the watershed to be managed can be very large (a river basin) or very small (a subbasin). Selection of watershed size depends on many factors, including ecological systems in the watershed, ground-water hydrologic influences, the type and scope of resource management problems and goals, and the level of resources available. Additionally, the institutional framework for watershed management will vary greatly depending on the legal framework that has been established in state law and local ordinances.

Advantages of Watershed Management

As discussed above, solving our nation's stormwater/nonpoint source problems, especially retrofitting existing "drainage systems" to reduce the pollutant loads they discharge to receiving waters, presents many complex challenges. Correcting these problems will be extremely expensive and technically difficult, and will take a long time. Accordingly, we need to re-evaluate our current approach to stormwater management to shift the emphasis towards more comprehensive, prevention-oriented strategies such as watershed management.

The following comparison illustrates the differences between the usual piecemeal approach to stormwater management and a comprehensive watershed approach (1):

- The usual approach: For existing urban development, the usual approach is to address local stormwater problems without evaluating the potential for the runoff control measure to cause adverse effects in downstream areas. In the case of new urban development, stormwater management responsibilities would be delegated to local land developers, and each would be responsible for constructing stormwater management facilities on the development site to maintain postdevelopment peak discharge rate, volume, and pollutant loads from the site at predevelopment levels. There would be little or no consideration of the cumulative effects of the developments with their individual stormwater systems on either the local government stormwater infrastructure or the downstream lands and waters.
- The watershed approach: This option involves developing a comprehensive watershed plan, known as the "master plan," to identify the most appropriate control measures and the optimal locations to control watershedwide activities. The watershed approach typically involves combinations of the following:
  - Reviewing the watershed and its characteristics to assess problems and potential solutions.
  - Strategically locating a single stormwater management facility (a regional system) to control postdevelopment runoff from several projects within a basin (or from a fully developed basin or subbasin).
  - Providing stormwater conveyance improvements where necessary upstream from the regional facility.
  - Employing nonstructural measures throughout the watershed, such as acquisition of floodplains, wetlands, and natural stormwater depressional storage areas; soundly planned land use; limitations on the amount of imperviousness; grassed swales rather than storm sewers; and roof runoff direction to pervious areas.

While the usual approach to urban stormwater management is relatively easy to administer, it offers several disadvantages. There is a greater risk of negative effects, particularly in watersheds that cover several jurisdictions. Insignificant flood protection benefits result from emphasis on the effects of minor localized flooding. Ineffective runoff control throughout the watershed is caused by the failure to evaluate locational differences in the benefits of stormwater management facilities. Relatively high local costs for facility maintenance are incurred, as are unnecessary costs associated with the use of small-scale structural solutions rather than large-scale nonstructural solutions, which typically are much cheaper.

Included among the possible negative effects of this piecemeal approach to stormwater management are the following:

- It may only partially solve the major flooding problem(s).
- It may solve flooding problems in the upstream jurisdiction but create flooding problems in downstream jurisdictions.
- Randomly located detention basins may actually increase downstream peak flows.
- Maintenance needs and costs associated with numerous onsite runoff controls are very high.
- Significant capital and operation/maintenance expenditures may be wasted.
- The costs of remedial structural solutions likely will be much greater than the cost of a proper management program.

The watershed master planning approach offers significant advantages over the piecemeal approach. It promises reductions in capital and operation/maintenance costs and reductions in the risk of downstream flooding and erosion, particularly in multijurisdictional watersheds. It offers better opportunities to manage existing stormwater problems and the ability to consider and use nonstructural controls. Other benefits include increased opportunities for recreational uses of stormwater controls, potential contributions to local land-use planning, enhanced opportunities for stormwater reuse, and popularity among land developers.

There are some disadvantages to the watershed approach:

- In advance, local governments must conduct studies to locate and develop preliminary designs for regional stormwater management facilities.
- Local governments must develop and adhere to a future land-use plan so that the regional facility is properly designed to capture runoff from the planned amount of development and impervious surfaces.
- Local governments must finance, design, and construct the regional stormwater management facilities before most development occurs and provide for reimbursement by developers over a buildout period that can last many years.
- In some cases, local governments may have to conduct extraordinary maintenance activities for regional facilities that the public feels are primarily recreational facilities that merit protection for water quality.

Another advantage of watershed management is that the resource management goals can be more resource oriented. Prevention practices and programs to protect natural systems and beneficial uses of our water bodies can be stressed. These typically are more cost effective than trying to restore natural systems after they have been adversely affected by human activities that occur within a watershed.

Watershed management allows coordination of infrastructure improvements with point and nonpoint source management programs and, most importantly, provides a vital link between land use and water resources management.

Watershed Management Framework

There is no single approach or institutional framework for establishing a watershed management program. While establishing a watershed management institutional and legal framework would be easiest if we could start with a clean slate, we cannot. There is an existing legal framework in each state, county, and city. These may differ greatly. In some states, there will be a long list of existing laws, rules, and programs that have been set up to respond to earlier state needs. In other states, there will be very few laws, rules, and programs that can form a foundation for establishing watershed management programs. Therefore, one of the keys to opening the watershed management door is flexibility. In some cases, the focus will be on enacting new laws. In other cases, the emphasis will be on revising existing laws (ordinances) to better integrate and coordinate programs and objectives.

Another key to establishing a watershed management framework is patience. Getting state laws or local ordinances enacted or modified is not an easy process. A long-term game plan must be developed and pursued with diligence. Each component of a watershed management program has its own controversies, guaranteeing that public debate will be vociferous on many issues. Therefore, priorities must be established. Typically, priority setting depends on state resource problems and needs, public sentiment, and the degree to which an issue becomes "sexy," thereby receiving coverage by the news media. In many cases, it may take several years to get a particular piece of legislation passed or revised.

To succeed, education of elected officials, state agency managers, and the public must be a priority. Public participation and support are essential in building a consensus. Many of the issues that watershed management programs address are complex and not easily demonstrated. Managers of stormwater and other nonpoint sources of pollution, unlike the managers of traditional point sources of pollution, cannot point to pipes that continuously discharge effluents. Therefore, promoters of watershed management programs must use multimedia presentations to not only educate but also to entertain. You must sell the need for watershed management!

Another key to success is to take advantage of any opportunities that arise. Unfortunately, these opportunities often occur after a natural disaster that results in the loss of property or lives. After Hurricanes Frederick and Andrew struck South Carolina and South Florida, respectively, considerable public debate arose about building codes, land uses, and development within sensitive and susceptible coastal area—whether to allow rebuilding in these areas and whether public programs such as the National Flood Insurance Program should subsidize development in such areas. These debates, especially of the costs and benefits, can be used to help build support for growth management and land acquisition programs. Furthermore, flooding (and in a few locales, water quality problems) can be used to break the "hydro-illogical cycle" and gain support for stormwater management programs and local stormwater utilities.

Finally, in building a watershed management framework, one must establish clear goals for the overall program. Some important goals include:

- Providing opportunities for preventive nonstructural controls in addition to structural controls that can help to mitigate the impacts of human activities within a watershed.
- Establishing clearly defined, holistic natural resource management goals.
- Setting priorities, both in terms of a long-term legislative agenda and by targeting watersheds.
- Encouraging public participation so that everyone "buys in" and feels that they are part of the solution.
- Integrating all available tools and resources into a coordinated, cost-effective, cooperative approach.
- Finding dedicated funding sources outside the main funding stream (also known as "general revenues") so that the watershed management programs do not compete with law enforcement, education, or other high-priority societal needs.

In developing, selling, establishing, and implementing a watershed management framework and associated programs, it is very important to keep in mind "the big Cs of watershed management" (2):

- *Comprehensive* management of people, land use, natural resources, water resources, and infrastructure throughout a watershed.
- *Continuity* of stormwater/watershed management programs over a long period, which is required to correct existing problems and prevent future ones.
- *Cooperation* between federal, state, and local governments; cities and counties; public and private sectors; and all citizens.
- *Communication* to educate ourselves and elected officials about how we are all part of the problem and how we can and must be part of the solution.
- *Coordination* of stormwater retrofitting to reduce pollutant loading and of other natural systems restoration activities with other proposed infrastructure improvements (e.g., road projects) or development/redevelopment projects to maximize benefits and cost-effectiveness.
- *Creativity* in best management practice technology, in funding sources, and in our approach to solving these complex, costly problems.
- *Consistency* in implementing laws, rules, and programs nationally and statewide to assure equity and fairness for everyone.
- *Cash* in large amounts and over a long period to correct existing problems and prevent future ones.
- *Commitment* to solving our current problems and preventing future ones so that we can ensure that our children have a bright future ("Just Say No To Stormwater Pollution").

Watershed Management Program Components

Watershed management involves the integration of management programs addressing the many differing human activities that occur within a watershed. This section discusses briefly many different components or programs that typically are considered a part of watershed management. The following list and discussion of programs is not all inclusive. Other programs addressing specific state or regional needs have been implemented around the country. In developing or implementing programs, it is important to take advantage of information and technology transfer clearinghouses and to communicate with people in other states, cities, and counties who have implemented similar programs.

Each of the various watershed management programs includes common aspects such as planning, holistic goals, science/technical support, implementation (usually with both regulatory and nonregulatory approaches), and extensive public participation. Public participation is needed in all aspects of the program: planning, rule development and adoption, permitting, and inspection/enforcement. Programs must also address how to obtain adequate funding and staffing; how to train staff and the public, especially the regulated community; how to ensure inspection and compliance; and how to ensure long-term operation and maintenance of structural controls. Finally, programs must be evaluated regularly to optimize their environmental effectiveness, cost-effectiveness, and efficiency in providing service. This requires a commitment to monitoring programs that can actually ascertain if the program's goals are being met.

Typically, these programs are implemented following enactment of a state law that requires a state agency to set up a program to address a specific concern. Program implementation via legislative mandate usually helps to ensure that a program has adequate legal authority and staffing/funding support. Some of the programs discussed can and have been established by the passage of a rule by a state agency using its general legislative powers, for example, programs for public education, pollution prevention, monitoring, and prioritizing target watersheds. Given the current scientific data on the pollutants found in stormwater, erosion and sediment control and even stormwater treatment programs can be established using general water pollution control authorities. These programs are very staff/resource intensive, however, requiring legislative approval of budget requests at a minimum.

Common watershed management programs include both planning and regulation. It is important to understand the difference between comprehensive planning and permitting. Both are needed to effectively manage growth and protect the quality of our environment and our citizens' quality of life:

- *Comprehensive planning* allows a community to make decisions about how and where growth will occur in the future. Comprehensive planning asks, is this the right location, is this the right time, and is this the right intensity for the proposed use of the land? Comprehensive planning seeks to prevent problems (social, economic, environmental) before development occurs.

- *Permitting,* on the other hand, asks only, how can we do the best job with this development on this particular site? Permitting is site-specific and seeks only to mitigate the impacts of the land-use decision. There always are inherent limitations in any regulatory program that comprehensive planning can help to overcome. Principal among these limitations is the fact that permitting is piecemeal and does not consider cumulative effects. Therefore, regulation and permitting cannot substitute for planning.

Watershed planning and management programs must include two equal components: the land planning framework and the water planning framework. An example of the hierarchial relationship of these planning frameworks is shown in Table 1.

Table 1. The Land Planning Framework Versus the Water Planning Framework

Land Planning	Water Planning
Land development regulations	Water management regulations
Local compliance plans	State water management plans
Regional policy plans	State water policy
State comprehensive plan	State comprehensive plan

Following is a discussion of many of the program components that typically are part of a watershed management framework. These can be divided into three categories:

- Land planning and management
- Water planning and management
- General resources planning and management

Land Planning and Management Program Components

Land planning and management programs often are called growth management programs. It is important to understand the clear distinctions between growth management, comprehensive planning, and land/environmental regulation:

- *Growth management* looks at broad issues and at the interrelationship of systems—natural systems, infrastructure, land use, and people. It attempts to assess how well we have been providing for the needs of our citizens in the past and, when new people move here, to determine what their needs are and how they will be provided. Growth management encompasses comprehensive planning, natural resource management, public facilities planning, housing, recreation, economic development, and intergovernmental coordination.

- *Comprehensive planning* is a governmental process for inventorying resources, establishing priorities, establishing a vision of where a community wants to go, and determining how to get there. It is a systematic way of looking at the different components of a community, county, region, and state.

- *Regulations* are the specific controls applied to different types of development activities to regulate and minimize their negative impacts. Typically, regulations are administered by all levels of government, federal, state, and local. At the local level, land development regulations are the ordinances that implement the local comprehensive plan.

State Comprehensive Plan

A state comprehensive plan serves as the base of both the land and water planning pyramids. A State Comprehensive Planning Act would establish goals and policies for each of the plan's various elements and require the state land planning agency to prepare a general state comprehensive plan. Elements in a state comprehensive plan usually include water resources, natural systems, air quality, coastal and marine resources, land and wildlife resources, waste management, public facilities (infrastructure), transportation, mining, agriculture, education, and economic development. If the state's land planning framework includes "regional planning councils" or "regional council of governments," those agencies would be responsible for developing a regional plan. Both the state and regional plans would have to be consistent with the goals and policies set forth in the state comprehensive planning act. These goals and policies, set by the legislature, are to provide guidance to state, regional, and local governments in developing and implementing programs, rules, or ordinances. Consistency must occur from the base of the planning pyramid all the way to its apex. To help ensure consistency and to integrate agency implementation programs with the law's goals and policies, this law can require the preparation of state agency functional plans. These plans can form the basis for agency budget requests, which must be related to the state comprehensive plan's goals and policies.

Growth Management and Land Development Regulation

The Local Government Comprehensive Planning Act (LGCPA), often referred to as the growth management act, establishes the key piece of the natural resources jigsaw puzzle: the direct connection between land-use management and water/natural systems management. Eight states (Oregon, Florida, New Jersey, Maine, Vermont, Rhode Island, Georgia, Washington) have implemented state growth management programs (3). While these programs have elements in common, each state has different implementation requirements. Some states "require" while other states "recommend" local plans, consistency, compliance, etc. An LGCPA should at least address the following components, which are common to each of the eight existing state growth management programs:

- Legislative authority and intent.
- Local comprehensive plans: Required? Voluntary? Schedule? Planning period? Required elements? Minimum requirements?
- Plan implementation: Required? Site planning? Land development regulations?
- Consistency with state goals/policies: Required? Monitoring? Enforcement?
- State review and approval: Required? Which agencies? Administrative process?
- Compliance: Monitoring? Incentives? Disincentives? Citizen enforcement?
- Limitations on the number and type of comp plan amendments: Frequency? Process?
- Regular plan updates and implementation appraisals: Required? Frequency?

Wetlands and Floodplain Protection

Wetlands and floodplains are the "bladder" and "kidneys" of a watershed. They provide a wide range of irreplaceable services at no cost, including maintenance and improvement of water quality; floodwater conveyance and storage; shoreline stabilization; water recharge and supply; sediment control; aquatic productivity; spawning and nursery grounds; habitat for shellfish, fish, waterfowl, endangered species and other wildlife; and open space and recreation. Unfortunately, we have not in the past appreciated these benefits. Instead, we looked on these areas as unproductive, snake-infested mosquito havens with no socially accepted redeeming value. Consequently, only about 40 percent of our nation's original 215 million acres of wetlands remain, largely the result of the conversion of wetlands and floodplains to agricultural lands.

Although Section 404 of the Federal Clean Water Act establishes a wetlands program, its effectiveness in maintaining, protecting, and restoring our nation's wetlands is highly questionable. Not only are nationwide general permits to conduct activities in wetlands relatively easy to obtain, but agricultural and silvicultural activities are largely exempt. Another problem hindering the environmental effectiveness of this federal program is a lack of national consistency. Furthermore, other federal programs (e.g., Section 205 of the 1948 Flood Control Act, National Flood Insurance Program) directly conflict with wetland and water quality protection efforts by promoting alteration and development of these sensitive lands.

A state wetlands protection act can be an important addition to a state's watershed management arsenal to either fill in the gaps of the federal program or to expand the protection of wetlands and floodplains. In developing and implementing a state wetland protection program, it is important to integrate, not duplicate, existing federal programs. Because the current federal wetlands permitting program is administered by the Army Corps of Engineers and EPA, typically the state water quality/environmental management agency is the implementing agency at the state level. Frequently, the "wetlands protection act" is simply a new section within a state's existing environmental laws.

Components that need to be addressed by a state wetlands/floodplain protection act include:

- Defining "wetland." A wetland should be defined by three characteristics: the elevation and duration of flooding, the presence of certain wetland-specific plants, and hydric soil conditions. The law should clearly state that wetlands are considered to be "waters" just like a river, lake, or estuary.
- Establishing a standard method to delineate wetlands. Wetlands represent the transitional edge between waters and uplands. Determining where a wetland ends and the upland begins is neither an easy nor an uncontroversial undertaking. Wetland scientists should be allowed to establish combinations of hydrologic, vegetation, and soil indicators and a process by which to "draw the wetland line."
- Requiring consistant statewide application of the wetland definition and wetland jurisdictional delineation method by all levels of government.
- Establishing wetland protection/management goals and policies that can set the basis for wetland regulations and permitting criteria.
- Creating goals and policies that foster more cost-effective pollution prevention approaches by stressing wetland avoidance rather than mitigation.
- Requiring or encouraging regional mitigation banks rather than onsite mitigation.
- Establishing a fair permitting process that ensures public participation, equity, an appeals process, and decisions based on scientific/technical merit.
- Allowing, with strict pretreatment requirements, the incorporation of certain wetlands into domestic wastewater and stormwater management/reuse systems, provided that the ecological characteristics of the wetland are protected, restored, or enhanced.
- Requiring the annual tracking of wetland losses and mitigation efforts, successes, and failures.
- Providing for assumption, by the state, of the federal Section 404 wetlands program.

State and Local Land Preservation and Acquisition

Regulating and restricting the use of private property are very controversial. The U.S. Supreme Court has ruled several times, however, that state and local governments have the legal authority to do so. In fact, it is the responsibility of government to ensure the health, safety, and welfare of the public. Restricting what can and cannot be done on a particular piece of property helps to maintain property values and to prevent contamination of air, land, water, and human resources. Care must be taken, however, to avoid the "taking of property." One way to help ensure that this goal is met and that extremely crucial or sensitive lands within a watershed are preserved is to implement land acquisition programs.

The federal government has implemented several types of land acquisition programs that have helped to preserve sensitive lands, protect vital wildlife habitats, and establish recreational lands, such as our national parks and national wildlife refuges. Federal budget problems and intense competition for the limited federal land acquisition funds, however, makes it difficult to gain these monies to obtain properties, especially those that do not have national or at least regional significance. Additionally, federal funding programs generally require matching funds from state and/or local governments. Therefore, the establishment of state and local land acquisition programs can greatly increase the ability to purchase and protect sensitive lands and, equally importantly, to capture limited federal funds.

Establishing state or local land acquisition programs requires extensive citizen participation and support. You will be asking the public to tax themselves to raise money to purchase lands, preserve them, and provide recreational opportunities. You must "sell" the program. Catchy phrases and acronyms are helpful. Citizens must see that they or their children will benefit and that the funds will be spent wisely and cost-effectively. Land acquisition programs must avoid conflicts of interest and be administered with great integrity and openness.

A state and local land preservation and acquisition act should contain the following components and considerations:

- Clearly defined program goals and policies. These will form the foundation for determining what types of properties will be purchased and how purchasing priorities will be established. The program's goals and policies should advocate the preservation and restoration of lands that contribute nonstructural environmental benefits. Additional resource management factors that should be considered in purchasing lands include open space and recreational and wildlife benefits.
- Integrated and coordinated federal, state, local, and private land preservation and acquisition programs. This will maximize the ability to leverage funds from various sources. Establishing interconnected wildlife corridors and greenways should be a priority.
- Extensive participation by citizens, private conservation groups, and state and local governments to establish program regulations, administrative procedures, and, most importantly, land-buying priorities.
- The long-term ownership and active land management of the property once it is purchased. Which agency

will be in charge, an environmental agency? A parks and recreation agency? A fisheries or wildlife agency? A private organization (i.e., Nature Conservancy, Trust for Public Land)? Does a land management plan need to be developed? How will land management be funded?

- Dedicated funding sources. Purchasing large quantities of land and then managing the land, especially with public access and use, requires significant funds over a long period. To obtain sufficient funds, it may be desirable for a state or local government to use its ability to sell bonds. Bonds can raise large amounts of money at one time, which can then be paid off like a mortgage. However, that requires having a source of funds that is stable and predictable over the life of the bond. Fees on real estate transactions (e.g., documentary stamps) and local option sales taxes have been used extensively around the country for this purpose.

Water Resources Planning and Management Programs

In general, the United States is blessed with an abundance of clean water resources. Water generally is available whenever we want it, in whatever quantity we desire and at a very low cost. Consequently, less attention and emphasis have been placed on water resources planning and management, especially from a holistic approach. In the past, water planning and management programs were implemented usually to address a crisis that had arisen. The continuing growth of our nation's population, however, continues to exert ever-growing demands on our vulnerable and limited water resources. Additionally, the need to begin managing unconventional pollution sources such as stormwater and other nonpoint sources requires a re-evaluation of the way we manage water. Accordingly, water resource planning and management programs are receiving increased attention and evaluation.

Within this subcategory of watershed management programs, we include water quantity and quality programs for the protection and management of surface and ground waters, as well as general environmental protection programs. All of these programs usually include both pollution prevention aspects and pollution treatment aspects.

Environmental Protection

Most states have enacted some type of state environmental protection act, typically to control traditional point sources of pollution. Generally, these laws are patterned somewhat after the federal Clean Water Act. These laws get revised frequently as either a new state environmental crisis or concern arises or the Clean Water Act gets amended by Congress. This law is an excellent example of how, over years, an existing law is revised to establish or refine existing or new environmental requirements or programs.

While state environmental protection laws around the country include many common and similar environmental requirements and mandates, there is also considerable variation among states. A major reason for this is that different states approach the same problem differently. For example, some states enact separate erosion and sediment control acts and stormwater management acts. Other states combine these two very important watershed management components. In some states, the law governing the siting and use of onsite wastewater disposal systems is found within a state's general health code law, while in other states it is found within the environmental law. These three watershed management components will be discussed as separate topics even though their legislative authority often is integrated into a state's environmental laws.

State environmental protection laws generally contain such components and considerations as:

- Establishment of the state environmental agency, along with its legal authority and powers and responsibilities.
- Establishment of an "environmental regulation commission," generally composed of citizens appointed by a political body (i.e., governor), which usually holds public workshops and adopts the state's environmental regulations and standards.
- Permitting evaluation criteria, permit fees, and administrative procedures, which typically include a legal, administrative hearing process to appeal permitting decisions.
- Programs, with adequate legal authority/direction and resources (staffing and funding), to address general environmental protection and management of air, land, and water resources (surface and ground water).
- Programs, with adequate legal authority/direction and resources, to minimize the impacts of specific pollution sources such as wastewater and industrial discharges, solid wastes, hazardous wastes, and toxic wastes.
- Pollution prevention programs such as "Amnesty Day," which allows citizens to safely dispose of hazardous or toxic household wastes; used oil recycling centers; waste reduction and assistance programs for industry; "Adopt a Road (Stream, Lake, Bay, Shoreline)" programs; recycling; and "Farmstead Assistance" ("Farm*A*Syst") programs.
- Programs to restore environmentally damaged lands and waters, especially critical areas such as wetlands, floodplains, steep slopes, and eroding lands.
- Programs to monitor the health of the environment and to assess the effectiveness of watershed man-

agement programs. Monitoring programs need to include sampling of the water column, sediment, and biological community. They need to be able to provide information concerning long-term trends in environmental health, as well as the status of the health of selected water bodies or natural systems.

Water Resources Planning and Management

Many states have enacted a water resources act that is distinct and separate from the state environmental protection act, perhaps because the planning and management of water resources is essential to the continued survival of life on our planet and because water is a major determinant of economic development and quality of life. Water resources planning and management must include consideration of both water quantity (water supply, water allocation, flooding) and water quality. A state water resources act needs to be fully integrated with the state environmental protection act. It must ensure that implementation of programs by both the state environmental protection agency and state/regional water resources agency is coordinated, consistent, and complimentary.

A state water resources act creates the framework for water resources planning and management programs to be undertaken by state, regional, and local governments. Using the goals and policies of the state comprehensive planning act, the environmental regulation commission adopts a regulation known as its state water policy. This rule contains general policy statements addressing the myriad water resource topics, such as water supply and conservation, surface water preservation and management, and natural systems preservation and management. It provides guidance for the implementation of all water resource programs and regulations, whether by a state, regional, or local entity. The act could establish regional "water(shed) management districts" which are set up on the basis of watershed boundaries. The districts would conduct regional watershed planning, help coordinate water management efforts undertaken by local agencies to ensure that watershedwide goals are met cooperatively, and operate regulatory and research programs.

A state water resources act should include such program components and considerations as:

- Establishing water(shed) management districts to administer special regional (watershed) water planning and management programs. These districts should provide statutory authorities and be given broad powers to protect, manage, and restore surface- and ground-water resources.
- Setting the institutional relationships between the state environmental agency, regional water management districts, and local governments. Strong oversight of programs, especially regulatory ones, delegated downwards for implementation is essential to ensure program consistency.
- Developing a state water policy to provide guidance for the implementation of all water programs and regulations in the state, which should be adopted as a rule, preferably as part of the state's environmental regulation code. The state water policy must be based on and consistent with the goals and policies in the state planning act. State, regional, and local water regulations and programs must be consistent with the state water policy. Ideally, goals and policies in a local comprehensive plan should also be consistent with the policy.
- Providing the districts with dedicated sources of revenue to ensure long-term, adequate funding of all necessary water resource management programs. Sources used in parts of the country include *ad valorem* assessments (property taxes), fees on water use, permitting fees, and special assessments.

Supplemental Surface Water and Environmental Protection Programs

There are several watershed management component programs that may be established within one of the above two statutes or which may be established in statute separately.

Erosion and Sediment Control Act/Program. Land disturbing activities are among the largest source of sediments and particle-borne pollutants. Preventing erosion and minimizing and capturing sediments, especially from construction sites, are essential parts of any watershed management framework. Since 1972, over 20 states have enacted erosion and sediment control laws and programs.

Establishment of an erosion prevention and sediment control law or program should include the following components and considerations:

- Clearly defined legal authority, goals/performance standards, and responsibilities of the implementing state and/or regional or local agencies.
- Assurance that publicly funded projects, especially highways, must comply with all program requirements, and an encouragement for these projects to serve as models.
- Determination of whether utility construction, agricultural, and forestry projects are to be included in the program.
- Agency responsibilities and relationships. Typically, implementation of an erosion and sediment control program involves a state agency and a regional/local agency such as a soil and water conservation district

or a local government. Delegation of the program from the state to the local agency must involve close oversight to ensure consistency.

- Adequate staffing and other resources to conduct research on the effectiveness of control measures, develop scientifically sound rules, and conduct training and education programs for plan reviewers, inspectors, developers, engineers, and site contractors. A state training and certification program for plan reviewers, inspectors, and contractors is highly recommended because it is very unlikely that public agencies will ever obtain sufficient staffing to conduct inspections of construction sites on a regular basis.
- Mutual integration of the state erosion and sediment program, the state stormwater management program, and the new federal National Pollutant Discharge Elimination System (NPDES) Stormwater Permitting Program.

Stormwater Management Act/Program. Most states have implemented some type of stormwater "drainage" program to ensure that their citizens and their properties are protected from flooding. In some states, special "drainage districts" or "drain commissions" have been established at a regional or local level. Today, however, we know that stormwater is also one of the major sources of pollutant loadings to our nation's rivers, lakes, and estuaries. Stormwater management is evolving slowly from its "drainage" focus to a much more comprehensive, multiple-objective program that addresses stormwater quality and quantity. Stormwater programs must attempt to prevent or minimize stormwater problems associated with new land-use activities but must also develop programs to reduce the pollutant loading discharged from older "drainage systems." This latter objective is extremely difficult and expensive to address. Watershed management approaches are essential. Typically, a state stormwater management program begins by addressing the problems associated with new land uses and then evolves into a more comprehensive, watershed-based program to address the retrofitting of older stormwater systems.

Components and considerations that need to be addressed by a state stormwater management act/program include:

- Clearly defined legal authority, goals/performance standards, and responsibilities of the implementing state and/or regional or local agencies.
- Assurance that publicly funded projects, especially highways, comply with all program requirements, and an encouragement for these projects to serve as models.
- Agency responsibilities and relationships. Typically, implementation of a stormwater management program involves a state agency and a regional/local agency such as a water(shed) management district, soil and water conservation district, or a local government. Delegation of the program from the state to the local agency must involve close oversight to ensure consistency.
- General goals and minimal treatment performance standards (on which best management practice design criteria will be based) based on the state water policy, and a biological or resource based performance standard for reducing the pollutant loading from existing drainage systems.
- Adequate staffing for planning, coordinating, permitting, and enforcement, and resources to conduct research on the effectiveness of control measures; to develop scientifically sound rules; and to conduct training and education programs for plan reviewers, inspectors, developers, engineers, and site contractors.
- A state training and certification program for plan reviewers, inspectors, and contractors. This is highly recommended, because it is very unlikely that public agencies will ever obtain sufficient staffing to conduct inspections of stormwater systems either during construction or afterwards on a regular basis. These programs can be integrated with similar erosion and sediment control programs.
- Integration of the state stormwater management program with the state erosion and sediment control program and with the new federal NPDES Stormwater Permitting Program.
- A mechanism, such as stormwater operating permits, to ensure that stormwater management systems are inspected at least annually to determine maintenance needs and that systems are maintained and operated properly. Ideally, this system is implemented by a local stormwater utility which provides the owner of a properly maintained and operated stormwater system with a stormwater utility fee credit as an economic incentive.
- Statutory authority for the establishment of dedicated funding sources for stormwater management programs at both the state and local level. At the state level, small fees on concrete, asphalt, fertilizer, or pesticides might be considered. At the local level, stormwater utilities are widely used around the country with great success.

Watershed Prioritization and Targeting Act/Program. The ever-growing number of water resources problems along with the financial constraints faced by all levels of government strongly suggest a need for the establishment of watershed prioritization and targeting programs. Many states, often as part of the implementation of stormwater/nonpoint source management programs, have set up such programs (4, 5). Considerations and components of a state watershed prioritization and targeting act/program include:

- Clearly identifying which state, regional, and local agencies will be involved in establishing priority watersheds. Public participation is essential to ensure the cooperation and "buy in" of citizens around the state and within the targeted watershed. Cooperation and joint ventures with private land conservation groups need to be encouraged.
- Providing guidance on what factors will be considered in the prioritization process. These may include requirements such as water bodies being of statewide or regional significance or of a certain level of degradation; the level of local government and citizen support, especially by those land owners that will need to install management practices; and the availability of local matching funds.
- Providing a legal mechanism for the adoption of the "priority list" by the appropriate state, regional, or local agency. Ensuring that the list is reviewed on a regular basis and updated or refined as needed.
- Providing a dedicated source of funds (state, regional, local) to develop and implement a watershed management plan within a realistic time schedule.

Onsite Wastewater Management Act/Program. The nation's rapid population growth and the accompanying move to the suburbs and even more rural areas has led to a tremendous proliferation of the use of onsite wastewater disposal systems (OSDSs). Often considered an inexpensive alternative to centralized wastewater collection and treatment systems, OSDSs can cause or contribute to health and environmental resource problems which are difficult and very expensive to solve. Like many areas of nonpoint source management, OSDS programs need to stress prevention but also be able to correct problems related to the past use and misuse of these systems. Traditionally, state health departments rather than state environmental or water resources agencies have administered OSDS programs. It is increasingly evident, however, that OSDSs are a major contributor to impairment of aquatic systems.

A state onsite wastewater management act/program should include the following components and considerations:

- Clearly defined legal authority, goals/performance standards, and responsibilities of the state, regional, or local entities involved in the implementation of the program.
- Goals and performance standards that not only address traditional health concerns but that also require consideration of the potential environmental effects of OSDSs.
- The adoption of OSDS regulations that govern the types of OSDS systems (e.g., drainfields, mound systems, aerobic units), the siting of systems (e.g., watertable elevation, soil types, setbacks from wetlands/waters), the design and performance of OSDS (e.g., secondary treatment? nitrates $\leq$10 mg/L?), determination of whether surface discharges will be allowed and under what conditions, inspections during construction and throughout the use of the system, and maintenance.
- Regular inspection (every 2 to 3 years) and maintenance (e.g., pumpout, drainfield) to help ensure that OSDSs continue to function properly. The establishment of OSDS management districts, which have defined service areas, funding sources, and legal authority, is one mechanism that can be used. Another method of ensuring that OSDSs continue to function properly is to require inspections and upgrading/maintenance of systems whenever a property is sold.

General Resources Planning and Management Programs

One of the challenges of implementing watershed management frameworks and programs is their complex, interwoven nature. Many aspects of watershed management transcend the simple classification scheme outlined at the beginning of this section. These include the need for broad-based natural resource management programs and for environmental education programs, especially those integrated into the curriculum of the K–12 education system. In many states, separate agencies have been established that have responsibility for the management of land, fish and wildlife, agriculture, mining, and parks and recreation. Often a state forestry department is responsible for the acquisition and management of state forest lands. The activities and programs of these agencies typically are an essential component of watershed management. Close coordination and cooperation between these agencies and the other "primary" agencies involved in watershed management are needed to ensure that programs do not conflict and to maximize the benefits and cost-effectiveness of all programs.

Additionally, while nearly every natural resources resource management agency has some type of environmental education programs, these typically are narrowly focused, dealing with a particular program. The growing importance of nontraditional pollution sources such as stormwater and nonpoint sources requires the development and implementation of a broad-based environmental curriculum that begins teaching children in kindergarten and continues all the way through their senior year of high school. Each of us must understand the basic interrelationships of the air, land, and water and how our everyday activities can and do contribute to the degradation of our natural systems. We must re-establish the ethic of stewardship, and the best way to accomplish this is through the education of our youth.

Example State Watershed Management Initiatives

Several states have developed and implemented some or many of the watershed management program components discussed above. In recent years, states have begun to try to integrate ongoing programs into a more comprehensive watershed management framework. Within this publication can be found papers that describe or discuss state programs such as Delaware and Florida, regional programs such as the Puget Sound (Washington) Management Program and the San Francisco Bay Program, and local programs such as the Prince George's County (Maryland) and Summit County (Ohio) programs.

One of the ways in which existing programs, especially planning and regulatory programs, can evolve into an integrated watershed approach is demonstrated by the ongoing efforts in North Carolina. The North Carolina Division of Environmental Management (NCDEM) has developed a plan in which basins, not stream reaches, are the basic unit of water quality management. The objectives of North Carolina's Basinwide Water Quality Management Initiative include (6):

- Identify priority problem areas and pollution sources that merit particular pollutant control, using modifications of rules (e.g., basin criteria) and increased enforcement.
- Determine the optimal water quality management strategy and distribution of assimilative capacity for each of the 17 major river basins within the state.
- Prepare, in cooperation with local governments and citizens, comprehensive basinwide management plans that set forth the rationale, approaches, and long-term management goals and strategies for each basin.
- Implement innovative management approaches that protect the state's surface water quality, encourage the equitable distribution of assimilative capacity, and allow for sound economic planning and growth.

The whole-basin initiative is envisioned as a fully integrated approach to water quality assessment and management. It integrates planning, monitoring, modeling, point source permitting and control, nonpoint source control, and enforcement within a basin. NCDEM has rescheduled its NPDES permit activities so that permit renewals within a given basin will occur simultaneously and will be repeated at 5-year intervals.

One of the difficulties in implementing a basin-wide approach is the setting of priorities, the establishment of a rotating schedule among the basins, and the correlation of management needs (monitoring, planning, permitting, enforcement) with staff and resource allocations. North Carolina prioritized and scheduled its 17 basins based on consideration of the nature and extent of known problems, a basin's importance in terms of human use, the availability of data, and staff workload balancing.

For each basin in turn, North Carolina will perform the 15-step process outlined below (6):

1. Compile all existing relevant information on basin characteristics and water quality.
2. Define the water quality goals and objectives for water bodies within the basin. Revise as necessary as more data are obtained.
3. Identify the critical issues (e.g., water supply protection, shellfish harvesting) and current water quality problems within the basin. Determine the major factors and sources (point, nonpoint, habitat degradation) that contribute to the problems.
4. Prioritize the basin's water quality concerns and critical issues. Ensure public participation and input from other government agencies and nongovernment groups.
5. Define the subbasin management units using basin hydrology, physiographic boundaries, problem areas, and critical issues.
6. Identify needs for additional information.
7. Collect additional information.
8. Analyze, integrate, and interpret the information collected. Revisit Steps 2 through 5 in light of the new information.
9. Determine and evaluate the management options for each management unit in the basin.
10. Select final management approaches for the basin and targeted subbasins.
11. Complete the draft whole basin management plan. Perform additional modeling and other analyses to finalize wasteload allocations.
12. Distribute the draft plan for review and comment, and conduct public hearings.
13. Revise the plan as appropriate in response to comments. Ensure adoption of the plan by the state's environmental management commission.
14. Implement the management approaches, including point and nonpoint source controls.
15. Monitor the program's success and update the plan every 5 years.

References

1. Camp Dresser and McKee. 1985. Feasibility study for a Roanoke Valley comprehensive stormwater management program. Final report prepared for the Fifth Planning District Commission.

2. Livingston, E.H., and M.E. McCarron. 1992. Stormwater management: A guide for Floridians. Tallahassee, FL: Florida Department of Environmental Regulation.

3. Gale, D.E: 1992. Eight state-sponsored growth management programs: A comparative analysis. JAPA 58(4):425-439.

4. Puget Sound Water Quality Authority. 1991. Puget Sound water quality management plan. Seattle, WA.

5. Wisconsin Department of Natural Resources. 1986. Nonpoint source pollution: Where to go with the flow. Madison, WI.

6. U.S. EPA. 1991. The watershed protection approach: An overview. EPA/503/9-92/002. Washington, DC.

The Evolution of Florida's Stormwater/Watershed Management Program

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Abstract

Research conducted during the late 1970s as part of the Section 208 Water Quality Management Program identified pollutant loading from stormwater discharges as the major source of water quality degradation in Florida. This paper reviews the evolution of Florida's stormwater regulatory program, from its initial emphasis on controlling stormwater problems from new development to its current emphasis on reducing pollutant loading from existing development. The philosophical and technical basis for the program are discussed, as are the program's major components. The paper emphasizes how the program is beginning to address the retrofitting of existing "drainage systems."

Developing and implementing a statewide stormwater management program requires several key components. Research must be undertaken to develop statewide rainfall distribution statistics, determine stormwater pollutant loading characteristics, determine the effectiveness of various stormwater treatment practices, and identify key design criteria for each type of best management practice. Education is essential and must be targeted at many different audiences: design engineers, state and local government staff and elected officials, construction personnel, inspectors, maintenance staff, and citizens. Dedicated funding sources at both state and local levels are very important, especially if the program is to achieve the desired environmental benefits and for retrofitting. Most importantly, integration of stormwater regulatory programs with other resource management programs on a watershed basis must occur for maximum environmental results and cost-effectiveness.

Introduction

Florida is blessed with a multitude of natural systems, from the longleaf pine-wiregrass hills of the Panhandle to the sinkhole and sand ridge lakes of the central ridge, the Everglades "River of Grass," and the coral reefs of the Keys. Abundant surface-water resources include over 20 major rivers and estuaries and nearly 8,000 lakes. Plentiful ground-water aquifers provide over 90 percent of the state's residents with drinking water. Add the state's climate and it's easy to see why many consider the Sunshine State a favored vacation destination and why the state has experienced phenomenal growth since the 1970s. Today, Florida is the fourth most populous state, and its population is still growing rapidly, although not at the 900 people per day (300,000 per year) rate that occurred throughout the 1970s and 1980s.

Florida's natural systems, especially its surface- and ground-water resources, are extremely vulnerable and easily damaged. This is partially the result of the state's sandy porous soils, karst geology, and abundant rainfall. The negative impacts of unplanned growth were seen as early as the 1930s, when southeast Florida's coastal water supply was threatened by saltwater intrusion into the fragile freshwater aquifer that supplied most of the potable water for the rapidly expanding population. By the 1970s, it was becoming all too clear that unplanned land-use, development, and water-use decisions were altering the state in a manner that, if left unchecked, could lead to profound, irretrievable loss of the very natural beauty that brought residents and tourists to Florida. Extensive destruction of wetlands, bulldozing of beach and dune systems, continued saltwater intrusion into freshwater aquifers, and the extensive pollution of the state's rivers, lakes and estuaries were only some of the negative impacts of this rapid growth.

Fortunately, Florida's citizens and elected officials became educated about these problems and began developing programs to protect and manage the state's natural resources. Florida began serious and comprehensive efforts to manage its land and water resources and its growth as the environmental movement in the nation and the state gained strength in the early 1970s. Florida's natural resources management programs have evolved over a 20-year period. Collectively, the individual laws and programs enacted during this period can be considered "Florida's Watershed Management Program." In many cases, these laws have been integrated either statutorily with revisions to existing laws or through the adoption of regulations by various state, regional, and local agencies.

The evolution of Florida's watershed management program typically involves the following sequence: 1) concern about a specific "pollutant" or problem creates a resource/environmental management program which usually begins by focusing on "new sources" (site basis); 2) over time, as new sources are controlled and the effectiveness of the program increases, the focus shifts to cleaning up "older sources" (watershed or regional basis); 3) ultimately, the focus shifts to integrating the program with similar ones to eliminate any duplication and to improve efficiency and effectiveness.

Florida's Stormwater Program: The Beginning

Section 208 of the Federal Clean Water Act required the development of areawide water quality management plans to control point and nonpoint sources of pollution. As part of Florida's program conducted during the late 1970s and early 1980s, many investigations were undertaken to assess the impacts of stormwater and the effectiveness of various best management practices (1). These studies demonstrated that stormwater, whether from agriculture, forestry, or urban lands, was the primary source of pollutant loading to Florida's receiving waters. Subsequently, it was concluded that the ability to meet the Clean Water Act objective of fishable and swimmable waters would require the implementation of stormwater programs to reduce the delivery of pollutants from stormwater discharges.

Recognition of this problem, along with the availability of federal funds, led Florida to draft regulations to control stormwater in the late 1970s. The first official state regulation specifically addressing stormwater was adopted in 1979 as part of Chapter 17-4, Florida Administrative Code (FAC). Chapter 17-4.248 was the first attempt to regulate this source of pollution, which, at the time, was not very well understood. Under Chapter 17-4.248, the Florida Department of Environmental Regulation (DER) based its decision to order a permit on a determination of the "insignificance" or "significance" of the stormwater discharge. This determination seems reasonable in concept; however, in practice, such a decision can be as variable as the personalities involved. What may appear insignificant to the owner of a shopping center may actually be a significant pollutant load into an already overloaded stream.

In adopting Chapter 17-4.248, DER intended that the rule would be revised when more detailed information on nonpoint source management became available. About a year after adoption, DER began reviewing the results of research being conducted under the 208 program. DER also established a stormwater task force with membership from all segments of the regulated and environmental communities. A revised stormwater rule, Chapter 17-25, FAC, was developed over 2 years, involving more than 100 meetings between department staff and the regulatory interests, and the dissemination of 29 official rule drafts for review and comment. The rule was adopted by the state's Environmental Regulation Commission (ERC) and became effective in February 1982. The adopted rule required a stormwater permit for all new stormwater discharges and for modifications to existing discharges that were modified to increase flow or pollutant loading.

The stormwater rule had to be implemented within the framework of the federal Clean Water Act. The act establishes two types of regulatory requirements to control pollutant discharges: technology-based effluent limitations, which reflect the best controls available considering the technical and economic achievability of those controls; and water quality-based effluent limitations, which reflect the water quality standards and allowable pollutant loadings set up by state permit (2). The latter approach can be developed and implemented through biomonitoring based on whole effluent toxicity, making it very applicable to stormwater. Florida's tremendous growth, the accompanying creation of tens of thousands of new stormwater discharges, and the lack of data on stormwater loading toxicity made this approach unimplementable, however.

Guidance on the development of stormwater regulatory programs and the role of water quality criteria has been issued by the U.S. Environmental Protection Agency (EPA) (3). The guidance recognizes that best management practices (BMPs) are the primary mechanism to enable the achievement of water quality standards. For the purposes of this paper, a BMP is a control technique that is used for a given set of site conditions to achieve stormwater quality and quantity enhancement at minimal cost. Further, the guidance recommends that state programs include the following steps:

- Design of BMPs based on site-specific conditions; technical, institutional, and economic feasibility; and the water quality standards of the receiving waters.
- Monitoring to ensure that practices are correctly designed and applied.
- Monitoring to determine both the effectiveness of BMPs in meeting water quality standards and the appropriateness of water quality criteria in reasonably ensuring protection of beneficial uses.
- Adjustment of BMPs when it is found that water quality standards are not being protected to a designed level, and/or evaluation and possible adjustment of water quality standards.

Proper installation and operation of state-approved BMPs should achieve water quality standards. While water quality standards are to be used to measure the effectiveness of BMPs, EPA recognizes that there should be flexibility in water quality standards to address the impacts of time and space components of stormwater as well as naturally occurring events. If water quality standards are not met, then the BMPs should be modified, the discharge should cease, or, in some cases, reassessment of the water quality standards should be undertaken.

Rationale for Stormwater Rule Standards

The overriding standards of the stormwater rule are the state's water quality standards and appropriate regulations established in other DER rules. Therefore, an applicant for a stormwater discharge permit must provide reasonable assurance that stormwater discharges will not violate state water quality standards. Because of the potential number of discharge facilities and the difficulties of determining the impact of any facility on a water body or the latter's assimilative capacity, DER decided that the stormwater rule should be based on design and performance standards.

The performance standards established a technology-based effluent limitation against which an applicant can measure the proposed treatment system. Compliance with the rule's design criteria created a presumption that the desired performance standards would be met, which, in turn, provided a rebuttable presumption that water quality standards would be met. If an applicant wants to use BMPs other than those described in the rule, then a demonstration must be made that the BMP provides treatment that achieves the desired pollutant removal performance standard. Actual design and performance standards are based on a number of factors:

- Stormwater management goals: Stormwater management has multiple objectives, including water quality protection, flood protection (volume, peak discharge rate), erosion and sediment control, water conservation and reuse, aesthetics, and recreation. The basic goal for new development is to ensure that postdevelopment peak discharge rate, volume, timing, and pollutant load do not exceed predevelopment levels. BMPs are not 100-percent effective, however, in removing stormwater pollutants, while site variations can also make this goal unachievable at times. Therefore, for the purposes of stormwater regulatory programs, DER (water quality) and the state's regional water management districts (WMDs) (flood control) have established performance standards based on risk analysis and implementation feasibility.
- Rainfall characteristics: An analysis of long-term rainfall records was undertaken to determine statistical distribution of various rainfall characteristics such as storm intensity and duration, precipitation volume, and time between storms. It was found that nearly 90 percent of a year's storm events occurring anywhere in Florida produce a total of 2.54 cm (1 in.) of rainfall or less (4). Also, 75 percent of the total annual volume of rain falls in storms of 2.54 cm or less. Finally, the average interevent time between storms is approximately 80 hr (5).
- Runoff pollutant loads: The first flush of pollutants refers to the higher concentrations of stormwater pollutants that characteristically occur during the early part of the storm, with concentrations decaying as the runoff continues. Concentration peaks and decay functions vary from site to site depending on land use, the pollutants of interest, and the characteristics of the drainage basin. Florida studies (6, 7) indicated that for a variety of land uses the first 1.27 cm (0.5 in.) of runoff contained 80 to 95 percent of the total annual loading of most stormwater pollutants. First flush effects generally diminish, however, as the size of the drainage basin increases and the percent impervious area decreases because of the unequal distribution of rainfall over the watershed and the additive phasing of inflows from numerous small drainages in the larger watershed. In fact, as the drainage area increases in size above 40 ha (100 ac), the annual pollutant load carried in the first flush drops below 80 percent because of the diminishing first flush effect.
- BMP efficiency and cost data: Numerous studies conducted in Florida during the Section 208 program generated information about the pollutant removal effectiveness of various BMPs and the costs of BMP construction and operation. Analysis of this information revealed that the cost of treatment increased exponentially after "secondary treatment" (removal of 80 percent of the annual load) (8).
- Selection of minimum treatment levels: After review and analysis of the above information, and after extensive public participation, DER set a stormwater treatment objective of removing at least 80 percent of the average annual pollutant load for stormwater discharges to Class III (fishable/swimmable) waters. A 95-percent removal level was set for stormwater discharges to sensitive waters such as potable supply waters (Class I), shellfish harvesting waters (Class II), and Outstanding Florida Waters. DER believed that these treatment levels would protect beneficial uses and thereby establish a relationship between the rule's BMP performance standards and water quality standards.

BMP Treatment Volumes and Design Criteria/Guidelines

The current stormwater treatment volumes for various BMPs are set forth in Table 1. Since adoption of the stormwater rule in 1982, the design criteria and treatment volumes have been revised several times as new

Table 1. BMP Treatment Volumes for Stormwater Discharges to Class III Waters

Swales	Infiltration of 80 percent of the runoff generated by a 3-yr/1-hr storm (typically about 5.1 cm [2 in.] of runoff).
Retention	Off-line infiltration of the first 1.25 cm (0.5 in.) of runoff or the volume calculated by 1.25 times the percent imperviousness of the project area, whichever is greater. On-line infiltration must treat an additional 1.25 cm of runoff above the volume required for off-line treatment.
Detention With Filtration	Filtration of detention volume.
Wet Detention	Detention of the first 2.54 cm (1 in. of runoff) or the volume calculated by 2.5 times the percent imperviousness of the project area, whichever is greater.
Wetlands	Same as for wet detention.

Notes: Discharges to sensitive waters must treat 50 percent more stormwater volume and may require infiltration pretreatment.
Discharges to sinkhole watersheds must treat the first 2 in. of runoff (Suwannee River WMD criterion).

information becomes available about the field effectiveness of various types of BMPs.

In addition to the stormwater treatment volumes, other design and performance standards have been set to ensure that BMPs function optimally to attain the stormwater treatment goal and other management objectives (9). These guidelines will be discussed for each of the BMPs currently being used extensively in Florida.

Swales

Swales are defined by Chapter 403, Florida Statutes (FS), as manufactured trenches that:

- Have a top width-to-depth ratio of the cross section equal to or greater than 6:1, or side slopes equal to or greater than 3 ft horizontal to 1 ft vertical.
- Contain contiguous areas of standing or flowing water only following a rainfall event.
- Are planted with or have stabilized vegetation suitable for soil stabilization, stormwater treatment, and nutrient uptake.
- Are designed to take into account soil erodibility, soil percolation, slope, slope length, and drainage area so as to prevent erosion and reduce pollutant concentration of any discharge.

Swale treatment of stormwater is accomplished primarily by infiltration of runoff and secondarily by adsorption and vegetative filtration and uptake (10). Recent investigations have concluded that Florida soil, slope, and water table conditions essentially preclude the use of swales as the sole BMP to treat stormwater (11). Therefore, the greatest utility of swales is as a pretreatment BMP within a BMP treatment train stormwater system. Infiltration pretreatment can be easily accomplished by using raised storm sewer inlets within the swale, or by elevating driveway culverts or using swale blocks to create small retention areas.

Retention

Off-line retention areas, which receive the first flush volume only while the later runoff is diverted to a flood control BMP, are the most effective stormwater treatment practice. Treatment is achieved through diversion and infiltration of the first flush, thereby providing total pollutant removal for all stormwater that is retained on site. To reduce operation needs, increase aesthetics, and reduce the land area needed for stormwater treatment, retention areas should be incorporated into a site's landscaping and open-space areas. Effectiveness of retention areas can be increased and ground-water impacts decreased by:

- Infiltrating the stormwater treatment volume within 72 hr or within 24 hr if the retention area is grassed.
- Grassing the retention area bottom and side slopes, which reduces maintenance and maintains soil infiltration properties.
- Maintaining at least 3 ft between the bottom of the retention area and seasonal high water tables or limerock.
- In karst-sensitive areas, using several small, shallow infiltration areas to prevent formation of solution pipe sinkholes within the system.

Exfiltration trenches typically are used in highly urbanized areas where land is unavailable for retention basins. They consist of a rock-filled trench surrounded by filter fabric in which a perforated pipe is placed. The stormwater treatment volume is stored within the pipe and exfiltrates out of the perforations into the gravel envelope and into the surrounding soil. Pretreatment with catch basins to remove sediments and other debris is essential to prevent clogging. To extend longevity and reduce maintenance, exfiltration systems should always be off-line.

Detention With Filtration

Detention with filtration systems were proposed as an alternative to retention for small projects (less than 8 acres) in those areas of Florida where local conditions, especially flat topography and high water tables, prevent infiltrating the stormwater treatment volume. The filters must consist of 2 ft of natural soil or other suitable fine-textured granular media that meet certain specifications, including:

- Filters must have pore spaces large enough to provide sufficient flow capacity so that the filter permeability is equal to or greater than the permeability of the surrounding soil.
- The design shall ensure that particles within the filter do not move.
- When sand or other fine-textured material other than natural soil is used for filtration, the filter material 1) will be washed (less than 1 percent silt, clay, or organic matter) unless filter cloth is used to retain such materials within the filter, 2) will have a uniformity coefficient between 1.5 and 4.0, and 3) will have an effective grain size of 0.20 to 0.55 mm in diameter.
- Be designed with a safety factor of at least two.
- Will recover the treatment volume (bleed down) within 72 hr.

Filters are placed in the bottom or sides of detention areas, where the filtered stormwater is collected in an underdrain pipe and then discharged. Experience has shown that these filters are very difficult to design and construct. Operation is also difficult because of low hydraulic head, and maintenance is nearly impossible. It is not a question of if a filter will clog, only when it will clog. In addition, filters are designed to remove particulate pollutants and do not remove dissolved pollutants such as phosphorus or zinc. Therefore, filtration systems are not recommended for use except under very special conditions and where a full-time maintenance entity such as a local government will assume such responsibilities.

Wet Detention

Wet detention systems consist of a permanent water pool, an overlying zone in which the stormwater treatment volume temporarily increases the depth while it is stored and slowly released, and a shallow littoral zone (biological filter). In addition to their high pollutant removal efficiencies (12), wet detention systems can also provide aesthetic and recreational amenities, a source of fill for the developer, and even "lake front" property, which brings a premium price.

Wet detention criteria are listed in Table 2. These have been developed to take full advantage of the biological, physical, and chemical assimilation processes occurring within the wet detention system. If the system is designed as a development amenity, the use of pretreatment BMPs integrated into the overall stormwater management system is highly recommended to prevent algal blooms or other perturbations that would reduce the aesthetic value. Raised storm sewers in grassed areas such as parking lot landscape islands, swale conveyances, and perimeter swale/berm systems along the detention lake shoreline are techniques that have been used frequently.

Table 2. Wet Detention Guidelines

1. Treatment volume as per Table 1.
2. Treatment volume slowly recovered in no less than 120 hr with no more than half of the volume discharged within the first 60 hr following the storm:
   - Volume in the permanent pool should provide a residence time of at least 14 days.
   - At least 30 percent of the surface area shall consist of littoral area with slopes of 6:1 or flatter that is established with appropriate native aquatic plants selected to maximize pollutant uptake and aesthetic value.
   - Littoral zone plants shall have a minimum 80 percent survival rate and coverage after 2 years. Cattails and other undesirable plants shall be removed.
   - The littoral zone is concentrated near the outfall or in a series of shallow benches ending at the outfall.
   - Side slopes should be no steeper than 4:1 out to a depth of 2 ft below the level of the permanent pool.
   - Maximum depth of 8 to 10 ft below the invert of the discharge structure is recommended. Maximum depth shall not create aerobic conditions in bottom sediments and waters.
   - The flow length between inlets and outlet should be maximized; a length-to-width ratio of at least 3:1 is recommended. Diversion barriers such as baffles
   - An oil and grease skimmer shall be designed into the outlet structure.
   - If the system is planned as a "real estate lake," pretreatment by infiltration is recommended.
   - Inlet areas should include a sediment sump.

Wetland Treatment

Wetland treatment was authorized by the 1984 Henderson Wetlands Protection Act, which allows stormwater treatment in wetlands that are connected to other state waters by a constructed ditch or by an intermittent water course that flows in direct response to rainfall, thereby causing the water table to rise above ground surface. Not only does this take advantage of natural treatment mechanisms but it gives another economic value to wetlands—an incentive to the developer to use, not destroy, the wetland—and it revitalizes ditched and drained wetlands by providing water.

Wetlands may be viewed as nature's kidneys—they store stormwater, dampen floodwaters, transform pollutants, and even retain pollutants, thereby providing natural stormwater treatment (13). Care must be taken, however, to protect the numerous assimilation mechanisms within the wetland plants and sediments. In addition, the wetland hydroperiod—the duration that water stays at various levels—must be protected or restored because it determines the form, function, and nature of the wetland. Therefore, pretreatment practices to attenuate stormwater volume and peak rate and to reduce oil, grease, and especially sediment are essential. The BMP treatment train concept must be used to provide pretreatment, which normally includes a pretreatment lake that is constructed adjacent to the wetland.

The following guidelines are presented for incorporating wetlands into a stormwater management system:

- The treatment volume is per Table 1, with the treatment volume slowly recovered in no less than 120 hr with no more than half of the volume discharged within the first 60 hr following the storm.
- Stormwater must sheet flow evenly through the wetland to maximize contact with the wetland plants, sediments, and microorganisms. Spreader swales, distribution systems, and level spreaders between the pretreatment lake and the wetland have been used extensively.
- Swales should be used for stormwater conveyance throughout the development.
- The hydroperiod must be protected or restored.
- Treatment volume capacity of the wetland is determined by the storage volume available between the normal low and high elevations. These elevations are determined by site-specific indicators such as lichen and moss lines, water stain lines, adventitious root formation, plant community zonation, hydric soils distribution and rack/debris lines.
- Erosion and sediment control during construction is essential because only a few inches of sediment deposited in the wetland will destroy the wetland filter.
- Inflow/outflow monitoring, sediment metal levels, and vegetative transect monitoring are required to help evaluate the effectiveness of these systems and the impacts of stormwater additions to wetlands.

Administration of the Stormwater Rule

Under the Florida Water Resources Act of 1972, DER, a water quality agency, serves as the umbrella administering agency delegating authority to five regional WMDs whose primary functions historically have been related to water quantity management. Therefore, a second objective in developing the stormwater rule was to coordinate the water quality considerations of DER's stormwater permits with the water quantity aspects of the districts' surface water management permits.

In addition, the delegation of the stormwater permitting program allows for minor adjustments to stormwater rule design and performance standards to better reflect regional conditions. Florida is a very diverse state, with major variations in soils, geology, topography, and rainfall that can directly affect the usability and treatment effectiveness of a BMP. Such problems can be minimized if districts adopt slightly different design and performance standards which are approved by DER before implementation.

Both DER's and the districts' stormwater rules essentially require a new development to include a comprehensive stormwater management system. The system should be viewed as a "BMP treatment train" in which a number of different BMPs are integrated into a comprehensive system that provides aesthetic and recreational amenities in addition to traditional stormwater management objectives.

The Challenge Ahead

The implementation of Florida's stormwater treatment requirements has been very effective in helping to reduce the stormwater pollutant loading from new development. As a result, the biggest stormwater management problem facing Florida is how to reduce pollutant loadings discharged by older systems, especially local government master systems constructed before the stormwater rule was implemented. These systems were designed solely for flood protection and rapidly deliver untreated stormwater directly to rivers, lakes, estuaries, and sinkholes.

Establishing a stormwater program to retrofit existing systems presents many technical, institutional, and financial dilemmas. The unavailability and cost of land in urbanized areas make conventional BMPs infeasible in most instances. Current state laws and institutional arrangements promote piecemeal, crisis-solving approaches aimed at managing stormwater within political boundaries, yet stormwater follows watershed boundaries. Land-use planning and management must be fully integrated into the stormwater management scheme. Retrofitting is also prohibitively expensive, and many local governments are already short of funds. Therefore, solving our existing urban stormwater problems requires comprehensive, coordinated, creative approaches and technology.

Following is a brief discussion of some of the essential elements of a comprehensive long-term effort to reduce pollutant loadings from older stormwater systems.

Watershed Management

A watershed approach that integrates land-use planning with the development of stormwater infrastructure is essential. After all, it is the intensification of land use and the increase in impervious surfaces within a watershed that create the stormwater and water resources management problems. Consequently, a watershed management team effort, involving state and local governments together with the private sector, is necessary. In fact, local governments are the primary team member because they determine zoning and land use, issue building permits and inspect projects, and have code enforcement powers that can help to ensure that stormwater systems are properly operated and maintained.

Local governments need to identify and map the existing natural stormwater system: the creeks, wetlands, flood plains, drainageways, and natural depression areas. Once mapped, these areas need to be zoned for conservation or low-intensity uses compatible with the functions provided by the natural system. The existing constructed stormwater system must also be mapped, and essential characteristics such as pipe size, drainage areas, and invert elevations must be determined. This information should then be fully integrated with the existing and future land-use plan for the watershed and a master stormwater management plan developed and implemented. The Growth Management Act of 1985, which requires all local governments to adopt comprehensive plans addressing current and future land use with infrastructure needs, establishes a base structure that could promote a watershed management approach.

Treatment Requirements for Older Systems

Numerous problems inherent in a highly urbanized area prevent the application of new development stormwater treatment standards from being imposed on older systems. Instead, a "watershed loading" concept is proposed which considers the beneficial uses of the receiving waters and the total stormwater load that can be assimilated by the receiving waters. The actual treatment level would depend on the watershed's total allowable loading, which is based on citizen desires for certain beneficial uses of the receiving water. The amount of load reduction needed to restore or maintain the desired beneficial uses of the receiving waters is known as the pollutant load reduction goal (PLRG).

Selective Targeting

The extremely high cost of retrofitting older urban stormwater systems also implies a need for careful evaluation of pollutant reduction goals. A long-term (25 to 40 years) plan based on prioritization of watersheds such that existing systems are selectively targeted for modification is needed to ensure that citizens receive the greatest benefit (pollutant load reduction, flood protection) for the dollar. The upgrading of older systems must also be coordinated with other already planned infrastructure improvements such as road widenings. An excellent example of this approach is the Orlando Streetscape Project. While downtown streets were torn up for this downtown renovation, the existing stormwater system was modified by the addition of off-line exfiltration systems to reduce pollution loads to downtown lakes.

Nonstructural BMPs and source controls also must be used extensively to reduce stormwater pollution from already developed areas. Improved street sweepers that pick up the small particles (<60 microns) that contain high concentrations of metals and other pollutants could also prove valuable in reducing stormwater loadings, especially from downtown business districts where other BMPs usually are infeasible. Education programs for the general public and for professionals involved in stormwater management also are vital. Citizens must understand how their everyday activities contribute to stormwater pollution. For example, citizens should not discard leaves, grass clippings, used motor oil, or other material into swales or storm sewers. Getting youth and citizen groups involved in storm sewer stenciling projects ("Dump No Wastes, Drains To Lake") is an excellent way of reducing dumping of potential pollutants into these conveyances. Even more importantly, comprehensive training and certification programs are needed for those in the private and public sectors who design, construct, inspect, operate, and maintain stormwater management systems.

Funding

The cost of providing needed stormwater infrastructure improvements to address current and future flooding and water quality problems is gigantic. Yet local governments are already struggling financially, and traditional revenue sources such as property taxes cannot be relied on to pay for stormwater management. Instead, a dedicated source of revenue based on contributions to the stormwater problem is needed. The stormwater utility can provide this. The city of Tallahassee implemented Florida's first stormwater utility in October 1986, and over 50 local governments have followed this example.

Innovative BMPs

The infeasibility of using traditional BMPs to reduce stormwater pollutant loads in highly urbanized areas means that creative and innovative BMPs are needed. For example, alum injection within storm sewers was used in Tallahassee to reduce stormwater loadings to Lake Ella (14). A sonic flow meter measures storm sewer flow, causing a flow-proportional dose of aluminum sulfate to be injected and mixed with the polluted stormwater. As the alum mixes with the stormwater, a small floc is produced which attracts suspended and dissolved pollutants by adsorption and enmeshment into and onto the floc particles. The floc then settles to the lake's bottom sediments, gradually blanketing and incorporating into the sediments and thereby reducing internal recycling of nutrients and metals. Other advantages of alum injection include excellent pollutant reduction (>85 percent) and relatively low construction and operations costs, especially for the highly urbanized areas. This type of system has been installed at several locations in Florida with exceptional treatment efficiencies.

Porous concrete consists of specially formulated mixtures of Portland cement, uniform open-graded coarse aggregate, and water. When properly mixed and installed, porous concrete surfaces have a high percentage of void space which allows rapid percolation of rainfall and runoff. Porous concrete is being used widely in Florida, especially for parking lots, and could be an important BMP to reduce stormwater loadings in highly urbanized areas. Recent field investigations of porous concrete parking areas that have been in place for up to 12 years revealed that the infiltration capacity of the concrete has not decreased significantly, a major concern (15). Further information about the use, design, and construction of porous concrete surfaces is available (15).

Regional stormwater systems that manage stormwater from several developments or an entire drainage basin offer many advantages over the piecemeal approach that relies on small, individual onsite systems. They provide economies of scale in construction, operation, and maintenance. Regional systems can also help manage stormwater from existing and future land uses and will be a central part of any retrofitting program. The use of regional systems is another good reason for a watershed management approach that fully integrates land use and stormwater management.

The Southeast Lakes Program—A Model

Many of the above elements of a watershedwide master stormwater planning approach are being implemented by the city of Orlando. The city has adopted an excellent local stormwater ordinance and developed a fine community education program and a prioritized urban lake management program (16). One of the most innovative programs is the Southeast Lakes Project, which is designed to correct flooding problems and to reduce stormwater pollutant loads to 15 urban lakes and 58 drainage wells that currently convey untreated stormwater to an aquifer. A corrective watershed management plan was cooperatively developed by the city, its consultants, DER, and the St. Johns River WMD. The project was initiated not because of enforcement of water quality standards but because of a loss of beneficial uses and local citizen desires and perceptions. Modifications to the existing stormwater systems will be made over a 10-year period, with treatment requirements based on "net environmental improvement" and total watershed load.

One of the most important aspects of the project is the use of innovative BMP designs that promote multiple objectives and take advantage of city-owned properties. At Al Coith Park, a spreader swale will be built on the park's perimeter. When it rains, runoff will enter and fill the swale, overtopping the sidewalk berm and sheet flow across the grassed parkland where it will percolate into the ground. At Lake Greenwood, the surrounding city-owned land is being converted into an urban wetland and expanded lake. The wetland and lake is a complex treatment train that incorporates many BMPs into a very aesthetically pleasing stormwater system and park that even includes reuse of stormwater to irrigate the park and adjacent city-owned cemetery. Near the Citrus Bowl, a packed-bed wetland filter has been installed that will treat water from Lake Clear during times of no rainfall. In addition to improved stormwater management, citizens are receiving the added benefits of recreation and open space. In addition, the retrofitting project has stimulated redevelopment and renovation of existing properties, thereby providing citizens with economic benefits as property values rise.

Chronologic Evolution of Florida's Watershed Management Program

Following is a chronology of the establishment and revision of Florida statutes and programs that are considered cornerstones of the state's overall watershed management efforts. As such, this chronology traces the evolution of Florida's watershed management program.

1970

Chapter 370, FS, created the Coastal Coordinating Council, which was the first state effort at integrating state/regional programs in the protection and use of coastal resources. Initial efforts from 1970 to 1975 focused on a comprehensive resource-based coastal protection program.

1972

A package of land and water planning, regulation, and acquisition programs was created:

- Chapter 380, FS: This creates the Developments of Regional Impact (DRI) and Areas of Critical State Concern (ACSC) land planning and management programs.
- Chapter 373, FS: The Florida Water Resources Act establishes the state's five regional WMDs; designates the Department of Pollution Control as the oversight agency for the WMDs; requires the development of a state water plan; and allows for the regulation of the water resource. WMDs financed by *ad valorem* property taxing authority of up to 1 mil ($1/$1000 value) which is set in the Florida Constitution. NWFWMD millage capped at 0.05 mil.
- Chapter 259, FS: The Land Conservation Act establishes a program, commonly known as the Environmentally Endangered Lands Program, which authorizes the state to purchase critical and sensitive lands; envisioned as a 10-year program investing $200 million and funded by the sale of state bonds.

1973

In Chapter 403, FS, the Florida Environmental Protection Act renames the Department of Pollution Control as the Department of Environmental Regulation and broadens its powers, duties, and programs. This law is the state's general environmental protection act. It is amended almost annually as new environmental concerns and needs arise and as existing programs evolve.

1975

Chapter 163, FS, the Local Government Comprehensive Planning Act and the state's first growth management legislation, was recommended by the first Environmental Land Management Study Committee (ELMS I). The law requires all cities and counties to prepare comprehensive plans which are submitted for review to the state's land planning agency, the Department of Community Affairs, which in turn sends the plans to other state agencies for review and comment. However, the LGCPA contains no "teeth." Local governments are under no statutory requirement to revise their plans by incorporating the comments and recommendations made by the state reviewing agencies. Furthermore, they are not required to pass land development regulations to implement their plans.

1976

Implementation by EPA and the states of Section 208 of the 1972 Clean Water Act occurs, requiring the development of Areawide Water Quality Management Plans. This was the first national program directed at the assessment and control of nonpoint sources of pollution. In Florida, millions of federal grant dollars allows the DER and 12 "Designated Area Agencies" to undertake extensive research on nonpoint source impacts, sources, controls, control effectiveness, and costs. These data provide the scientific basis for the development and implementation in 1982 of a statewide rule that requires treatment of stormwater for new development and redevelopment projects.

1978

Chapter 380, FS, is amended, adding Part II, the Florida Coastal Management Act, which requires establishment of a program based on existing statutes and rules to serve as a basis for receiving federal approval under the Federal Coastal Zone Management Act of 1972. After approval of the program by the National Oceanic and Atmospheric Administration, Office of Coastal Zone Management, federal grants fund many initiatives to better protect and manage coastal resources. One particular initiative establishes an estuarine watershed management program with emphasis on sediment mapping. This project leads to the development of innovative, reliable coastal sediment sampling, analytical, and assessment techniques.

1979

The first components of the state's Areawide Water Quality Management Plan, the Agriculture Nonpoint Source Plan and the Silviculture Nonpoint Source Plan, are submitted to and approved by EPA. These call for a non-regulatory approach with a regulatory backstop if BMPs required by farm conservation plans are not implemented or if the forestry BMPs required by the state's adopted *Silviculture BMP Manual* are not followed.

Chapter 17-4.248, FAC, the state's first stormwater rule, is adopted by the state ERC as a rule of DER. This rule is intended as a temporary regulation until ongoing research on BMP design and effectiveness is completed. The rule's adoption is controversial, but data collected during from 208 program studies conclusively show that stormwater runoff, especially from urban land uses and highways, is a "pollutant" and therefore should be controlled. Florida's continuing rapid growth makes it imperative that treatment of stormwater, using BMPs, be required for new stormwater discharges that would be "a significant source of pollution."

Chapter 253, FS, is amended to establish the Conservation and Recreation Land (CARL) Trust Fund, which provides additional funding for the purchase of Environmentally Endangered Lands and other lands deemed appropriate and in the public interest by the Governor and Cabinet.

1981

Through action taken by the Governor and Cabinet, the Save Our Coasts land acquisition program is established. The program proposes to spend $200 million over 10 years to purchase coastal lands such as beaches, shorelines, and sensitive areas. Funding is provided by the sale of state bonds backed by documentary stamps as authorized in Chapter 375, FS, which sets policy on how the Land Acquisition Trust Fund is to be administered.

Chapter 373, FS, is amended with the creation of the Save Our Rivers land acquisition program. Administered by the WMDs, this program proposes to spend $320 million over 10 years to purchase wetlands, floodplains, and other lands necessary for water management, water supply, and the conservation and protection of water resources.

1982

Chapter 17-25, FAC, is adopted by the ERC after 2 years of rule adoption workshops and 29 official rule drafts. The rule is technology based rather than water quality based, although the state's water quality standards remain as a backstop should a stormwater discharge be causing violations. A performance standard of 80 percent average annual load reduction is recommended, based on BMP effectiveness and cost data, to establish equity with minimum treatment levels for point source discharges. The rule creates design criteria for various types of BMPs, including retention, detention with filtration, and wet detention. The rule creates "general permits" for certain types of BMPs (i.e., retention, detention with filtration) if they are built to the design criteria. Implementation of the rule is delegated to the South Florida WMD, allowing stormwater treatment requirements to be merged with stormwater quantity (flood control) requirements in one permit.

1984

Chapter 403, FS, is revised to create Section IX, which is known as the Henderson Wetlands Protection Act. This legislation expands the authority of the DER to protect wetlands; establishes administrative procedures to allow landowners to obtain legally binding "wetland lines"; allows the DER to consider fish and wildlife habitat, endangered species, and historical and archaeological resource and other relevant concerns in wetland permitting; allows the use of certain wetlands for incorporation into domestic wastewater and stormwater management systems; transfers wetland regulation for agriculture and forestry activities to the WMDs; and requires the WMDs to protect isolated wetlands and consider fish and wildlife habitat requirements.

The Southwest Florida Water Management District (SWFWMD) receives delegation of the stormwater rule.

In the late 1970s and early 1980s, an extensive appraisal of Florida's growth management system was undertaken, which concluded that the existing system was not working. Shaped by the *Final Report of the Governor's Task Force on Resource Management* (1980) and the second Environmental Land Management Study Committee (ELMS II), a totally new blueprint for managing growth emerged. The ELMS II Committee recommended a comprehensive package of integrated state, regional, and local comprehensive planning; reforms to the DRI law; and coastal protection improvements. The state legislature responded between 1984 and 1986 by enacting several laws. For example, Chapter 186, FS, the State and Regional Planning Act, mandates that the Governor's Office prepare a state comprehensive plan and present it to the 1985 state legislature. It also requires the preparation of regional plans by the state's 11 regional planning councils and provides them with $500,000 for plan preparation.

1985

Chapter 187, FS, the State Comprehensive Plan, originally is envisioned to be a leadership document—the foundation of the entire planning process—with strong, measurable, and strategic goals that will set the course for Florida's growth over the next 10 years. Each state agency is to prepare an agency functional plan, based on the state plan, on which its budget appropriations will be made. Unfortunately, one of the most important elements of the state plan, the development and adoption of a capital plan and budget, is never prepared. However, the plan contains important goals and policies in 25 different areas, including water resources, coastal and marine resources, natural systems and recreation, air quality, waste management, land use, mining, agriculture, public facilities, and transportation.

Important and relevant goals include:

- Ensure the availability of an adequate water supply.
- Maintain the functions of natural systems.
- Maintain and enhance existing surface- and groundwater quality.

Important and relevant policies include:

- Eliminate the discharge of inadequately treated wastewater and stormwater.
- Protect natural systems in lieu of structural alternatives, and restore modified systems.
- Promote water conservation and the use and reuse of treated wastewater and stormwater.
- Establish minimum flows and levels for surface waters to ensure protection of natural systems.

1985 to 1986

Chapter 163, FS, is amended with enactment of the Local Government Comprehensive Planning and Land Development Regulation Act of 1985. This law requires all local governments to prepare local comprehensive plans and implementing regulations, which must be consistent with the goals and policies of the state and regional plans. Numerous state and regional agencies review the local plans and submit their objections, recommendations, and comments to the Department of Community Affairs for transmittal to the local government. This time the local plans must be revised to incorporate the objections, recommendations, and comments. Furthermore, local governments face sanctions from the state that could result in the loss of state funding if adopted local plans are not consistent with the state and regional plans.

Florida's revised growth management system is built around three key requirements: consistency, concurrency, and compactness. The consistency requirement establishes the "integrated policy framework," whereby the goals and policies of the state plan frame a system of vertical consistency. State agency functional plans and Regional Planning Council regional plans must be consistent with the goals and policies of the state plan while local plans are required to be consistent with the goals and policies of the state and appropriate regional plan. Local land development regulations (LDRs) must also be consistent with the local plans goals and policies. Horizontal consistency at the local level also is required to ensure that the plans of neighboring local governments are compatible. Consistency is the strong cord that holds the growth management system together.

Concurrency is the most powerful policy requirement built into the growth management system. It requires state and local governments to abandon their long-standing policy of deficit financing growth by implementing a "pay as you grow system." Once local plans and LDRs are adopted, a local government may approve development only if the public facilities and services (infrastructure) needed to accommodate the impact of the proposed development can be in place concurrent with the impacts of the development. Public facilities and services subject to the concurrency requirements are roads, stormwater management, solid waste, potable water, wastewater, parks and recreation, and, if applicable, mass transit. Level of service standards acceptable to the community must be established for each type of public facility.

Compact urban development goals and policies are built into the State Comprehensive Plan and into regional plans. Such policies as separating rural and urban land uses, discouraging urban sprawl, encouraging urban in-fill development, making maximal use of existing infrastructure, and encouraging compact urban development form the basis for this requirement.

1986

Chapter 403.0893, FS, is created as the only surviving section of a stormwater management bill that was developed over a 10-month period. The bill was an attempt to put into statute a cost-effective, timely process to retrofit existing drainage systems to reduce the pollutant loadings discharged to water bodies. Only the section creating explicit legislative authority for local governments to establish stormwater utilities or special stormwater management benefit areas is enacted.

The St. Johns River WMD adopts Chapter 40C-42, FAC, and the Suwannee River WMD adopts Chapter 40B-4, FAC. Adoption of these two stormwater management regulations and the addition of staff to implement these programs allows DER to delegate administration of its stormwater treatment rule to these WMDs, which, in turn, allows DER's stormwater quality permit to be combined with the districts' stormwater quantity permit.

1987

Chapter 373, FS, is revised to add a new section, the Surface Water Improvement and Management (SWIM) Act, which establishes six state priority water bodies. It directs the WMDs, under DER supervision, to prepare a priority water body list and develop and adopt comprehensive watershed management plans to preserve or restore the water bodies. It provides $15 million from general revenue sources and requires a match from the WMDs. The act does not establish a dedicated funding source, making the program dependent on uncertain annual appropriations from the legislature.

1988

Chapter 17-43, FAC, the SWIM rule, is adopted by the ERC. It sets forth factors to consider in the selection of priority water bodies, specifies the format for SWIM plans to ensure some consistency, and establishes administrative processes for the development and adoption of SWIM plans by the WMDs and for their submittal to DER for review and approval.

The State Nonpoint Source Assessment and Management Plan, prepared pursuant to Section 319 of the federal Clean Water Act, is submitted to EPA and approved. This qualifies the state for Section 319 nonpoint source implementation grants, which are used for BMP demonstration projects and to refine existing nonpoint source management programs. The delineation of the state's ecoregions (based on river systems), selection of ecoregion reference sites, and modification of EPA's Rapid Bioassessment Protocols and metrics for use in Florida are initiated.

1989

Chapters 373 and 403, FS, are revised as part of the 1989 stormwater legislation. The legislation clarifies the stormwater program's multiple goals and objectives; sets forth the program's institutional framework, which involves a partnership between DER, the WMDs, and local governments; defines the responsibilities of each entity; addresses the need for the treatment of agricultural runoff by amending Chapter 187, FS, to add a policy in the Agriculture Element to "eliminate the discharge of inadequately treated agricultural wastewater and stormwater"; further promotes the watershed approach being used by the SWIM program; attempts to integrate the stormwater program, SWIM program, and local comprehensive planning program (but does not succeed); establishes State Water Policy, an existing but little-used DER rule, as the primary implementation guidance document for stormwater and all water resources management programs; and creates the State Stormwater Demonstration Grant Fund as an incentive to local governments to implement stormwater utilities and provides $2 million.

1990

Chapter 17-40, FAC, State Water Policy, undergoes a total revision and reorganization so that it can be used as guidance by all entities implementing water resource management programs and regulations. Section 17-40.420 is created and includes the goals, policies, and institutional framework for the state's stormwater management program.

DER is designated as the lead agency with responsibility for setting goals for the program, for providing overall program guidance, for overseeing implementation of the program by the WMDs, and for coordinating with EPA, especially with the advent of the new National Pollutant Discharge Elimination System stormwater permitting program.

WMDs are the chief administrators of the stormwater regulatory program (quantity and quality); they are responsible for preparing SWIM watershed management plans, which include the establishment of stormwater PLRGs; they provide technical assistance to local governments, especially with respect to basin planning and the development of stormwater master plans.

Local governments are the frontlines in the stormwater/watershed management program because they determine land use and provide stormwater and other infrastructure. They are encouraged, but not required, to set up stormwater utilities to provide a dedicated funding source for their stormwater program. Their stormwater responsibilities include preparation of a stormwater master plan to address needs imposed by existing land uses and those needs to be created by future growth; operation and maintenance activities; capital improvements of infrastructure; and public education. They are encouraged to set up an operating permit system wherein stormwater systems are inspected annually to ensure that needed maintenance is performed.

Important goals include:

- Preventing stormwater problems from land-use changes and restoring degraded water bodies by reducing the pollution contributions from older stormwater systems.
- Retaining sediment on site during construction.
- Trying to ensure that the stormwater peak discharge rate, volume, and pollutant loading are no greater after a site is developed than before.

Important minimum treatment performance standards include:

- 80 percent average annual load reduction for new stormwater discharges to most water bodies.
- 95 percent average annual load reduction for new stormwater discharges to Outstanding Florida Waters, which are a special class of exceptionally high-quality water bodies.
- Reducing, on a watershed basis, the pollutant loading from older stormwater systems as needed to protect, maintain, or restore the beneficial uses of the receiving water body.

Chapter 375, FS, is amended with the creation of Preservation 2000, a 10-year land acquisition program with a goal of spending $300 million per year. The legislation divided available annual funding among seven programs: CARL, Save Our Rivers (SOR), Florida Communities Trust, State Parks, State Forests, State Wildlife Areas, and Rails to Trails. The program is funded the first year by state bonds backed by an increase in the documentary stamp fee. Unfortunately, a long-term dedicated funding source is not identified, making the program subject to annual legislative appropriations. Between 1972 and 1991, the state's land acquisition programs have invested over $1.5 billion to buy over 1.2 million acres. Equally important, as a result of the state land acquisition programs, 14 Florida counties have created local programs that currently commit up to $600 million for land conservation. Revenue sources for these local land acquisition programs include local option sales tax, impact fees, added property taxes, and local bonds.

1991

Chapter 40C-42, FAC, is completely revised by the St. Johns River WMD to modify the design criteria for stormwater treatment BMPs so that they will achieve the minimum treatment levels set in State Water Policy. Stormwater reuse becomes essential for developments discharging to Outstanding Florida Waters.

Chapter 40C-44, FAC, is adopted by the St. Johns River WMD to regulate certain agricultural pumped discharges (formerly regulated as industrial wastewater) and establishes design and performance criteria for these agricultural stormwater management systems.

The SWFWMD initiates development of an agricultural stormwater management program for certain types of agricultural activities including row crops and citrus. The program includes regulatory incentives to obtain technical assistance from U.S. Department of Agriculture, Soil Conservation Service, or other qualified individuals to prepare and implement a farm-specific resource management plan that contains certain required BMPs.

1992

DER and the WMDs, in response to increasing demands on the state's waters and the increasing number of water quantity and quality problems, begin the development of district water management plans. collectively these district plans, together with the DER's plan, will create the state water management plan. These plans are based on the goals and policies set in State Water Policy and in the state comprehensive plan. For each of four major areas (water supply, water quality, flood protection, natural systems protection), four key planning steps will occur:

- Resource assessment to identify current or anticipated problems.
- Examination of options.
- Declaration of policy.
- Designation of implementation strategies.

Section 314 Federal Clean Lake Program Lake Assessment Grant is obtained to initiate the delineation of lake ecoregions, select lake ecoregion reference sites, and test/validate lake bioassessment sampling protocols and metrics.

1993

Chapters 373 and 403, FS, are revised extensively as part of the DER/Department of Natural Resources merger to create the Department of Environmental Protection (DEP) and as a part of the Environmental Permit Streamlining bill. The goals of the streamlining bill are to eliminate duplication, especially in permitting; increase administrative and environmental effectiveness by increasing delegation of programs from DEP to the WMDs; and ensure greater program consistency and integration. Key specific actions of the bill include:

- Moving the "Wetlands Protection Act" from Chapter 403 to Chapter 373, FS, thereby delegating the wetland resource permits to the WMDs except for certain projects that require other types of DEP permits.
- Merging the existing surface water/stormwater management permit with the wetland resource permit to create an environmental resource permit.
- Redefining wetlands based on their hydrology, vegetation, and soils, and requiring the development of a single wetland delineation method that will be used by the DEP, WMDs, and local governments.

Recommendations of the third Environmental Lands Management Study Committee (ELMS III) are enacted into law (with a 180-page act), thereby amending several state laws. The act seeks to strengthen the state planning process by:

- Requiring the Governor to biannually review and analyze the state comprehensive plan and recommend any necessary revisions.
- Requiring the Governor to prepare a new growth management portion of the state comprehensive plan. This is to provide a more detailed and strategic state policy guidance for state, regional, and local governments in implementing the state plan. It is to identify urban growth centers; set strategies to protect identified areas of state and regional environmental importance; and provide guidelines for determining where urban growth is appropriate and should be encouraged. The growth management document must be adopted by the legislature. However, to what extent local comprehensive plans, state agency strategic plans, and regional policy plans must be consistent with the state plan is unknown—to be recommended by the Governor and adopted as law by the 1994 legislature.

The act also provided greater flexibility and less requirements in local comprehensive plans for small cities (≤5,000) and counties (≤50,000); streamlined the plan amendment process by limiting the types of revisions requiring state review and approval; strengthened the local plan evaluation and appraisal process; terminated or made optional the development of regional impact (DRI) process in certain areas and revised the DRI process; and authorized local option gas tax of up to 5 cents.

Discussion and Recommendations

Florida has established a wide variety of laws, regulations, and programs at the state, regional, and local level to protect, manage, and restore the state's incredibly valuable yet vulnerable natural resources, especially its water resources. There is no doubt that these programs have been effective in helping to reduce adverse impacts on natural resources resulting from the state's rapid and continuing growth over the past 20 years. Even with the implementation of these programs, however, many of Florida's natural resources have been severely strained or degraded. Some of these adverse effects can be attributed to activities that occurred before the implementation of modern watershed management programs, such as the channelization of the Kissimmee River and the creation of the vast drainage canal network south of Lake Okeechobee, both of which are contributing to the decline of Lake Okeechobee, the Everglades, and Florida Bay. Other adverse impacts, though, are directly related to the state's rapid growth and development during the last 20 years. These include water supply problems, water quality problems, declining habitat, and impacts on endangered species such as the manatee and the Florida panther.

Why are these adverse impacts still occurring given the wide range of watershed management programs that have been implemented in Florida? What could be done to reduce these effects and possibly restore already degraded areas? Following is a list of program deficiencies and recommendations to correct them:

- While the statutes enacted by the legislature may be helpful, insufficient resources have been provided to the governmental entities that are to implement the programs. The state's reliance on sales tax as it primary means of raising "general revenues" means that state revenues are tied closely to economic conditions. Relying on such sources during a recession, especially when population growth is still occurring, means that the state budget is nearly always in crisis. Dedicated sources of funding are needed if watershed management programs are going to compete for limited state resources and have adequate resources to actually achieve their intended benefits.

- The statutes and programs are not fully integrated, leaving gaps in both land planning and water planning programs. In particular, there is a need to better integrate water and land planning and regulatory programs. The local government growth management program needs to be more closely connected to state and regional water management programs. The requirements set forth in State Water Policy and in the district/state water management plans need to be used by local governments in their land-use planning programs. These local plans need to be consistent among all state, regional, and local programs.
- Greater emphasis needs to be placed on ensuring the long-term maintenance and operation of stormwater management systems. Because these systems are a part of the local infrastructure, local governments need to take a more active role in this area. Establishing stormwater operation permits as part of a stormwater utility funded program is an excellent way of providing an economic incentive to a land owner to maintain and operate an onsite stormwater management system properly.
- Greater emphasis needs to be placed on erosion and sediment control on construction sites and on utility installation projects. A major deficiency is ensuring the regular inspection of erosion prevention and sediment control practices. Implementation of a training and certification program for inspectors and contractor supervisors, similar to the Certified Construction Reviewer Program in Delaware, is needed.
- Retrofitting existing drainage systems to reduce their pollutant loading is one of the biggest, most difficult, and most expensive challenges the state has ever faced. One of the major problems in meeting this challenge is the need to develop new stormwater treatment techniques that are not land intensive. Funding of demonstration projects and for research of new techniques in needed.
- While Floridians are among the most educated citizens in the country with respect to water resources and stormwater management issues, more education is needed to help gain citizen support for watershed management programs. The state's environmental education program needs to focus on establishing a comprehensive natural resources management curriculum that begins in kindergarten and continues all the way through high school. Additionally, because of the large number of people who are moving to Florida, especially retirees, continuous education programs are needed to educate these people about the vulnerability and importance of Florida's natural resources.

References

1. Livingston, E.H. 1984. A summary of activities conducted under the Florida Section 208 water quality management planning program, February 1978—September 1984. Final report submitted to the U.S. Environmental Protection Agency.
2. U.S. EPA. 1983. Water quality standards handbook. NTIS PB92231851. Washington, DC: Office of Water Regulations and Standards.
3. U.S. EPA. 1987. Nonpoint source controls and water quality standards. In: Water quality standards handbook. Washington, DC: Office of Water. pp. 2-25.
4. Anderson, D.E. 1982. Evaluation of swale design. M.S. thesis. University of Central Florida, College of Engineering, Orlando, FL.
5. Wanielista, M.P., Y.A. Yousef, G.M. Harper, T.R. Lineback, and L. Dansereau. 1991. Precipitation, interevent dry periods, and reuse design curves for selected areas of Florida. Final report submitted to the Florida Department of Environmental Regulation, Tallahassee, FL.
6. Wanielista, M.P., and E.E. Shannon. 1977. Stormwater management practices evaluations. Report submitted to the East Central Florida Regional Planning Council, Orlando, FL.
7. Miller, R.A. 1985. Percentage entrainment of constituent loads in urban runoff, South Florida. U.S. Geological Survey WRI Report 84-4329.
8. Wanielista, M.P., Y.A. Yousef, B.L. Golding, and C.L. Cassagnol. 1982. Stormwater management manual. Prepared for Florida Department of Environmental Regulation, Tallahassee, FL.
9. Livingston, E.H., J.C. Cox, M.E. McCarron, and P.A. Sanzone. 1988. *The Florida development manual: A guide to sound land and water management*. Tallahassee, FL: Florida Department of Environmental Regulation.
10. Yousef, Y.A., M.P. Wanielista, H.H. Harper, D.B. Pearce, and R.D. Tolbert. 1985. Removal of highway contaminants by roadside swales. Report FL-ER-30-85. Submitted to Florida Department of Transportation, Tallahassee, FL.
11. Wanielista, M.P., Y.A. Yousef, L.M. VanDeGraaff, and S.H. Rehmann-Koo. 1985. Enhanced erosion and sediment control using swale blocks. Report FL-ER-35-87. Submitted to Florida Department of Transportation, Tallahassee, FL.
12. U.S. EPA. 1983. Results of the nationwide urban runoff program. Final report.
13. Richardson, C.J. 1988. Freshwater wetlands: Transformers, filters or sinks? FOREM 11(2):3-9. Duke University School of Forestry and Environmental Studies.
14. Harper, H.H., M.P. Murphy, and E.H. Livingston. 1986. Inactivation and precipitation of urban runoff entering Lake Ella by alum injection in storm sewers. In: Proceedings of the North American Lake Management Society International Symposium, Portland, OR (November).
15. Florida Concrete and Products Association. 1988. Pervious pavement manual. Orlando, FL.
16. Zeno, D.W., and C.N. Palmer. 1986. Stormwater management in Orlando, Florida. In: Urban runoff quality: Impact and quality enhancement technology. Engineering Foundation Conference, Henniker, NH (June).

The State of Delaware Sediment Control and Stormwater Management Program

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Institutional Philosophy

Before submitting proposed legislation regarding stormwater management or sediment control, representatives of the State of Delaware Department of Natural Resources and Environmental Control (DNREC) conducted an extensive educational program to document the serious nature of water quantity and quality problems that exist statewide. This problem documentation was successful in that elected officials, affected industries, and the general public acknowledged the need for a comprehensive approach to sediment control and stormwater management. The statewide legislation was unanimously approved in four committees and on the floor of both the state senate and the house of representatives. The local conservation districts were instrumental in their support of the legislation. In addition, the regulations detailing the legislative requirements were approved with no negative comments after an extensive educational process and with the assistance of a regulatory advisory committee.

A basic premise of the program is that sediment control during construction and stormwater quantity and water quality control postconstruction are all components of an overall stormwater management program that functions from the time that construction is initiated through the lifespan of the constructed project (Figure 1). Program implementation was initiated on July 1, 1991, and the initial emphasis of the program is to prevent existing flooding or water quality issues from worsening. The intent is to limit further degradation until more comprehensive, watershed-specific approaches, as detailed in the state legislation and regulations, can be adopted.

Program Structure

The structure of the sediment and stormwater management program is based on the premise that ultimate program responsibility must rest with the state. In the case of Delaware, the state agency responsible for program implementation is DNREC. DNREC is the ultimate approval authority. Local conservation districts and jurisdictions, however, may request delegation of four program components:

- Sediment control and stormwater management plan approval.
- Inspection during construction.
- Postconstruction inspection of permanent stormwater facilities.
- Education and training.

The sediment control and stormwater management plan review and approval process must be completed before any building or grading permits are issued. Criteria for plan review and approval are contained in state regulations, and design aids and handbooks have been developed or approved by DNREC. One important distinction of the Delaware program is that the delegated local agency handles day-to-day inspection responsibilities.

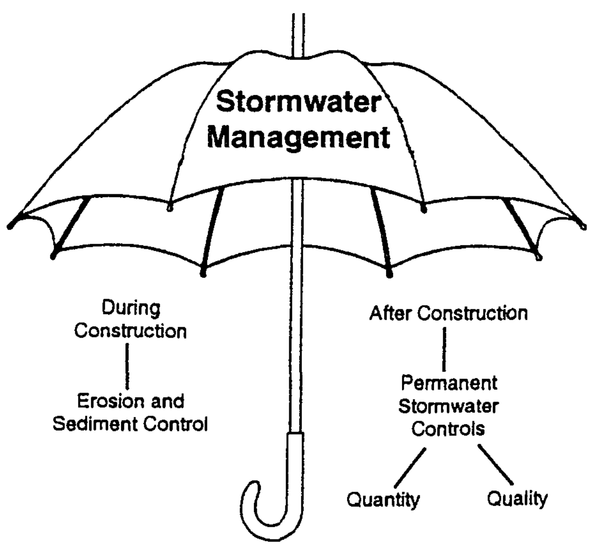

Figure 1. Stormwater management.

Projects for which site compliance cannot be achieved are transferred to the state, where progressive, aggressive enforcement is carried out. State enforcement options include civil and criminal penalty provisions.

Control Practices

Site control practices (Figures 2 and 3) are grouped into two categories: temporary practices during construction and permanent practices for postconstruction runoff. Sediment control practices, designed for temporary site control, must comply with the *Delaware Erosion and Sediment Control Handbook*. This handbook details numerous practices that are available for use depending on applicability. The plan review process ensures that the sediment control practices are located appropriately.

In addition to the traditional structural controls that the handbook contains, the regulations have several requirements that are important to providing overall site control. Site stabilization must be accomplished if the disturbed areas are not being actively worked for a period in excess of 14 days. In addition, unless modified for a specific type of project, no more than 20 acres may be disturbed at any one time to facilitate phasing of a project.

The regulations specifically require that water quality must achieve an equivalent removal efficiency of 80 percent for suspended solids. From a permanent stormwater management standpoint, initial consideration for control must be a pond that has a permanent pool of water. These wet ponds also have an extended detention requirement placed on them in addition to peak flow control of larger storms. Ponds having a normal pool are preferred over either normally dry extended detention ponds or infiltration practices due to their documented performance records and the ability of wet ponds to reduce downstream nutrient loadings. Wet ponds, if properly designed, also can be an amenity to the community where they are placed. A major emphasis is being placed on constructed wetlands as a primary stormwater treatment system in upland areas. The Delaware program does not encourage the use of existing wetlands for stormwater treatment.

Another option for site control is the use of infiltration practices. These practices are allowed but not encouraged due to their potential for clogging and concern over

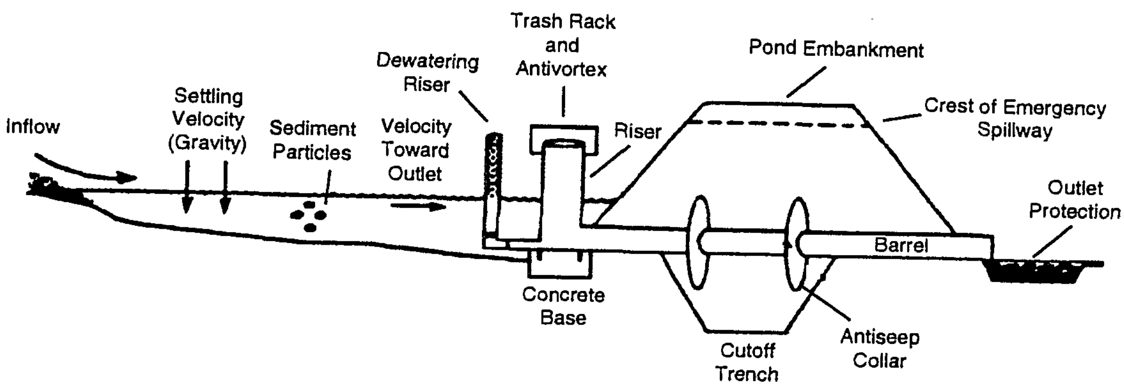

Figure 2. Sediment pond (to be converted to permanent stormwater management facility).

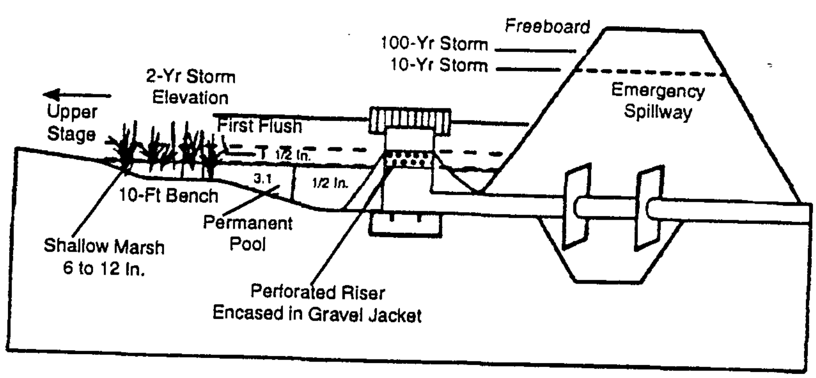

Figure 3. Extended detention pond.

ground-water pollution. Experience in other jurisdictions has demonstrated the potential that infiltration practices have for clogging. Where infiltration practices are used, upslope and downslope impacts in the event of clogging are carefully considered during the plan review process. Infiltration of stormwater runoff is a necessary component of an overall stormwater management program, but critical safeguards relating to filtering of stormwater and ground-water pollution concerns must be considered before design approval.

Filtration of runoff also must be a program component either as a stand-alone practice or in conjunction with other practices, primarily infiltration. Common filtration practices generally rely on vegetative filtering of runoff over filter strips or through swale systems. On highly impervious sites, vegetative filters often are not feasible; in these situations, a sand filter design may be appropriate for initial water quality treatment (Figure 4). Several variations in sand filter designs may be applicable from site to site, but defined design criteria must be followed if the system is to be effective at pollutant removal.

Unique Features

Several features of the Delaware program are unique. The regulations clearly require that stormwater management practices achieve an 80-percent reduction in suspended solids load after a site has been developed. The only other state to present a similar performance criteria is Florida. The 80-percent figure was selected based on a review of documented stormwater practice performances around the country. That level of performance can be achieved with present technology application. Long-term removal rates in excess of 80 percent may require extraordinary measures such as water reuse, which may be required on a local basis but which is not practical from a statewide perspective.

The concept of delegation of program components is fairly unique with respect to program implementation. In Delaware, each aspect of program implementation may be delegated, with DNREC acting as a safety net in the event that a conservation district or a local government fails to adequately implement an aspect of the program. The initial concept of delegation was developed in Maryland for inspection of sediment control; the concept was expanded in the Delaware law and regulations to encompass all aspects of program implementation. The actual interaction of state and local program implementers has quickly become a partnership effort, with the state providing technical expertise and educational training while the conservation districts and local governments provide for actual program implementation.

A major way in which the Delaware program is unique is in the use of privately provided inspectors (Certified Construction Reviewers). The land developer on larger projects (over 50 acres in size or where the state or delegated inspection agency requires) must provide sediment control and stormwater inspectors to assist the appropriate governmental inspection agency. These inspectors must attend and pass a DNREC course on inspection, inspect active construction sites at least once a week, and submit an inspection report to the developer/contractor and the inspection agency on their findings and recommendations. The inspection agency still must periodically inspect the site to ensure the adequacy of site controls, but the designated inspector reduces the frequency of inspection for the inspection agency. Failure to accurately record site conditions or failure to notify either the contractor/developer or inspection agency of site deficiencies may jeopardize the desig-

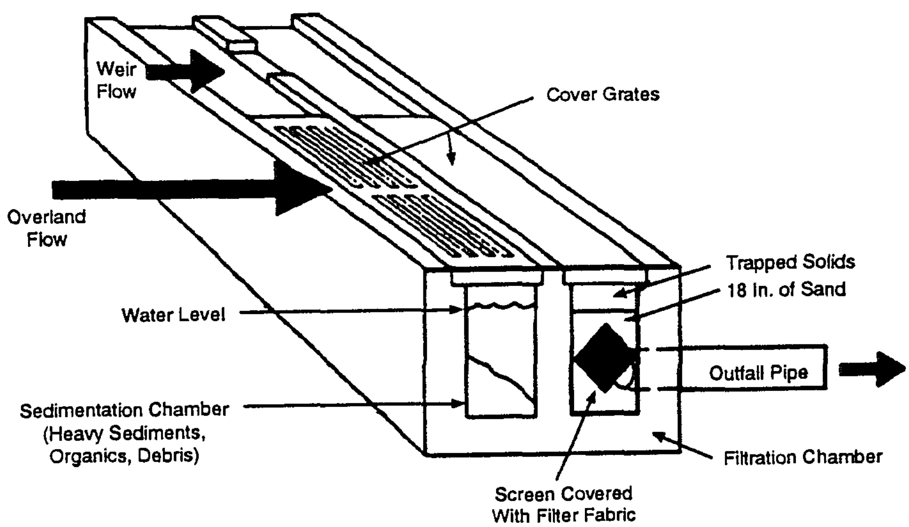

Figure 4. Sand filter design.

nated inspector's certification, which could be grounds for enforcement action against the contractor/developer.

Another important concept that is becoming increasingly popular among states implementing sediment control programs is the requirement that contractors must have a responsible individual(s) certified as having attended a DNREC course for sediment control and stormwater management. The Delaware course lasts approximately 4 hours and attempts to acquaint contractors with the importance of good site erosion and sediment control and stormwater management, as well as with their responsibilities under the law. The contractor certification program is extremely popular with contractors and reduces the "we-they" problems that often exist in regulatory programs.

Evolution

The program discussed above represents the initial phase of program implementation in Delaware. The next step relates to addressing stormwater management from a watershed perspective. The sediment and stormwater regulations contain a Designated Watershed concept that allows for the design and construction of practices on a watershed basis that, when coupled with land-use planning, wetland restoration, and other nonstructural practices, reduces existing flooding problems or improves existing water quality. The expectation is that one watershed will be designated in each county to serve as a model for other watersheds. These watersheds will be studied from a hydrologic, water quality, and stream habitat and diversity standpoint, and alternative land uses and stormwater controls will be considered along with their impact on water quality. Based on the results of the watershed study, a recommended approach for watershed protection will be developed in conjunction with local government officials that presents a blueprint for future resource protection in these Designated Watersheds.

Funding is another area that must be addressed if the initial program is to be expanded. The state law and regulations provide a framework for expanding traditional funding mechanisms with more innovative types of funding. The regulations contain significant information on the consideration of stormwater utilities (user fees) as an alternative to permit fees or general funding. The stormwater utility is expected to accompany the Designated Watershed concept as a mechanism to fund the watershed studies, planning, design, implementation of practices, and the maintenance of completed stormwater management structures.

One area that has not been satisfactorily addressed at this time is the maintenance of residential stormwater management structures. Commercial stormwater management structure maintenance is not expected to present a significant problem, because one entity is generally responsible for overall site maintenance; residential stormwater management structure maintenance, however, is not so easily assured. At this time, residential maintenance is generally the responsibility of a community association, but eventually that responsibility must become a public responsibility if maintenance is to be assured. If that shift of responsibility is to occur, a dedicated funding source, such as a stormwater utility, will have to be implemented.

The issue of land use and its relationship to water quantity and water quality needs to evolve if resource protection is to be accomplished. Significant effort will be expended in educating local government officials on the importance of wetlands, open space, greenways, cluster development, and other options to conventional "cookie cutter" zoning. The Designated Watershed approach will provide specific details on the benefits of alternative land-use approaches and their impacts on water quality and aquatic resources.

An effective stormwater management program must be multifaceted in its approach and implementation. It must cross conventional lines that are based on an erroneous assumption that total resource protection can be provided through the implementation of structural controls that are considered only after entire site utilization has been maximized. Land-use limitations, dedicated open space, vegetated buffer areas, and reduced impervious areas are all components of an overall resource protection strategy. The implementation of a structural control strategy alone will only reduce the rate of resource decline. That type of program needs to be implemented as a first step, but programs should recognize the need for continued evolution for true resource protection to occur.

Section 6217 Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance

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Abstract

In recognition of the fact that over half of the nation's population lives in coastal areas and that nonpoint source pollution remains a significant limiting factor in attaining coastal water quality goals, Congress enacted Section 6217 of the Coastal Zone Act Reauthorization Amendments of 1990 (CZARA). Section 6217 establishes a requirement that states with federally approved coastal zone management programs develop and implement coastal nonpoint pollution control programs to address nonpoint sources affecting coastal waters.

These coastal nonpoint programs are to be implemented through changes to state nonpoint source pollution programs approved by the U.S. Environmental Protection Agency (EPA) under Section 319 of the Clean Water Act and through changes to state coastal zone management programs approved by the National Oceanic and Atmospheric Administration (NOAA) under Section 306 of the Coastal Zone Management Act. The central purpose of Section 6217 is to strengthen the links between federal and state coastal zone and water quality management programs and thereby enhance state and local efforts to manage land uses that affect coastal water quality. States are to achieve this by implementing 1) management measures in conformity with guidance published by EPA under Section 6217(g) of CZARA, referred to as the (g) guidance or the management measures guidance, and 2) additional management measures developed by states where necessary to achieve and maintain water quality standards.

In addition to the (g) guidance, NOAA and EPA have jointly produced program development and approval guidance that outlines the requirements for state coastal nonpoint programs. The program guidance outlines the process by which states will develop their programs and submit them for approval. It also includes the criteria by which EPA and NOAA will evaluate state coastal nonpoint programs.

This paper provides an overview of the program development and approval guidance by briefly describing the elements of the program development process and the necessary components for an approvable state program. Included in this description are coastal zone boundary modification recommendations; identification of nonpoint sources to be addressed; implementation of management measures; additional management measures/critical areas; enforceable policies and mechanisms; program coordination, public participation, and technical assistance; and the program approval process.

Overview

As part of the Coastal Zone Act Reauthorization Amendments of 1990 (CZARA), Congress enacted a new Section 6217, entitled "Protecting Coastal Waters." This new section requires states with federally approved coastal zone management programs to develop and implement coastal nonpoint pollution control programs (referred to here as coastal nonpoint programs).[1] These coastal nonpoint programs are to build and expand upon existing efforts to control nonpoint pollution by state coastal zone management and nonpoint source control agencies.

Section 6217(g) of the statute requires the U.S. Environmental Protection Agency (EPA), in consultation with the National Oceanic and Atmospheric Administration (NOAA), the U.S. Fish and Wildlife Service, and other federal agencies, to publish and periodically update "guidance for specifying management measures for sources of nonpoint pollution in coastal waters." This

[1]The term "state" refers to states, territories, and commonwealths having coastal management programs approved under Section 306 of the Coastal Zone Management Act. There are currently 29 such programs.

technical guidance, or (g) guidance, was published on January 19, 1993. A companion guidance document, entitled *Coastal Nonpoint Pollution Control Program: Program Development and Approval Guidance*, was also released on the same date. Though the program guidance was not required by the statute, NOAA and EPA developed the guidance in an effort to identify clearly the necessary elements for an approvable state coastal nonpoint program.

The statute sets out a two-tiered process for implementing management measures. First, states are to implement technology-based management measures throughout the Section 6217 management area. Second, states must implement additional management measures where water quality standards are not attained or maintained. The states are to determine these additional measures. The program guidance further explains the justification necessary to exclude any nonpoint source category or subcategory from the first tier of a state coastal nonpoint program and sets out the components each state program should include. The program guidance provides for a threshold review process that allows states to work with NOAA and EPA to evaluate their existing nonpoint programs and identify gaps that need to be filled. Finally, the program guidance establishes a process for submitting programs to NOAA and EPA for approval and a schedule for program development, approval, and implementation.

The focus of this paper is the "nuts and bolts" of each state coastal nonpoint program. Each program will vary due to unique differences in both state physiographic features and government structure. Even so, the basic components of a state coastal nonpoint program need to include those elements identified in the statute and discussed in the program guidance.

Statutory Requirements

Section 6217 requires that several elements be included in each state coastal nonpoint program in order to receive NOAA and EPA approval. These basic statutory requirements, excerpted from the program guidance, appear below. State programs must:

- Be closely coordinated with existing state and local water quality plans and programs developed pursuant to Sections 208, 303, 319 and 320 of the Clean Water Act, and with state coastal zone management programs.
- Provide for the implementation, at a minimum, of management measures in conformity with the guidance published under Section 6217(g) to protect coastal waters generally.
- Provide for the implementation and continuing revision from time to time of additional management measures that are necessary to attain and maintain applicable water quality standards and protect designated uses with respect to:
  - Land uses that, individually or cumulatively, may cause or contribute significantly to a degradation of 1) coastal waters not presently attaining or maintaining applicable water quality standards or protecting designated uses or 2) coastal waters that are threatened by reasonably foreseeable increases in pollution loadings from new or expanding sources.
  - Critical coastal areas adjacent to coastal waters that are failing to attain or maintain water quality standards or that are threatened by reasonably foreseeable increases in pollutant loadings.
- Provide for technical and other assistance to local governments and the public to implement additional management measures.
- Provide opportunities for public participation in all aspects of the program.
- Establish mechanisms to improve coordination between state agencies and between state and local officials responsible for land-use programs and permitting, water quality permitting and enforcement, habitat protection, and public health and safety.
- Propose to modify state coastal zone boundaries as the state determines is necessary to implement NOAA recommendations under Section 6217(e), which are based on findings that modifications to the inland boundary of a state coastal zone are necessary to more effectively manage land and water uses to protect coastal waters.

Program Development

The Section 6217 Management Area

The statute requires that NOAA conduct a review of each state's existing coastal zone boundary to determine whether or not the area encompassed by the boundary includes the land and water uses that have "significant" impacts on the state's coastal waters. The impact of land and water uses on coastal waters is considered both "individually and cumulatively." In cases where NOAA finds that modifications to the inland boundary of a state's existing coastal zone are necessary to more effectively manage land and water uses, NOAA is required to recommend a modification to the existing coastal zone. Although expressed in terms of a recommendation that a state modify its coastal zone boundary, NOAA's recommendation also defines what NOAA and EPA believe should be the geographic scope of that state's coastal nonpoint program, i.e., the "6217 management area."

NOAA conducted a review of each state's coastal zone boundary, using existing national data to evaluate land

and water uses within the state. The national data included information on such parameters as population, land area, harvested crop land, and soil loss from crop land. Information was compiled for each state and summarized in a draft document entitled *National Summary: State Characterization Reports.*

In evaluating indicators of nonpoint source pollution, NOAA analyzed data for areas within the state's existing coastal zone and for areas within and outside of coastal watersheds. NOAA used the smallest U.S. Geological Survey mapping unit as a definition of the coastal watershed. In cases where indicators suggested that nonpoint pollution beyond the coastal watershed might have a significant impact on coastal waters, NOAA assessed the need to further extend the boundary to encompass these land and water uses. The area finally recommended by NOAA for inclusion (both the land area encompassed by the existing coastal zone boundary and any area landward of the existing boundary) constitutes the 6217 management area.

NOAA recently provided recommendations to states for modifying their existing coastal zone boundaries. These boundary recommendations generally conform with the state coastal watershed boundaries, except in cases where indicators of nonpoint pollution beyond the coastal watershed appear significant. In such cases, NOAA recommends that an additional area landward of the coastal watershed be included in the 6217 management area. In addition to the boundary recommendations, NOAA issued a set of draft criteria that states may use in developing their response to the boundary modification recommendation. The final boundary determination will be accomplished through the state response to the NOAA recommendation and a public review and comment process at the state level. States have the option of either extending their existing coastal zone boundary inland or exercising other state authorities within the 6217 management area.

Identification of Nonpoint Sources To Be Addressed

The basic premise of Section 6217 is that technology-based controls should be implemented for all nonpoint sources that, either individually or cumulatively, have significant impacts on coastal waters. There need not be a demonstration that an individual source has an impact on water quality. In this sense, Section 6217 is akin to the technology-based approach of the point source program under the Clean Water Act. For program approval, states are to implement management measures throughout the 6217 management area for all nonpoint source categories (e.g., agriculture) and subcategories (e.g., confined animal facilities) identified in the management measures guidance. States also may include management measures for other sources (e.g., mining) not identified in the guidance if the state determines such measures are necessary to protect coastal waters generally.

The program guidance provides for exclusions of nonpoint source categories and subcategories under certain circumstances. If the state can demonstrate that the source is neither present nor anticipated in the 6217 management area, the source may be excluded. States also may exclude sources that do not, individually or cumulatively, present significant adverse effects to living coastal resources or human health. It should be noted that the burden of proof is on the state to demonstrate that the application of the management measures to the remaining sources will protect coastal waters generally. In other words, if a state wishes to exclude a particular nonpoint source category from management measures implementation, the state must demonstrate that the nonpoint category does not (and is not reasonably expected to) present significant adverse effects to living coastal resources or human health.

For either type of exclusion, the state must provide documentation of the rationale and data used to justify the exclusion. The program guidance includes certain factors that may be considered in exclusions. They are as follows:

- Pollutant loadings or estimates of loadings from the sources.
- Intensity of land use.
- Ecological and human health risk associated with the source.

NOAA and EPA will review the information provided by the state to determine if the category or subcategory may be excluded from the coastal nonpoint program.

Implementation of the (g) Management Measures

State programs need to provide detailed information on how each of the management measures will be implemented. The program guidance includes a description of the information to be included in the coastal nonpoint program for each nonpoint category and subcategory. This information includes the scope, structure, and coverage of the state program; the designated lead agency and supporting agencies that will implement the program; a program implementation schedule with milestones; enforceable policies and mechanisms to ensure management measure implementation; interagency coordination mechanisms; a process to identify practices to implement the management measures; operation, maintenance, and inspection procedures to ensure continuing performance of the measures; and monitoring activities to evaluate the effectiveness of the measures.

States may already have programs in place that can be incorporated into the coastal nonpoint program. States need to provide information on how these existing programs can be used to implement the management measures and identify where necessary changes will be made. For example, a state may have a program that requires local ordinances for erosion and sediment control. Because the program guidance requires "enforceable policies and mechanisms" at the state level, the state would have to show some means of ensuring local implementation of erosion and sediment control. This could be in the form of backup state enforcement or some other state oversight of local programs.

Where states do not have existing programs to address a given nonpoint category or subcategory, they will have to develop new authorities and programs to ensure implementation of the management measures. This may include developing new state authority. Both existing and new programs need to be incorporated into the coastal nonpoint program.

Additional Management Measures/Critical Areas

The program guidance requires states to implement additional management measures under two conditions:

- Where coastal water quality remains impaired even after implementation of the (g) measures.
- In areas whose function is critical to water quality.

States must first identify waters that are threatened or impaired as a result of nonpoint pollution impacts. Land adjacent to these waters plays a particularly important role in attaining or maintaining water quality. There may be situations where new and expanding land uses could result in further impacts to threatened or impaired waters from nonpoint sources, beyond those controlled by the (g) measures. The purpose of additional management measures in this case is pollution prevention to avoid water quality problems that might otherwise develop.

Additional management measures also are required for coastal waters that are not attaining or maintaining applicable state water quality standards or protecting designated uses. There are two instances where states will need to implement additional management measures due to water quality impairments. First, if a state has identified waters that are failing to meet water quality standards and determines that existing pollution prevention activities and/or the implementation of the (g) measures will not be adequate to achieve water quality standards, the state will have to implement additional measures for those waters at the time of program approval. The second is following implementation of the (g) measures and monitoring to evaluate effectiveness of the (g) measures. If a state determines that water quality impairments (as a result of nonpoint sources) exist even after implementation of the (g) measures, the state will have to implement additional management measures.

Enforceable Policies and Mechanisms

Besides the provisions for state coastal nonpoint programs found in Section 6217, CZARA also amended Section 306 of the Coastal Zone Management Act (CZMA) to require that (before approving a coastal zone management program) NOAA finds "... the management program contains enforceable policies and mechanisms to implement the applicable requirements of the coastal nonpoint pollution control program of the state required by Section 6217..." (Section 306(d)16). The CZMA also includes a definition of "enforceable policy": "[t]he term 'enforceable policy' means state policies which are legally binding through constitutional provisions, laws, regulations, land use plans, ordinances, or judicial or administrative decisions, by which a state exerts control over private and public land and water uses and natural resources in the coastal zone."

The program guidance outlines a variety of both regulatory and nonregulatory approaches that a state may design to meet the requirement for enforceable policies and mechanisms. Examples of regulatory approaches include permit programs, local zoning requirements, and state laws. Nonregulatory approaches could include economic incentives (such as cost-share programs) or disincentives (such as taxes or user fees). Nonregulatory approaches must be backed by enforceable state authority to ensure management measure implementation.

Several existing state programs to control nonpoint sources are backed by state laws. In other cases, state requirements are delegated to local authorities for implementation or rely on state funds, which provide cost-share monies for implementing practices. For a state coastal nonpoint program to be approvable, the state needs to demonstrate that these programs are ultimately subject to state enforcement authority. An example of how this might work for a cost-share program that is currently voluntary is for the state to back up the voluntary program with a "bad actor" provision in state law. In cases where participation in the voluntary program does not result in implementation of the management measures, the state would have the ability to penalize the "bad actors" or those who failed to take advantage of the voluntary opportunity.

Traditional regulatory approaches could offer more direct state oversight of management measures implementation. A state could issue general permits for specific source categories that include certain criteria that must be met by all those who meet the category definition. Conditions on the general permit would allow tailoring of requirements for site-specific circumstances. Issuance of individual permits (such as those issued by many states for septic systems) could also be used for a specific entity.

Program Coordination, Public Participation, and Technical Assistance

The program guidance requires several other program elements, including provision for administrative coordination, public participation, and technical assistance. These elements are critical to successful implementation of coastal nonpoint programs because they provide necessary linkages between state, regional, and local governments; between government agencies and the public; and between government agencies and affected user groups. Such linkages ensure the involvement of a variety of players and, if well developed, build strong support for programs from the grass-roots level to the state capitol.

Administrative coordination is inherent in the involvement of state coastal zone management agencies and state water quality agencies as equal partners in the development of coastal nonpoint programs. These ties need to be further enhanced through the involvement of other state agencies (such as state forestry, state agriculture, and state health departments) and with local governments who will be instrumental in implementing programs at the ground level. Such relationships can be further defined and solidified through memoranda of agreement, joint permitting processes, cross training of staff, and interagency committees.

Public participation is an integral part of the coastal nonpoint program because public support is necessary to ensure effective program development and implementation. The program guidance requires that states must provide opportunities for public participation in all aspects of the coastal nonpoint program. Specifically, each state needs to demonstrate that its program has undergone public review and comment before submittal to NOAA and EPA for approval.

Technical assistance is particularly important in providing regional and local governments with needed direction on how to implement the provisions of state coastal nonpoint programs. The statute outlines a variety of technical assistance areas, including "assistance in developing ordinances and regulations, technical guidance, and modeling to predict and assess the effectiveness of such measures, training, financial incentives, demonstration projects, and other innovations to protect coastal water quality and designated uses." Technical assistance also will be necessary for affected user groups and the public. The program guidance also includes assurances that NOAA and EPA will continue to provide technical assistance to states as they develop and implement their programs.

Program Submission and Approval

States have 30 months from the publication of the final (g) guidance to develop their coastal nonpoint programs. The final (g) guidance document was published on January 19, 1993, giving states until July 19, 1995, to submit their programs (see timeline below). During this period, states have opportunities to meet with NOAA and EPA and discuss their progress on program development. The program guidance establishes a threshold review process whereby NOAA and EPA conduct an initial review of a state's program to address key issues and decision points. Threshold review is voluntary but provides an opportunity for states to identify gaps in their programs early in the process, giving a better idea of what to expect when the program is finally submitted for approval. It also helps focus limited resources where they can be used in the most efficient and effective manner.

In addition to threshold review, the program guidance sets out a conditional approval provision for state programs that are submitted without all of the necessary elements for final approval. NOAA and EPA recognize (under limited circumstances) that a state may submit a program for which all necessary enforceable policies and mechanisms are in place but that the state may need additional time to develop state, regional, or local authorities to implement the state requirements. Under such circumstances, NOAA and EPA may grant conditional approval of a state program for a period of 1 year. Final approval of the program would depend on the state's ability to demonstrate that all necessary enforceable policies and mechanisms are in place. A conditional approval will not affect the date by which states must achieve full implementation of the (g) measures. Full implementation still must proceed and be completed within 3 years of the first federal approval action, whether that approval is conditional or not.

Summary

Table 1 presents a timeline for coastal nonpoint program development, approval, and implementation.

Table 1. Coastal Nonpoint Program Development, Approval, and Implementation

Date	Process
January 1993	Final (g) measures and program approval guidance issued
January 1993	Coastal nonpoint program development: threshold review (optional), formal/informal
July 1995	States submit final Section 6217 coastal nonpoint programs
January 1996	EPA/NOAA complete review of state programs (program approval)
January 1996	State begins implementation of (g) measures
January 1999	Full implementation of (g) measures
January 2001	Completion of 2-year monitoring period
January 2004	Full implementation of additional management measures

Compliance With the 1991 South Carolina Stormwater Management and Sediment Reduction Act

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Abstract

The 1991 Stormwater Management and Sediment Reduction Act is comprehensive legislation intended to address the management of stormwater runoff from a watershed perspective. The Act establishes a statewide program making requirements consistent across political boundaries. It gives local governments several options to address specific problems though the creation of stormwater utilities or designated watersheds. Considerations are made for citizen complaints and input into program development and operation.

Introduction

Stormwater management and sediment reduction is an integral part of nonpoint source pollution control. Amendments to the federal Clean Water Act in recent years have emphasized stormwater management and sediment control as basic parts of National Pollutant Discharge Elimination System (NPDES) permitting. Several states recognized erosion and sediment control as a major problem in the early 1970s. States had used different approaches, ranging from comprehensive statewide regulatory legislation (e.g., North Carolina) to the voluntary approach of enabling legislation to allow local governments to enact ordinances to regulate erosion and sediment control on the local level. Traditionally, stormwater management was not part of enabling legislation or statewide programs.

In the early to mid 1980s, some states began to incorporate stormwater management into these programs. The Clean Water Act amendments strengthened the case for attaching the stormwater management issue to the erosion and sediment control programs. To date, several states have implemented combined programs.

South Carolina passed enabling legislation in 1971 to allow local governments to pass ordinances to regulate erosion and sediment control. This approach met with very little success; only 22 local ordinances were passed in 22 years. In 1983, the Erosion and Sediment Reduction Act was passed to regulate state-owned lands. This act was to set an example for local programs. The act exempted the South Carolina Department of Highways and Public Transportation by requiring them to establish a program of their own.

In 1991, the South Carolina General Assembly recognized the increasing problems from years of mismanagement of stormwater runoff. On May 27, 1991, Governor Carroll Campbell signed the 1991 Stormwater Management and Sediment Reduction Act. Pursuant Regulation 72-300 became effective June 26, 1992.

Requirements of the Act

The 1991 act sets minimum standards for program development for control of sediment and water quantity statewide. The act allows local governments to establish stormwater utilities and designated watersheds. It also mandates a statewide regulatory program for stormwater management and sediment reduction.

The intent is to delegate program components to local governments or conservation districts. There are four components to the program: plan review, inspection, enforcement, and education and training. Criteria for delegation of each component is set forth in the regulations. Any or all of the components may be delegated. The delegation is valid for 3 years. The South Carolina Land Resources Conservation Commission provides oversight of the local program to ensure its proper operation. In the event that delegation is not requested, the commission operates the program within that jurisdiction or until a local entity requests delegation. The local government has first right of refusal to request delegation. If the local government chooses not to request delegation, the local conservation district may request the delegation.

The commission retains jurisdiction of certain activities to the exclusion of all others. The commission will permit activities by persons with eminent domain, the federal government, and all local governments.

Requirements for Individual Site Development

Minimum standards are established for individual site development. There are important dates that should be recognized when determining specific requirements for site development. The effective date of the act was May 27, 1992. The effective date of Regulation 72-300 was June 26, 1992. All sites with land-disturbing activities that affect 5 acres or more and that began on or after October 1, 1992, are required to permit through this program regardless of local program status. Beginning July 1, 1993, any land-disturbing activity starting on or after that date in the fifteen most populated counties as listed in Section 72-303 must permit through the program. Additional counties are phased in for 1994 and 1995. Size limits have been set for land disturbances from 0 to 2 acres as a reporting requirement following guidance in 72-307(H). Permits for land disturbances of 2 to 5 acres are required under the guidelines of 72-307(I). Land disturbances greater than 5 acres must follow Section 72-307.

Site-Specific Requirements

The site-specific requirements have some general similarities to the federal Clean Water Act requirements for construction. One of the major differences addresses the quantity of water released. These regulations are broken into different parts according to the stage of the land-disturbing activity.

Postconstruction requirements include both quantitative and qualitative controls. For quantity control, post-development release rates for the 2-year/24-hour and 10-year/24-hour design storms are controlled to the 2-year/24-hour and 10-year/24-hour predeveloped release rates. Quality controls for the first flush are implemented where ponds are the proposed method of control. A wet pond requires capture of the first half inch of runoff volume from the impervious areas site. This flow can be mixed with the clean permanent pool volume and discharged over 24 hours. A dry pond requires that the first 1 inch of runoff volume from impervious areas is captured and released over 24 hours. The first flush must be separated from the additional flow into the dry basin.

Where ponds are not the proposed method of control, nonstructural controls are required. Riparian vegetation strips, grass waterways, sand filters, and other measures to meet postconstruction water quality concerns are acceptable alternatives.

During construction, the requirement is qualitative, dealing exclusively with control of offsite discharge of sediment. A performance standard of 80 percent removal (total suspended solids in versus total suspended solids out) or an efficiency of an effluent standard of 0.5 mL/L peak effluent settable solid concentration, whichever is most lenient, must be achieved. Sites with 10 disturbed acres draining to a single point are required to have a sediment basin. Otherwise, a combination of structural and nonstructural practices may be used. There is no sampling requirement to prove compliance with these standards. Plans are developed using modeling techniques to predict performance of this standard for the 10-year/24-hour design storm.

A construction sequence, one of the most important requirements, is required as part of the overall plan. The sequence, which is developed by the project designer, contains all site activities, from installing tree protection to final landscaping and paving. Close compliance with the construction is required. The contractor must follow this sequence, with modifications allowed for unforeseen circumstances; however, the sequence is not normally modified.

Inspection and Enforcement

Site inspection is of primary importance to operations of this program. Without inspection, the program is doomed to failure. Weekly unannounced site inspections are made on each site. Further, a set of approved plans is required to be held on site.

Enforcement provisions in the act provide for fines of up to $1,000 per day. Also, stop-work orders may be issued. These enforcement provisions are used when violations occur and cooperation is not received to correct the problem. There are no criminal penalties associated with violations of this act.

Enforcement actions require that the owner be notified by certified mail of any violation. Land-disturbing activities commencing without a permit are subject to an immediate stop-work order. Violations are cited in the inspection report, with a copy given to the designated day-to-day contact and a copy mailed to the owner. If corrective action is not taken within the specified time frame, a certified letter is mailed to the owner. This letter outlines the corrective action required and the penalties to be assessed.

Citizen Complaint Process

A citizen may file a complaint concerning any portion of program operation or site-specific regulation. The complaint is filed with the implementing agency for action. If satisfaction is not achieved, a hearing may be requested. This hearing must follow procedures listed in the South Carolina Administrative Procedures Act. If satisfaction is not achieved in this hearing, the complaint may be appealed in the court system.

Florida's Growth Management Program

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Abstract

Between 1970 and 1990, Florida's population nearly doubled, from 6,791,418 to 12,937,926. Recognizing that this rapid growth—up to 900 people per day—could overwhelm the state's social, economic, and environmental resources, the Florida legislature twice passed growth management acts. This paper reviews the history of growth management in Florida, with emphasis on the differences between the 1975 and 1986 legislation. The state's current growth management program and process is described, focusing on the institutional framework and the relationship to the state's water quality management program. The role of various state and regional resource management agencies in the review and approval of local government comprehensive plans and the implementing land development regulations is discussed, including specific areas of Florida's growth management program that are essential to the management of water resources. The paper also presents examples of goals within the State Comprehensive Plan that can form the foundation for watershed management and the maintenance and restoration of water resources. Lessons learned in the implementation of Florida's growth management program are reviewed, with recommendations made to improve the program's environmental effectiveness.

Introduction

Florida's citizens and political leaders accepted the notion that the strong and sustained growth that Florida enjoyed after World War II was an unmixed blessing that would ensure economic health with no negative effects. It was assumed that growth not only paid for itself but also produced surplus revenues for state and local governments. Florida's public policy toward growth during the 1950s and 1960s could best be described as "Build now, worry later."

During this period, Florida grew at a phenomenal rate with the population rising from 2,771,305 in 1950 to 6,791,418 in 1970 and to 12,937,926 in 1990. Today, Florida is the fourth most populous state and is still growing rapidly, although not at the rate of 900 people per day (300,000 per year) that occurred throughout the 1970s and 1980s.

The negative impacts of unplanned growth were seen as early as the 1930s, when southeast Florida's coastal water supply was threatened by saltwater intrusion into the fragile freshwater aquifer that supplied most of the potable water for the rapidly expanding population. By the 1970s, it was becoming all too clear that unplanned land use and development decisions were altering the state in a manner that, if left unchecked, could lead to profound, irretrievable loss of the very natural beauty that brought residents and tourists to Florida. Extensive destruction of wetlands, bulldozing of beach and dune systems, continued saltwater intrusion into freshwater aquifers, and the extensive pollution of the state's rivers, lakes, and estuaries were only some of the negative impacts of this rapid growth.

What Is Growth Management?

Florida is one of eight states to have implemented a growth management program (1). Understanding Florida's growth management system requires a clear understanding of the distinctions between growth management, comprehensive planning, and land/environmental regulations:

- *Growth management* looks at broad issues and at the interrelationship of systems: natural systems, infrastructure, land use, and people. It attempts to assess how well we have provided for the needs of our citizens in the past and on how to determine and provide for the needs of new citizens. Growth management encompasses comprehensive planning, natural resource management, public facilities planning, housing, recreation, economic development, and intergovernmental coordination.
- *Comprehensive planning* is a governmental process for inventorying resources, establishing priorities, establishing a vision of where a community wants to

go, and determining how to get there. It is a systematic way of looking at the different components of a community, county, region, and state.

- *Regulations* are the specific controls applied to different types of development activities to regulate and minimize their negative impacts. Typically, regulations are administered by all levels of government, federal, state, and local. At the local level, land development regulations are the ordinances that implement the local comprehensive plan.

Comprehensive Planning Versus Regulation

Comprehensive planning allows a community to make decisions about how and where future growth will occur. Comprehensive planning asks, Is this the right location? Is this the right time? Is this the right intensity for the proposed use of the land? Comprehensive planning seeks to prevent problems (social, economic, environmental) before development occurs.

Permitting, on the other hand, asks only, How can we do the best job with this development on this particular site? Permitting is site-specific and seeks only to mitigate the impacts of the land-use decision. Limitations are always inherent in any regulatory program, and comprehensive planning can help to overcome them. Principal among these limitations is the fact that permitting is piecemeal and does not consider cumulative effects. Therefore, regulation and permitting cannot substitute for planning. Both are needed to manage growth effectively and to protect quality of life.

Growth Management in Florida, Chapter 1

Florida began serious and comprehensive efforts to manage its growth as the environmental movement in the nation and the state gained strength. In 1972, the Florida legislature enacted the first modern package of land and water planning, regulation, and acquisition programs. This package included:

- Chapter 373, Florida Statutes (F.S.), establishing the state's five regional water management districts, requiring the development of a state water plan, and allowing for the regulation of the water resource.
- Chapter 403, F.S., establishing the state's Department of Environmental Regulation and its powers and duties.
- Chapter 259, F.S., establishing the Environmentally Endangered Lands program, which authorized the state to purchase critical and sensitive lands.
- Chapter 380, F.S., creating the Developments of Regional Impact (DRI) and Areas of Critical State Concern (ACSC) programs.

In 1975, at the recommendation of the first Environmental Land Management Study Committee (ELMS I), the Legislature enacted the state's first growth management legislation. Chapter 163, F.S., the Local Government Comprehensive Planning Act (LGCPA), required all cities and counties to prepare a comprehensive plan. These plans were submitted for review to the state's land planning agency, the Department of Community Affairs (DCA), which in turn sent the plans to other state agencies for review and comment.

Despite the legislature's good intentions, the growth management legislation passed in the 1970s contained fatal flaws. First, the LGCPA contained no "teeth." Local governments were under no statutory requirement to revise their plans by incorporating the comments and recommendations that the state agencies involved in the review of the local comprehensive plans had made. Furthermore, they were not required to pass land development regulations to implement their plans. Most importantly, state and local officials never recognized that substantial new funding would have to be provided to make the program work. Funding was essential for the mandated planning, for supporting the costs of infrastructure, and for implementing strategies to manage growth. Finally, the law did not require local governments to ensure that public facilities and services kept up with the demands imposed by population growth. As Florida's population continued to boom in the 1980s, this failure to connect the costs of growth with land-use decisions and population increases resulted in billions of dollars of backlog in public facilities and services, increased strain on existing facilities, and an ever-increasing deficit in the quality of life for Floridians.

Growth Management in Florida, Chapter 2

In the late 1970s and early 1980s, an extensive appraisal of Florida's growth management system was undertaken; the appraisal concluded that the existing system was not working. Shaped by the Final Report of the Governor's Task Force on Resource Management (1980) and the second Environmental Land Management Study Committee (ELMS II), a totally new blueprint for managing growth emerged. The ELMS II recommended a comprehensive package of integrated state, regional, and local comprehensive planning, reforms to the DRI law, and coastal protection improvements. The legislature responded by enacting the following growth management framework:

- *The State and Regional Planning Act of 1984* (Chapter 186, F.S.) mandated that the Governor's Office prepare a state comprehensive plan and present it to the 1985 legislature. It also required the preparation of regional plans by the state's 11 regional planning councils and provided $500,000 for plan preparation.

- *The 1985 State Comprehensive Plan* (Chapter 187, F.S.) originally was envisioned to be a leadership document—the foundation of the entire planning process—with strong, measurable, and strategic goals that would set the course for Florida's growth over the next 10 years. Each state agency was to prepare an agency functional plan, based on the State Comprehensive Plan, upon which its budget appropriations would be made. Unfortunately, one of the most important elements of the State Plan—the development and adoption of a capital plan and budget—was never prepared.
- *The Local Government Comprehensive Planning and Land Development Regulation Act of 1985* (Chapter 163, F.S.) required all local governments to prepare local comprehensive plans and implement regulations consistent with the goals and policies of the state and regional plans. Numerous state and regional agencies reviewed the local plans and submitted their objections, recommendations, and comments to the Department of Community Affairs for transmittal to the local government. This time, the local plans had to be revised to incorporate the objections, recommendations, and comments. Furthermore, local governments faced sanctions from the state that could result in the loss of state funding if adopted local plans were not consistent with the state and regional plans.

Florida's revised growth management system is built around three key requirements: consistency, concurrency, and compactness:

- The *consistency* requirement established the "integrated policy framework," whereby the goals and policies of the State Plan framed a system of vertical consistency. State agency functional plans and regional planning council regional plans had to be consistent with the goals and policies of the State Plan, while local plans had to be consistent with the goals and policies of the state and appropriate regional plan. Furthermore, the individual elements of each local plan must be internally consistent, a requirement that has the power to make local plans into coherent, meaningful, balanced documents for guiding the future of a community. Local land development regulations (LDRs) must also be consistent with the local plan's goals and policies. Horizontal consistency at the local level also is required to ensure that the plans of neighboring local governments are compatible. Consistency is the strong cord that holds the growth management system together.
- *Concurrency* is the most powerful policy requirement built into the growth management system. It requires state and local governments to abandon their long-standing policy of deficit financing growth by implementing a "pay as you grow system." Once local plans and LDRs are adopted, a local government may approve a development only if the public facilities and services (infrastructure) needed to accommodate the impact of the proposed development can be in place concurrent with the impacts of the development. Public facilities and services subject to the concurrency requirements are roads, stormwater management, solid waste, potable water, wastewater, parks and recreation, and, if applicable, mass transit.
- *Compact* urban development goals and policies are built into the State Comprehensive Plan and into regional plans. Policies such as separating rural and urban land uses, discouraging urban sprawl, encouraging urban in-fill development, making maximum use of existing infrastructure, and encouraging compact urban development form the basis for this requirement.

Synopsis of the 1985 Growth Management Process

Content of Local Comprehensive Plans (2)

The plans are prepared in accordance with the minimum requirements set forth in Rule 9J-5, Florida Administrative Code (FAC), "Minimum Criteria for Review of Local Government Comprehensive Plans and Determination of Compliance."

Who Prepares the Plan?

The local government may designate itself as the local planning agency (LPA) or designate a LPA by ordinance to prepare the plan and recommend it to the local government for adoption. Procedures assuring maximum public input and participation must be implemented by the local government and the LPA.

What Is Included in the Plan?

Plans shall consist of materials, written or graphic, including maps, as are appropriate for the prescription of goals, objectives, principles, guidelines, and standards for the orderly and balanced future economic, social, physical, environmental, and fiscal development of the area. The plan must contain the nine required elements and, if the local government population exceeds 50,000, a Mass Transit Element and an Aviation and Port Element.

What Are the Required Plan Elements?

These elements must be internally consistent and economically feasible. Each element consists of data analysis along with the setting of goals and policies to achieve desired results. The elements include:

1. *Capital Improvements Element*, which must consider the projected need and location of public facilities over the next 5 years:

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a) This element must contain a component with principles for construction of new public facilities or for increasing capacity of existing facilities.

b) A component must also be provided outlining principles for correcting existing public facility deficiencies.

c) The element must set forth standards to ensure availability and adequacy of public facilities.

d) It must establish the acceptable levels of service for all facilities.

2. *Future Land Use Element*, which must include a future land use map. The map and policies of this element must be based on studies, data, and surveys that determine the projected population changes, show the distribution and amount of land for each land use type (e.g., residential, commercial, industrial) needed to accommodate the growth, show the availability of public services, address renewal of blighted areas, and eliminate nonconforming uses.

3. *Traffic Circulation Element*, showing existing and proposed transportation routes needed to achieve the desired level of service based on future population and land uses.

4. *Public Services/Facilities Element*, which establishes the level of service for wastewater, solid waste, stormwater, and potable water. An analysis must be undertaken to determine whether existing facilities are providing current residents with the desired level of service, and whether these facilities can meet the demands for service created by projected future development; to identify any existing or future service deficiencies; to determine strategies and schedules for correcting these deficiencies; and to insert these needed infrastructure improvements into the Capital Improvements Element.

5. *Conservation Element*, to provide principles and guidelines for the conservation, use, and protection of natural resources, including air, water, recharge areas, wetlands, estuarine marshes, soils, beaches, floodplains, rivers, bays, lakes, wildlife and marine habitat, and other natural and environmental resources.

6. *Recreation and Open Space Element*, which must establish a level of service for recreational facilities, set forth how these will be met as the population grows, and ensure public access to beaches.

7. *Housing Element*, with standards and principles to be followed to ensure the provision of housing for existing residents and provide for future growth. It must also include provisions for adequate sites of future housing for low and moderate income persons, for mobile homes, and for group homes.

8. *Coastal Management Element*, which must be prepared by those jurisdictions having a coastline. This element is to set forth policies to maintain, restore, and enhance the overall quality of the coastal zone environment, including wildlife; to protect human life against the effects of natural disasters; and to limit public expenditures that subsidize development in high-hazard coastal areas.

9. *Intergovernmental Coordination Element*, to coordinate the plan with those of adjacent local governments, school boards, special districts, etc.

The Plan Adoption and Review Process

Local plans are submitted to the DCA at a rate of 10 to 15 per month in accordance with the schedule and dates set out in Rule 9J-5, FAC.

The local government sends the proposed plan to DCA for review and written comment. DCA in turn sends copies to other state agencies for review and comment within 45 days. Within 45 days after receiving comments from these other agencies, the DCA issues an Objections, Recommendations, and Comments (ORC) Report, which summarizes the comments received from all of the reviewing agencies. The local government has 60 days to revise the plan, hold a public hearing, and formally adopt it.

Upon adopting the revised plan, the local government sends the adopted plan to DCA. DCA has 45 days to review and issue a legal Notice of Intent to find the plan "in compliance" or "not in compliance." The term "in compliance" means consistent with the State Comprehensive Plan, the Regional Plan, and Rule 9J-5, which sets forth minimum criteria.

If the local plan is found to be not in compliance, the following process occurs:

- A formal Chapter 120, F.S., Administrative Hearing is held, at which the local government can show by a preponderance of evidence that the plan is in compliance. A Final Order upholding or overturning DCA's determination of compliance is sent to the Governor and Cabinet.
- If the plan is not in compliance, the Governor and Cabinet can either specify remedial actions to bring the plan into compliance or impose sanctions on the local government, resulting in the loss of state revenue sharing funds, loss of state funds for road improvements, and loss of eligibility for some grant programs.

If the local plan is found to be in compliance:

- A legal notice of intent is published in a local newspaper.
- Within 21 days, any affected party may file a petition for a formal Chapter 120 hearing to appeal DCA's compliance decision.

- After the hearing, a final order is issued that either upholds or overturns the DCA compliance determination. If overturned, the Governor and Cabinet again can either specify remedial actions or impose sanctions.

Plan Adoption and Approval Status

As of August 1993, a total of 186 local comprehensive plans were in compliance, while 30 were not in compliance. Another 212 plans had been brought into compliance through a negotiated compliance agreement between the DCA and the local government, and 29 plans that were not in compliance have a pending compliance agreement that has not been signed (3). Of the 259 local comprehensive plans determined to be not in compliance, the compliance issues that caused the findings to be made are summarized in Table 1 (4).

The Plan Amendment Process

Chapter 163 limits amendments to an adopted comprehensive plan to only twice a year. These amendments must be adopted following the same procedure as when the plan was first adopted. The plan amendment review process is similar to the original plan review process, involving the following steps:

1. The land owner submits a request for plan amendment to the local government. Usually this must include certain data and information to help the local government determine the potential impacts of the proposed amendment.
2. The local government holds a public hearing to determine whether to adopt the proposed plan amendment.
3. Proposed plan amendments are submitted to the DCA for review to ensure consistency with state and regional plans and with Rule 9J-5. DCA transmits the amendment to other state agencies for their review and comment within 30 days. DCA has a total of 45 days to review the amendments; incorporate comments, objections and recommendations from other state agencies; and send the ORC Report to the local government.
4. The local government conducts a public hearing where it can adopt, adopt with modifications, or not adopt the amendment.

Table 1. Compliance Issues

Compliance Issue	Number	Percentage
Natural resource protection	198	76
Level of service standard	183	71
Land use	163	63
Concurrency management system	128	49
Affordable housing	89	34
Financial feasibility	84	32
Coastal management	59	23
Intergovernmental coordination	56	22
Land development regulation	21	8

Implementing the Plan: Adopting Land Development Regulations

A key feature of the 1985 growth management legislation is the requirement that local governments adopt LDRs within 1 year after submission of the revised plan to DCA for formal review. LDRs are defined in Chapter 163, F.S., as "ordinances enacted . . . for the regulation of any aspect of development." They are an exercise of the general governmental police power for the protection of the public health, safety, and welfare. LDRs must address, at a minimum, the following areas:

- Subdivisions.
- Implementation of land-use categories included in the land-use element and map (zoning), along with regulations to ensure the compatibility of adjacent land uses and to provide for open space.
- Protection of potable water wellfields.
- Stormwater management (quantity and quality).
- Protection of environmentally sensitive land.
- Signage.
- Public facilities and services to meet or exceed the established level of service standards.
- Onsite vehicular and pedestrian traffic flow and parking.

The LDRs must be adopted by ordinance, and the adoption process must comply with the notice and public hearing process set forth in Florida law. Finally, the LDRs must be combined into a single land development code.

Unlike local plans, LDRs do not undergo comprehensive state review and approval. The DCA may review and take action on individual LDRs under only two circumstances. The first is for "completeness review," in which the DCA must have reasonable grounds to believe that a local government has totally failed to adopt any of the required LDRs. "Reasonable grounds" means that DCA has received a letter(s) from a party or parties stating facts that show the local government has failed to adopt one or more of the required LDRs. DCA can then require a local government to submit its LDRs for review. DCA then enters into a period of review and consultation with the local government to determine whether the local government has complied with statutory requirements. If DCA determines that a local government has failed to adopt one or more required LDRs, it notifies the local government within 30 days. The local government then must adopt the LDRs and submit them to DCA. If the local government fails to adopt the LDRs, DCA institutes action in circuit court to require adoption of the required LDRs.

The second type of state review is to assure that the LDRs "implement and are consistent with the local comprehensive plan." This review looks more closely at the actual content and substance of the ordinances. This review can only be initiated by a "substantially affected person" (citizen), however, and it cannot be initiated by the DCA. A consistency challenge must occur within 12 months after the final adoption of the LDR. The substantially affected person must petition DCA to initiate a Chapter 120 administrative hearing. If DCA reviews the information in the petition and determines that the LDRs are not consistent with the plan, then DCA requests an administrative hearing. If DCA reviews the information in the petition and determines that the LDRs are consistent with the plan, then the affected party can request an administrative hearing. If the Final Order from the administrative hearing finds the LDR is inconsistent, then the Governor and Cabinet determine what types of sanctions will be imposed on the local government.

Comprehensive Plans and the Protection of Natural Resources

A main purpose of the comprehensive planning program is to maintain, restore, and protect Florida's very valuable, vulnerable natural resources. The goals and policies set forth in the State Comprehensive Plan along with the requirements in Rule 9J-5, which set forth specific objectives and policies that must be included in each plan element, provide the basis for the protection of natural resources.

Within the State Comprehensive Plan, goals and policies that specifically address minimizing impacts of various activities on natural resources and the general conservation, protection, and proper use and management of natural resources are found within the Water Resources, Coastal/Marine Resources, Natural Systems and Recreation Lands, Air Quality, Waste Materials, Land Use, Mining, Agriculture, Public Facilities, Conservation, and Transportation Elements. The following are examples of these goals and policies.

For the Water Resources Element, the goal is to "assure the availability of an adequate supply of water . . . and . . . maintain the functions of natural systems and the overall present level of surface and ground-water quality. Florida shall improve and restore the quality of waters not presently meeting water quality standards." Policies include:

- Protect and use natural water systems in lieu of structural alternatives, and restore modified systems.
- Establish minimum seasonal flows and levels for surface waters to ensure protection of natural resources, especially marine, estuarine, and aquatic ecosystems.
- Discourage the channelization, diversion, or damming of natural riverine systems.
- Encourage the development of a strict floodplain management program to preserve hydrologically significant wetlands and other natural floodplain features.
- Protect surface and ground-water quality and quantity.
- Eliminate the discharge of inadequately treated wastewater and stormwater runoff into waters of the state.

Coastal/Marine Resources policies include:

- Accelerate public acquisition of coastal and beachfront land to protect coastal and marine resources.
- Avoid spending state funds that subsidize development in high-hazard coastal areas.
- Protect coastal and marine resources and dune systems from the adverse impacts of development.

For the Natural Systems and Recreational Lands Element, the goal is to protect and acquire unique natural habitats and ecosystems and to restore degraded natural systems. Policies include:

- Protect and restore the ecological functions of wetlands systems to ensure their long-term environmental, economic, and recreational value.
- Promote restoration of the Everglades system and of the hydrological and ecological functions of degraded or disrupted surface waters.
- Implement a comprehensive planning, management, and acquisition program to ensure the integrity of Florida's river systems.

Agriculture policies include:

- Eliminate the discharge of inadequately treated agricultural wastewater and stormwater runoff to surface waters.
- Conserve soil resources to prevent sedimentation of state waters.

Rule 9J-5 contains many minimum requirements for goals, objectives, and policies that are directly related to the conservation, protection, and proper use and management of natural resources. The following are some examples.

Public Facilities policies include:

- Correct existing facility deficiencies and coordinate the extension of, or increases in the capacity of, facilities to meet future needs.
- Maximize the use of existing facilities to discourage urban sprawl.

- *Regulate land* use and development to protect the functions of natural stormwater features and natural ground-water aquifer recharge areas.

Conservation policies include:

- Conserve, appropriately use, and protect the quantity and quality of water, minerals, soils, native vegetative communities, fisheries, wildlife, and wildlife habitat.
- Protect air quality, native vegetative communities, and water quality.
- Protection and conservation of the natural functions of soils, fisheries, wildlife habitats, surface waters, ground waters, and beaches and shorelines.

Growth Management in Florida, Chapter 3

After several years of living with and implementing the 1985 growth management law, numerous issues were arising that suggested that the program needed fine tuning. On one side were people who thought that the program and process were hindering economic development, stepping on private property rights, and becoming cumbersome administratively. Others felt that the program was not adequately protecting social, economic, and environmental resources. In 1991, the third Environmental Land Management Study Committee (ELMS III) was formed to provide recommendations to the 1993 legislature on ways to further improve and refine Florida's growth management laws. The Committee's report included the following conclusion (5):

> Florida's growth management process is not in a state of disrepair, but it needs some immediate attention. More importantly, it needs executive leadership to protect the substantial investment that has been made so that it will not be lost, or worse, become a liability. Decisions that are made over the next 12 to 18 months will determine whether our efforts will be able to deliver the promises made. The tools for managing future growth and change are in place. The challenge is whether these tools and our leadership can respond when asked to perform.

The Committee's Final Report and Recommendations formed the basis for a new planning and growth management act which passed by overwhelming margins in both the house and the senate in the closing days of the 1993 session. Among the provisions of the 180-page law are some major changes relating to state planning, regional planning, the DRI process, local planning and concurrency, and infrastructure funding as explained below (6).

State Planning

One of the biggest criticisms of Florida's growth management system is the lack of strong leadership at the state level. The State Comprehensive Plan originally was envisioned as a leadership document with strong, measurable, and strategic goals that would set a course for the state's growth and guide the development and implementation of state programs. State agency and program budgeting decisions, however, never were changed to incorporate the State Plan's requirements. Furthermore, key components of the State Plan—the capital plan and budget—never were developed or adopted. These omissions have resulted in a lack of a cohesive, integrated, comprehensive vision of Florida's future as well as a lack of financial resources to implement the program and to correct existing infrastructure deficiencies.

The 1993 Growth Management Act strengthens the state planning process in two ways. First, it requires the Governor's Office to review and analyze the State Comprehensive Plan biannually and submit a written report recommending revisions or explaining why no revisions are necessary. Second, the act requires that a new Growth Management Element be prepared and submitted to the 1994 legislature. The element must be strategic in nature; provide guidance for state, regional, and local actions necessary to implement the State Plan; identify metropolitan and urban growth centers; establish strategies to protect identified areas of state and regional environmental significance; and provide guidelines for determining where urban growth is appropriate and should be encouraged.

Regional Planning

The 1993 Growth Management Act greatly changes the role and powers of the regional planning councils. The regional planning councils are charged with planning and coordinating intergovernmental solutions to multijurisdictional growth-related problems, with no regulatory authority. Regional policy plans will now be required to address only affordable housing, economic development, emergency preparedness, regionally significant natural resources, and regional transportation, and these plans will no longer be a basis for determining the consistency of local plans.

The DRI Process

The act provides for the termination of the DRI process in large jurisdictions (counties greater than 100,000 population) when they adopt specific intergovernmental coordination mechanisms. The law also greatly revises the DRI process in those counties and cities that retain the process. Fewer projects will be considered DRIs, the regional planning councils will be allowed to address only state and regional resources or facilities, and the review process is expedited for projects that are consistent with the local comprehensive plan.

Local Planning

The act makes several very substantial changes in the local planning process, especially with respect to the plan amendment review process, sanctions, intergovernmental coordination, and evaluation and appraisal reports. The plan amendment review process is streamlined, with DCA issuing an ORC Report for a proposed amendment only if a regional planning council, affected person, or local government requests it or if DCA decides to conduct such a review. All adopted plan amendments will be reviewed by DCA for compliance with state laws. The law greatly changes and strengthens the evaluation and review reporting requirements. The DCA is directed to adopt a rule establishing a phased schedule for the submittal of evaluation and appraisal reports no later than 6 years after local plan adoption and then every 5 years thereafter.

Concurrency and Infrastructure Funding

The act codifies DCA's existing concurrency management rule and policies, thereby providing specific legislative guidance on this critical component of the planning process. To avoid conflicts with other state planning goals, the act authorizes local governments to provide an exception from transportation concurrency requirements in areas designated for urban in-fill development, urban redevelopment areas, existing urban service areas, or certain downtown revitalization areas. The act authorizes local governments to adopt a "pay and go" system for transportation concurrency if the local plan includes a financially feasible capital improvement plan to upgrade transportation facilities and establishes an impact fee or other system requiring the developer to pay its fair share of needed transportation facilities. Unfortunately, while ELMS III recommended a 10-cent statewide gas tax increase to provide infrastructure funding, the legislature only authorized local governments to increase the local option gas tax by up to 5 cents.

Recommendations

Based on experience with Florida's growth management programs over the past 15 years, the following recommendations are made to streamline the process and enhance protection of Florida's natural resources.

The program and its requirements must recognize the inherently different growth management needs of highly urbanized areas or rapidly growing areas and separate them from the planning needs of rural areas, especially those with very slow growth rates. Flexibility, with consistency, is the key.

Rural local governments, especially in those areas experiencing growth, have the most to gain from comprehensive planning. Hopefully, they can avoid the mistakes that have been made in central and southern Florida where unplanned growth adversely affected social, economic, and environmental resources. Rural local governments, however, need extensive technical assistance and funding to develop and implement sound comprehensive plans.

Probably the greatest hindrance to solving Florida's existing growth management problems and preventing future growth from exacerbating them is the implementation, at both state and local levels, of dedicated funding sources. At the state level, the Growth Management Program, the Surface Water Improvement and Management Program, the State Stormwater Demonstration Grant Program, and the Preservation 2000 Land Acquisition Program are underfunded and depend on annual legislative appropriations. Dedicated funding sources such as increases in documentary stamp taxes or the placement of small fees on products such as concrete, asphalt, fertilizer, pesticides, and water use or even electric bills could generate sufficient funding levels to ensure that these programs succeed. At the local level, impact fees, gasoline taxes, and the establishment of stormwater utilities (already implemented by over 50 local governments) are essential if funds sufficient to pay for needed infrastructure improvements are to be raised.

The state's land planning and water planning frameworks need to be better integrated. In particular, the Department of Environmental Regulation and the five regional water management districts need to be the lead agencies involved with water management issues. Greater consistency and integration is needed between local comprehensive plans and requirements set forth in State Water Policy, Chapter 17-40, FAC. Currently, local comprehensive plans only are required to "consider" State Water Policy rather than to be "consistent with."

References

1. Gale, D.E. 1992. Eight state-sponsored growth management programs: A comparative analysis. JAPA 58(4):425-439.

2. Gluckman, D., and C. Gluckman. 1987. Citizen's handbook to the Local Government Comprehensive Planning Act. Handbook prepared for the Florida Audubon Society, Maitland, FL.

3. Department of Community Affairs. 1993. Compliance determinations for local government comprehensive plans. Tallahassee, FL.

4. Department of Community Affairs. 1993. Analysis of issues resulting in a finding of not in compliance for local government comprehensive plans. Tallahassee, FL.

5. ELMS III Committee. 1993. Final report and recommendations. Tallahassee, FL.

6. Pelham, T. 1993. The ELMS III legislation: Revising Florida's Growth Management Act. Florida Administrative Law Section Newsletter 16(3):11-16.

Stormwater and the Clean Water Act: Municipal Separate Storm Sewers in the Moratorium

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Abstract

Urban stormwater and related pollutant sources have been shown to be major sources of water quality impairment. Section 402(p)(6) of the Clean Water Act requires the U.S. Environmental Protection Agency to identify additional stormwater sources to be regulated to protect water quality under Phase II of the National Pollutant Discharge Elimination System (NPDES) program. Mitigating water quality impairment associated with urban runoff requires comprehensive efforts with special emphasis on comprehensive approaches to stormwater management for new development. Municipal governments in urbanized areas appear to be critical institutions for making many of the day-to-day decisions necessary to address problems associated with stormwater, including measures to minimize the risks to water resources associated with stormwater from areas undergoing urbanization. In addition, municipalities have the police power needed to implement some components of stormwater programs and the ability to collect funds to be used in program implementation. This paper looks at the use of NPDES permits for discharges from municipal separate storm sewers systems in urbanized areas as a tool for defining the federal/state/municipal relationship for addressing stormwater management.

Environmental Background

Urban stormwater discharges have been shown to be a major cause of impairment of surface water resources. The *National Water Quality Inventory 1990 Report to Congress* provides a general assessment of surface water quality based on biennial reports submitted by the states under Section 305(b) of the Clean Water Act (CWA). The report indicates that of the rivers, lakes, and estuaries that the states assessed, roughly 60 to 70 percent are supporting the uses for which they were designated. Urban lands, however, only account for 2 percent of lands in the United States (1). The report indicates that urban runoff is a major source of impairment for 53 percent of impaired estuary acres, 36 percent of impaired ocean coastal miles, 29 percent of impaired lake acres, 6 percent of impaired Great Lake shoreline, and 9.6 percent of impaired river miles. The report also indicates that combined sewer overflows, which are a mixture of urban runoff, sanitary sewage, and industrial process discharges, are sources of impairment for 4 percent of impaired estuary acres, 3.6 percent of impaired ocean coastal miles, 7.5 percent of impaired Great Lakes shoreline, and 2.8 percent of impaired river miles. Urban runoff affects receiving waters in or near urban population centers and therefore may limit the uses and values of the waters closest to the most people.

Surface water resources are affected by two characteristics of urban runoff: 1) elevated pollution concentrations and loadings and 2) changes in flow patterns that accompany urbanization. The nature of the receiving water determines whether increased pollutant loadings or changes to natural flow patterns or a combination of both are causes of impairment. For example, slower moving rivers, streams, lakes, and estuaries can be more sensitive to increased pollutant loadings than to changes in flow patterns. Conversely, faster moving streams, such as those found in hilly or mountainous areas, can flush pollutants but may be sensitive to dramatic changes in flow patterns. A good comparison of these impacts is provided by Pitt, who compares impacts in Coyote Creek (San Jose, California), a stream with relatively slow flows, with impacts in Kelsey and Bear Creeks (Bellevue, Washington), streams with high flows and good flushing capabilities (2, 3).

Sources of Pollutants in Urban Stormwater

Pollutants discharged from municipal separate storm sewer systems originate from a variety of diffuse

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sources. EPA has identified four major classes of sources that contribute pollutants to discharges from municipal separate storm sewer systems (4):

- Nonstormwater sources
- Residential and commercial sources
- Industrial sources
- Construction activities

Nonstormwater Sources

Although separate storm sewers are primarily designed to remove runoff from storm events, materials other than stormwater find their way into and are ultimately discharged from separate storm sewers. For example, in Sacramento, California, less than half the water discharged from the stormwater drainage system was directly attributed to precipitation (5). Nonstormwater discharges to storm sewers come from a variety of sources, including:

- Illicit connections and cross connections from industrial, commercial, and sanitary sewage sources.
- Improper disposal of wastes, wastewaters, and litter.
- Spills.
- Leaking sanitary sewage systems.
- Malfunctioning septic tanks.
- Infiltration of ground water contaminated by a variety of sources including leaking underground storage tanks.
- Wash waters, lawn irrigation, and other drainage sources.

For a more complete description of nonstormwater discharges to storm sewers, see U.S. EPA (6).

Table 1 provides a summary of several studies involving problems with nonstormwater discharges. These case studies illustrate the wide range of pollutants that can enter storm sewers from nonstormwater discharges,

Table 1. Summary of Nonstormwater Discharge Problems

Study Site	Comments
Jones Falls Watershed, Baltimore City and County, MD	During the NURP study of the Jones Falls Watershed, 15 illicit connections were discovered in portions of the watershed. The illicit connections were grouped into four types: direct discharges from residences; leakage from cracked or broken sewer lines; decades-old overflows from the sanitary sewer; and sanitary sewage pumping station malfunctions. Elevated levels of pathogens, TSS, ammonia, TKN, total nitrogen, COD, and TOC were identified.
Tulsa, OK	A physical inspection was conducted of 120,000 ft of storm sewer 48 in. and larger serving a drainage area of approximately 12 square miles. Thirty-five potential nonstormwater discharges were observed. Twenty-three of these were observed and/or suspected sanitary sewer connections, four were potable water discharges, and eight were of unknown origin. In addition, 12,900 ft of sanitary sewer was laid within the storm sewer, where the storm sewer served as a conduit. Most illicit connections were associated with development that occurred before 1970. Other documented observations were structural defects (900 ft of pipe showed signs of structural defects), pipe cross through (176 total), and debris buildup.
Washtenaw County, MI	Inspection of 1,067 businesses, homes, and other buildings was conducted, with 154 of the buildings (14%) identified as having illicit connections, including connections in restaurants, dormitories, car washes, and auto repair facilities. About 60% of the automobile-related businesses inspected had illicit discharges. A majority of the illicit connections discovered had been approved connections when installed. Pollutants that were detected included heavy metals, nutrients, TSS, oil and grease, radiator fluids, and solvents.
Fort Worth, TX	Twenty-four outfalls in a 10-mile radius were targeted for end-of-pipe observations. The success of the program was judged by a decline in the number of undesirable features at the target outfalls from an average of 44 undesirable observations per month in 1986 (522 total) to an average of 21 undesirable observations per month in 1988. The Fort Worth investigation indicated problems associated with allowing septic tanks, self-management of liquid waste by industry, and construction of municipal overflow bypasses from the sanitary sewer to the storm drains. These problems were attributed to the inability of the publicly owned treatment works to expand as rapidly as urban growth occurred. During a 30-month period, problems detected included 133 hazardous spills, 125 incidents related to industrial activity, 265 sanitary sewer line breaks, and 21 bypass connections of the sanitary sewer to the storm sewer. Highlighted cases included a 20-gal/min flow from a cracked sanitary sewer from a bean processing plant to a storm drain and an illicit connection of a sanitary sewer line from a 12-story office building to a storm sewer. Most industrial pollution enters the storm sewer system from illegal dumping, storm runoff, accidental spills, and direct discharges. Metals were not detected in dry-weather discharges but were found in significant levels in receiving water sediment. City officials state that the high metal concentrations in sediment are consistent with otherwise unexplained serious reported fish kills.

Table 1. Summary of Nonstormwater Discharge Problems

Study Site	Comments
Seattle, WA	The city of Seattle has detected improper disposal and illicit connections from industrial sites by investigating sediment in storm sewers. One storm drain outfall representing a major source of lead to the Duwamish River was traced back to a former smelter that crushed batteries to recover lead. Lead concentrations in the sediment were high enough to allow the city to send it to an operating smelter to be refined. Another storm drain contained high levels of creosote, pentachlorophenol, copper, arsenic, and PCBs, which (except for the PCBs) were traced back to a wood treatment facility. Contaminated sediments removed from the storm drain (30 yd^3) contained 145 lb of contaminants. Sediments removed from storm drains in another industrial area contained very high levels of PCBs (about 1 lb PCBs/70 yd^3 sediment).
Upper Mystic Lake, NY	The NURP study for the Mystic Lake Watershed project identified contamination of stormwater runoff and subsequently surface water contamination of surface waters by sanitary discharges as a major problem in the watershed that contributed large quantities of phosphorus, certain metals, and bacteria. Interactions at 19 manholes that served both sanitary and storm sewer lines were identified as the major contributor of pollutants.
Bellevue, WA	The NURP report for Bellevue recorded 50 voluntary citizen reports of illegal dumping and other nonstormwater discharges during a 27-month period. The incidents reported were varied and resulted in at least two significant fish kills. Of the citizen reports, 25% involved improper disposal of used oil to the storm sewer. Other reports involved spills; illicit connections of floor drains, septic tank pipes, and a car wash; chemical dumping; and concrete trucks rinsing out into catchbasins or streams.
Ann Arbor, MI	Studies in 1963, 1978, and 1979 found that discharges from the Allen Creek storm drain contained significant quantities of fecal coliform, fecal streptococci, solids, nitrates, and metals. Of the 160 businesses dye-tested, 61 (38%) were found to have improper storm drain connections. Chemical pollutants including detergents, oil, grease, radiator wastes, and solvents were causing water quality problems. Monitoring of the storm drainage system during storm events indicated a decrease in the concentration of 32 of 37 chemicals monitored after the improper connections were removed.
Medford, OR	Fecal coliform tests at storm drain outfalls in city parks were used to detect four leaking sewer lines, which either were located above the storm lines or saturated the ground with effluent, which entered the nearby storm drains, an agricultural equipment wash rack, and a house with sanitary lines plumbed to the storm drain. In addition, in one of the oldest sections of town a large storm drain bored in the early 1900s also contained the sanitary sewer line. Under manholes, the sanitary line was only a trough. Even minor clogs or breaks resulted in a spillover of effluent in the storm drain below.
Toronto, Ontario	Dry weather sampling of discharges from 625 storm drains in the Humber River Watershed. About 10% of the outfalls were considered significant sources of nutrients, phenols, and/or metals, while 30 of the outfalls had fecal coliform levels >10,000/100 mL. Investigations identified 93 industrial and sanitary sewage illicit connections. Problems included residential connections of sanitary sewage to the storm sewers and yard runoff from a meat packing plant to a storm drain.
Grays Harbor, WA	Dry weather sampling of 29 outfalls of separate storm drains indicated that discharges from six of the outfalls had abnormally high pollutant levels with suspected illicit connections. The area under consideration had originally been served by combined sewers. Earlier efforts to separate the system had been incomplete, with some residences discharging sanitary sewage to the storm drain.
Seward, NY	Sewage from septic tanks with clogged drainfields in clay soils flowed into open storm sewers. The open storm sewers posed health risks to neighborhood children and lowered property values.
Norfolk Naval Station, VA	The Norfolk Naval Shipyard was originally built in 1767 and has had numerous additions since that time. It has an extensive network of underground pipes that includes both separate storm sewers and sanitary/industrial sewers. In response to a lawsuit, officials at the shipyard conducted dye-testing of sanitary facilities throughout the shipyard, which led to the identification and elimination of 25 cross connections of sanitary and industrial waste to the separate storm sewer system.
Sacramento, CA	The city of Sacramento is currently undertaking a project to identify pollutant discharges and illegal connections into the stormwater drainage systems. Recent studies identified acute toxicity in stormwater, and revealed that less than half the water discharged from the drainage system was not directly attributable to precipitation. Mass loading estimates of copper, lead, and zinc discharged by the drainage system were several times higher than the estimated pollutant loads of these metals from the Sacramento Regional Treatment Plan secondary effluent.
Hazardous waste case studies	Cases of onsite waste disposal where pollutants were added to runoff that eventually ended up in drainage systems and other cases where a generator dumped wastes directly down a drain were common. Of the 36 cases of illegal dumping investigated in a GAO report, 14 cases investigated involved disposal of hazardous waste directly to, or with drainage to, a storm sewer, flood control structure, or the side of a road. An additional 10 sites involved disposal to the ground, landfills (other than those receiving hazardous wastes), and trash bins, which can then result in added pollutants to subsequent stormwater discharges.

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including pathogens, metals, nutrients, oil and grease, metals, phenols, and solvents. Removal of these non-stormwater pollutant sources often provides opportunities for dramatic improvement in the quality of discharges from separate storm sewers.

Residential and Commercial Runoff

Residential and commercial activities are the predominate land uses in most urbanized areas (UAs), typically occupying between 55 to 85 percent of the total area. Major pollutants associated with residential and commercial runoff include heavy metals, oxygen demanding materials, bacteria, nutrients, floatables, organics, pesticides, polynuclear aromatic hydrocarbons (PAHs), and other toxic organic pollutants.

From 1978 through 1983, the U.S. Environmental Protection Agency (EPA) provided funding and guidance to the Nationwide Urban Runoff Program (NURP) to study the nature of runoff from commercial and residential areas. The NURP study provides insight into what can be considered background levels of pollutants in runoff from residential and commercial land uses. Sites used in the NURP study were carefully selected so that they were not affected by pollutant contributions from construction sites, industrial activities, or illicit connections. Data from several sites had to be eliminated from the study because of elevated pollutant loads associated with these sources.

Data collected in NURP indicated that on an annual loadings basis, suspended solids in discharges from separate storm sewers draining runoff from residential and commercial areas are approximately an order of magnitude or more greater than in effluent from sewage treatment plants receiving secondary treatment. In addition, the study indicated that annual loadings of chemical oxygen demand (COD) is comparable in magnitude with effluent from sewage treatment plants receiving secondary treatment.

Table 2 compares annual pollutant loadings for three metals—zinc, lead, and copper—from urban runoff from the Metropolitan Washington UA, from a sewage treatment plant that provides advanced treatment and that serves about 2 million people (the Blue Plains sewage treatment plant), and from major industrial process wastewater discharges located in Maryland and Virginia.

When analyzing annual loadings associated with urban runoff, it is important to recognize that discharges of urban runoff are highly intermittent, and that the short-term loadings associated with individual events will be high and may have shockloading effects on receiving water.

Pollutant loadings for urban stormwater are based on the "Simple Method" developed by the Washington Metropolitan Council of Governments (7). Pollutant concentrations used in this model were based on those published in U.S. EPA (8). The values for lead were reduced by 75 percent to account for assumed reductions due to reductions in the use of lead in gasoline.

Pollutant loadings for direct dischargers in the Toxics Release Inventory are as reported in Cameron (9). The Toxics Release Inventory contains data on toxic chemical releases by industrial facilities that use 10,000 lb or more of specified toxic chemicals and does not include all releases from all industrial facilities in a state.

Industrial Runoff

A number of studies indicate that runoff from industrial land uses has relatively poorer water quality than other general land uses (8, 10-13). In general, a greater variety and larger amounts of toxic materials can be used, produced, stored, or transported in industrial areas. Industrial activities that can provide a significant source of pollutants to stormwater from industrial sites include loading and unloading, outdoor storage, outdoor processes, illicit connections or management practices, and waste disposal practices. In addition, many heavy industrial areas have a large degree of imperviousness, which results in high volumes of runoff. Atmospheric deposition and spills and leaks associated with material transport can contribute to significant levels of toxic constituents in runoff to areas surrounding or in close proximity to heavy industrial activity.

Table 2. Annual Pollutant Loadings (in Pounds) in Stormwater From Selected Pollutant Sources

Pollutant	Urban Stormwater From Metropolitan Washington	Blue Plains POTW[a]	All MD and VA Direct Industrial Discharges in 1987 Toxic Release Inventory
Zinc	480,000	137,000	132,000
Lead	132,600	5,500	31,300
Copper	113,000	21,000	127,000
Nitrogen	30,000,000	12,000,000	Not available
Phosphorus	1,200,000	113,000	Not available
BOD5	9,500,000	1,400,000	Not available

[a]Blue Plains POTW loadings estimates based on EPA Permit Compliance System (PCS) data for 1989.

Runoff From Construction Activities

The amount of sediment in stormwater discharges from construction sites can vary considerably, depending on whether the discharges are uncontrolled or whether effective management practices are implemented at the construction site. Sediment loads from uncontrolled or inadequately controlled construction sites have been reported to be on the order of 35 to 45 tons/acre/year. Sediment loads from uncontrolled construction sites are typically 10 to 20 times that of agricultural lands, with sediment loads as high as 100 times that of agricultural lands and typically 1,000 to 2,000 times that of forest lands. Over a short period, construction sites can contribute more sediment to streams than was previously deposited over several decades.

Changes to Flow Patterns: Physical Impacts

Urbanization can result in dramatic changes to the natural flow patterns of urban streams and wetlands. In undeveloped watersheds, most rainfall infiltrates into the ground and recharges ground-water supplies. Urbanization alters the natural vegetation and natural infiltration characteristics of a watershed, which results in much higher peak flows and reduced base flows in urban streams. Increased peak flows can result in stream bank erosion, streambed scour, flooding, channelization, and elimination or alteration of habitat (14). Increases in peak flows can also create the need to modify stream channels through a variety of engineered structures, such as retaining walls, rip-rap, and channel dredging.

Increased imperviousness and loss of wetlands and natural flow channels also decrease the amount of rainwater available for ground-water recharge. Reduced ground water levels reduce base flows in streams during dry weather periods, which impairs the aquatic habitat, impairs riparian wetlands, and makes receiving streams more sensitive to other pollutant inputs and sedimentation.

Development Patterns

In the United States, population patterns typically do not follow the political boundaries of municipalities. Prior to 1950, many large core cities annexed additional fringe areas as populations of the urban center increased. The trend of core cities increasing in area through annexation has largely stopped in most major UAs. In most states, smaller "suburban" local governments surrounding the core city are retained or created.[1] Thus, today most urban centers are composed of a large core city surrounded by several smaller "suburban" municipalities.

Every 10 years, the Bureau of Census defines UAs to characterize the population and development patterns of large urban centers of 50,000 or more. UAs are composed of a central city (or cities) with a surrounding closely settled area. The population of the entire UA must be greater than 50,000 persons. The closely settled area outside of the city, the urban fringe, must have a population density generally greater than 1,000 persons per square mile (just over 1.5 persons per acre) to be included. The boundaries of UAs are based on population patterns, not political boundaries; therefore, they do not include significant portions of rural land.

The Bureau of Census has defined 396 UAs in the United States based on the 1990 Census. These UAs have a combined population of 158.3 million, or 63.6 percent of the nation's total population;[2] however, these areas only account for 1.5 to 2 percent of the land surface of the country. Most increases in population occur in urban fringe or suburban municipalities rather than in core cities.[3]

Clean Water Act Requirements

In 1972, the CWA was amended to provide that the discharge of any pollutants to waters of the United States from a point source is unlawful, except where the discharge is authorized by an NPDES permit. The term "point source" is broadly defined to include "any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, [or] channel, . . . from which pollutants are or may be discharged." (Congress has specifically exempted agricultural stormwater discharges and return flows from irrigated agriculture from the definition of point source.) Although the definition of point source is very broad, prior to 1987, efforts under the NPDES program to control water pollution have focused on controlling pollutants in discharges from

[1]The patterns and functions of local governments in suburban fringe areas vary from state to state. In some states, such as Maryland, Virginia, Florida, and California, and, to a lesser degree, a number of southern states and Texas, large urban populations outside of core cities are in unincorporated portions of counties. In these cases, the county government conducts the major functions of local government. However, in most States, including New England, mid-Atlantic, Great Lake, midwestern, and most western states, the primary form of local government for many municipal functions is not a county but either an incorporated place or a minor civil division. (These terms are defined in Table 3.)

[2]The Census Bureau defines urban populations more broadly than UAs. Urban populations include the populations of UAs and any other dense population of 2,500 or more people. The 1990 Census indicates that 28.8 million people who lived outside of UAs were classed as urban populations. The Bureau of Census classified populations that are not classified as urban (including UAs) as rural. The 1990 Census indicates that 61.6 million people were classified as living in rural areas.

[3]The 1990 Census indicates that the total population of the United States increased by 22.1 million between 1980 and 1990. Of this growth, 86 percent (19 million) was in Census-designated UAs. Cities with a population of 100,000 or more accounted for 22 percent of this growth (4.9 million), while suburban areas surrounding these areas grew by 11.5 million (52 percent of the national total). Another 12 percent of the national growth (2.6 million) occurred in UAs that did not have a core city of 100,000 or more.

publicly owned treatment works (POTWs) and industrial process wastewaters. The major exception to this are the 10 effluent limitation guidelines that EPA has issued for stormwater discharges: cement manufacturing (40 CFR 411), feedlots (40 CFR 412), fertilizer manufacturing (40 CFR 418), petroleum refining (40 CFR 419), phosphate manufacturing (40 CFR 422), steam electric (40 CFR 423), coal mining (40 CFR 434), mineral mining and processing (40 CFR 436), ore mining and dressing (40 CFR 440), and asphalt emulsion (40 CFR 443).

As part of the Water Quality Act of 1987, Congress added Section 402(p) to the CWA to require EPA to develop a comprehensive, phased program for regulated stormwater discharges under the NPDES program. Under the first phase of the post-1987 program, EPA is to develop requirements for:

- Stormwater discharges associated with industrial activity.
- Discharges from large municipal separate storm sewer systems (systems serving a population of 250,000 or more) and medium municipal separate storm sewer systems (systems serving a population of 100,000 to 250,000).
- Discharges that are designated by EPA or an NPDES-approved state as needing an NPDES permit because the discharge contributes to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States.

Section 402(p)(1) of the CWA creates a temporary moratorium on the requirement that point source discharges of pollutants to U.S. waters must be authorized by an NPDES permit for other stormwater discharges.[4] Under the moratorium, EPA is prohibited from issuing NPDES permits for discharges composed entirely of stormwater that are not specifically exempted from the moratorium (the discharges listed above to be addressed during the first phase of the program) prior to October 1, 1994.[5] Before this time, EPA, in consultation with the states, is required to conduct two studies on stormwater discharges. The first study is to identify those stormwater discharges or classes of stormwater discharges for which permits are not required prior to October 1, 1994, and to determine, to the maximum extent practicable, the nature and extent of pollutants in such discharges. The second study is to establish procedures and methods to control stormwater discharges to the extent necessary to mitigate impacts on water quality.

Based on the two studies, EPA is required to issue regulations by no later than October 1, 1993, that designate additional stormwater discharges to be regulated to protect water quality and establish a comprehensive program to regulate such designated sources. The program must, at a minimum:

- Establish priorities.
- Establish requirements for state stormwater management programs.
- Establish expeditious deadlines.

The program may include performance standards, guidelines, guidance, management practices, and treatment requirements, as appropriate.

The 1987 amendments to the CWA made significant changes to the permit requirements for discharges from municipal separate storm sewers. Section 402(p)(3)(B) of the CWA provides that NPDES permits for such discharges:

- May be issued on a system- or jurisdictionwide basis.
- Shall include a requirement to effectively prohibit non-stormwater discharges into storm sewers.
- Shall require controls to reduce the discharge of pollutants to the maximum extent practicable, including management practices, control techniques and system, design and engineering methods, and such other provisions as the Director determines appropriate for the control of such pollutants.

Initial Implementation

On November 16, 1990, EPA published the initial NPDES regulations under Section 402(p) of the CWA (see 55 FR 47990). The November 16, 1990, regulations:

- Defined the initial scope of the program by defining the terms "stormwater discharge associated with industrial activity" and large and medium "municipal separate storm sewer systems."
- Established permit application requirements.
- Established deadlines.

The regulatory definitions of large and medium municipal separate storm sewer systems specifically identified 173 incorporated cities and 47 counties, and allowed for additional designations of adjacent municipalities on a case-by-case basis. EPA estimates that 400 additional municipalities with a combined population of about 16 million people have been designated by EPA and authorized NPDES states, and that 23 cities with a population of 100,000 or more (and a combined population of 8.6 million people) have been excluded from stormwater

[4] The Conference Report for the 1987 amendments to the CWA provides that after the moratorium ends on October 1, 1994, "*all* municipal separate storm sewers are subject to the requirements of Sections 301 and 402" (emphasis added) (15).

[5] The 1987 amendments to the CWA originally provided that the moratorium on other stormwater discharges (Water Resources Development Act) expire on October 1, 1992. Under the amendments, EPA was required to issue additional regulations to address these sources.

requirements due to large populations served by combined sewer systems.

The November 16, 1990, regulations were based on 1980 Census data. Data from the 1990 Census indicates that 30 additional cities have a population of more than 100,000, and five of the cities listed in the November 16, 1990, regulations no longer have a population of 100,000 or more. In addition, the 1990 Census indicates that 12 additional counties have an unincorporated, urbanized population of 100,000, and two counties listed in the November 16, 1990, regulations no longer have an unincorporated, urbanized population of 100,000.

The November 16, 1990, regulations also established requirements for a comprehensive, two-part permit application for discharges from large and medium municipal separate storm sewer systems. The major objectives of the permit application requirements are to ensure that municipalities develop comprehensive municipal stormwater management programs that address water quality, and to begin to implement these programs.

The permit application requirements for discharges from municipal separate storm sewer systems represent a new approach to addressing pollutant sources under the NPDES program. NPDES permit application requirements for other types of discharges traditionally focused on sampling end-of-pipe discharges. Permit applications for discharges from municipal separate storm sewer systems place a lesser emphasis on discharge sampling for a number of reasons, including the large number of discharge points commonly associated with municipal systems and the recognition that many municipalities were only initiating efforts to reduce pollutants in stormwater discharges at the time (see 55 FR 47990). Municipalities are required to submit comprehensive applications providing information that: 1) identifies major sources of pollution to the system, 2) characterizes pollutants in system discharges, 3) describes existing and proposed municipal stormwater management programs, and 4) describes the administrative and legal aspects of the municipal stormwater management program.

Perhaps the most important aspect of the permit application requirements is that they lay out the framework for municipalities to propose comprehensive municipal stormwater management programs. When developing permit conditions, permit writers will consider the management programs that are proposed as part of the permit applications. The municipal stormwater management programs envisioned by the November 16, 1990, regulations address the four following areas:

- *Measures to reduce pollutants in runoff from residential and commercial areas:* A major focus of this program component is controlling pollutants in stormwater from new development where stormwater controls are generally more cost effective and municipalities do not have to incur costs directly. Retrofitting controls for existing development can also be considered where practicable. Another focus is vegetation maintenance and snow removal activities for roads. Other source control measures, such as transportation plans, can be required where practicable.
- *Measures to reduce pollutants in runoff from industrial facilities:* EPA anticipates that a large percentage of stormwater discharges associated with industrial activity discharge through municipal separate storm sewer systems. The Agency intends to coordinate requirements in permits for stormwater discharges associated with industrial activity with efforts to develop municipal stormwater management programs in permits for discharges from municipal separate storm sewer systems serving a population of 100,000 or more. Under this coordinated effort, municipal permittees will have a major role in implementing programs to control pollutants from stormwater associated with industrial activity that discharges through their municipal separate storm sewers. For example, municipal operators can assist EPA and authorized NPDES states in identifying priority stormwater discharges associated with industrial activity; reviewing and evaluating stormwater pollution prevention plans developed by industrial facilities pursuant to NPDES permit requirements; and complying with requirements. (See 56 FR 40972 for a more complete description of the relationship EPA intends to develop between federal, state, and local governments for controlling pollutants in stormwater from industrial sources.)
- *Measures to reduce pollutants in runoff from construction sites:* Many municipalities currently have sediment and erosion requirements for construction activities. These programs, however, often are not adequately implemented or enforced. NPDES permit conditions for municipalities are expected to focus on ensuring adequate municipal implementation and enforcement of their controls. (See 57 FR 41206 and Metropolitan Washington Council of Governments [17].)
- *Measures to detect and control nonstormwater discharges to the storm sewer system:* Nonstormwater discharges to separate storm sewer systems are a major pollutant source in many municipalities. EPA anticipates that permits will require municipalities to continue field screening efforts started during the permit application phase of the program and to undertake other efforts to detect and control nonstormwater discharges.

For a more complete description of the components of a municipal stormwater management program, see *Guidance Manual for the Preparation of Part 2 of the*

NPDES Permit Applications for Discharges From Municipal Separate Storm Sewer Systems (16).

The November 16, 1990, regulations take two very different approaches to defining the roles of different levels of government. With respect to permits for large and medium municipal systems, the efforts of the NPDES permit authority (EPA or an authorized NPDES state) are directed toward ensuring that municipalities develop and implement stormwater management programs to control pollutants to the maximum extent practicable. Under these requirements, the NPDES program can define the role of municipalities in a flexible manner that allows local governments to assist in identifying priority pollutant sources within the municipality and to develop and implement appropriate controls for such discharges. With respect to permits for stormwater discharges associated with industrial activity, the NPDES permit authority has a direct role in regulating individual industrial sites.

Moratorium Sources: Why Municipalities?

Section 402(p)(6) of the CWA requires EPA to issue regulations that designate additional stormwater discharges to be regulated to protect water quality and that establish a comprehensive program to regulate such designated sources. EPA can generally take two different approaches to identifying classes of discharges to be regulated by NPDES permits: 1) to require municipalities to develop systemwide stormwater management programs, or 2) to require NPDES permit coverage for targeted commercial and residential facilities. When evaluating whether to address selected municipalities in the regulatory program required under Section 402(p)(6), the following factors should be considered:

- There are institutional considerations.
- Some existing municipal functions can be modified to address stormwater concerns in a cost-effective manner.
- Municipal participation is necessary for regional or systemwide stormwater management programs.
- There are pollutant load considerations.
- Issuing permits to municipalities allows for municipal programs that incorporate innovative controls, such as market-based incentives and pollutant trading.
- Municipalities are in the best position to address high risk sources, including new development, and to protect priority resources and watersheds.
- Some municipal activities are significant pollutant sources.
- Municipalities can ensure maintenance of structural controls and implementation of nonstructural measures.

Institutional Considerations

Municipalities contain the institutions that are critical for surface water resource protection programs. Urban stormwater management has been, is, and will continue to be primarily the responsibility of local governments (18). Municipalities install or oversee the installation of storm sewer systems to provide drainage for lands used for residential, commercial, and industrial activities as well as roads and highways. Municipalities can provide the institutional framework necessary to implement many components of an effective stormwater management program.

Components of a comprehensive stormwater management program that only municipalities can effectively address include land use planning, detailed oversight of new development, maintenance of roads, retrofitting controls in areas of existing development, and operation and maintenance of municipal storm drains. Municipalities can provide the detailed planning necessary to implement watershed and other risk-based approaches.

The role of municipalities under the NPDES program is to make stormwater management programs work. This involves overseeing day-to-day program operations, identifying local priorities and pollutant sources, developing detailed program requirements, conducting site inspections and evaluations, monitoring activities, assessing impacts to surface water resources, initiating compliance efforts, and ensuring effective outreach. Municipal activities can be funded by a variety of mechanisms, including general revenues, developer fees, flood control assessments, and stormwater utilities. Raising funds at the municipal level can provide a municipalitywide source of funds that can then be directed at priority projects. Thus, comprehensive programs can be implemented in a phased manner over a long period. In addition, such an approach takes advantage of pollutant trading concepts by directing resources from many sources to priority sources.

The role of the federal government and authorized NPDES states under the NPDES municipal stormwater program is to ensure that regulated entities implement pollution control measures. In the municipal stormwater area, this means providing oversight to guide the direction of municipal programs and providing technical assistance. Oversight activities include issuing permits that establish the framework for municipal stormwater control programs and taking targeted enforcement actions, for example, when municipalities fail to develop and implement a program. In addition, the NPDES authority must work in partnership with municipalities to ensure that, where appropriate, priority pollutant sources that municipalities may have difficulty controlling, such as certain federal or state facilities, are directly issued NPDES permits for their stormwater discharges. As Thomas Mumley, Associate Water Resource Control

Engineer at the San Francisco Regional Water Quality Control Board (19) states:

> Successful control of urban runoff will require a carrot, a stick, and . . . the implementation of common-sense, cost-effective, environmentally beneficial measures. . . . We need incentives to change our ways . . . we now have a big stick to drive these needed efforts, in the form of the NPDES stormwater regulations [for municipalities] which require the implementation of these measures. Fortunately, the current regulations promote flexibility[6] and don't impose a lot of bureaucratic red tape, and therein lies the carrot.

Expanding the Mission of Existing Municipal Programs

Municipalities typically operate programs whose primary mission is to address a set of concerns other than stormwater or water quality. Expansion of the mission of these existing municipal programs to address stormwater concerns can be much more cost effective than initiating entirely new programs. Municipal functions that can be adapted to assist in providing stormwater management benefits include oversight of new development, pretreatment program implementation, fire safety inspections, flood control, trash collection, management of municipal lands, and road maintenance. Municipal lands, for example, can provide retrofit opportunities for a number of reasons. The use of municipal lands for retrofits typically does not require additional property purchases. In addition, the use of municipal lands ensures opportunities to provide future maintenance and security in preservation of the retrofit control. (See Washington State Department of Ecology [20] for special stormwater management practices for public buildings and streets; vehicle and equipment maintenance shops; maintenance of open space areas; maintenance of public stormwater facilities; maintenance of roadside vegetation and ditches; maintenance of public utility corridors; water and sewer districts and departments; and port districts.)

In addition, many municipal activities and programs can be significant sources of pollutants, such as road maintenance, road construction, siting and operating flood control devices, maintenance of municipal vehicles, municipal landfills, and airports.[7] Expanding the mission of these programs can assist in the development of a pervasive municipal ethic regarding stormwater management that ensures effective use of municipal resources and mitigates the effects of municipal activities that can affect water resources.

Regional or Systemwide Programs

Urban stormwater is a diffuse source of pollution. The impacts of stormwater on receiving waters generally cannot be attributed to individual sources or discharge points; rather, the cumulative effects of many discharges from widespread areas of urban development in a watershed are of major concern. Often, approaches that consider watershed characteristics are necessary for success.

Control of urban stormwater is critical from a regional perspective, which addresses the entire UA. The lack of regional or systemwide planning is often cited as a major reason for incomplete and unsuccessful stormwater control efforts and for the inability to protect downstream areas from stormwater from upstream development. A comprehensive stormwater management program cannot rely solely on addressing individual sources within large UAs.

A regional approach can also bring together financial resources, planning, and scientific expertise not otherwise available for individual municipalities, thereby increasing the likelihood for success. Regional entities that can play an important role in planning, implementing, and evaluating stormwater programs include flood control districts, stormwater or drainage districts, counties, and Councils of Governments.

Pollutant Load Considerations

UAs comprise a mixture of different land uses. For general planning purposes, most UAs are distributed as follows: residential, 50 to 70 percent; commercial, 10 to 20 percent; industrial, 10 to 15 percent; open area, 10 to 15 percent (13). Concentrations of pollutants in stormwater from nonindustrial areas can be assumed to be roughly the same for different land use types, but the degree of imperviousness plays an important role in determining pollutant loads (8). This is because many diffuse sources of pollutants to urban stormwater operate in different land use areas, and areawide sources are important. While commercial and industrial land uses generally have a higher level of imperviousness than some types of residential development, a large amount of residential area will result in residential land use being a major pollutant source to stormwater. For example, a study of the Santa Clara Valley found that the volume of stormwater flows from residential and

[6] Concerns have been raised regarding the requirements under the current Clean Water Act that NPDES permits for municipal separate storm sewers, in addition to mandating the reduction of pollutants to the maximum extent practicable, must ensure compliance with water quality standards. The water quality standards issue is not discussed in this paper.

[7] Some municipal activities are considered to be industrial activities under the NPDES program. Section 1068 of the Intermodial Surface Transportation Efficiency Act of 1991 placed stormwater discharges associated with industrial activity owned or operated by a municipality with a population of less than 100,000 in the moratorium from NPDES permit requirements.

commercial land uses in the Valley was 10 times greater than the volume of flow from industrial uses. The loading of metals in stormwater flows from residential and commercial lands was estimated to be 5 to 30 times greater than from industrial lands (11).

A program that only addresses industrial stormwater flows is limited because it only addresses a fraction of the total urban stormwater flows. Similarly, programs to address illicit connections to storm sewers should address municipal sources. Municipalities have responsibilities associated with several important classes of illicit connections, including sanitary collection systems (ownership of collection system), improper connections between sanitary and storm sewer systems, and improper connections from residential or commercial areas. For example, investigations in Houston, Texas, indicated that most of the city's problems associated with nonstormwater discharges to the separate storm sewer system were associated with broken wastewater collection system lines discharging to its stormwater collection system (21).

In general, municipal programs should include legal authority to address the majority of stormwater sources into their municipal system. However, this does not mean that a municipality should have to ensure that every existing residential, commercial, or industrial site within its jurisdiction actively controls its stormwater. Rather, municipalities should develop programs that result in the implementation of practicable controls for high-priority sources that maximize cost-effectiveness by considering possible sources and conditions within the jurisdiction. In addition, EPA must be a partner in efforts to control selected priority sources, such as industrial, federal, and state facilities. For example, some municipalities have indicated that practical problems are associated with controlling stormwater from federal and state facilities. In such cases, a partnership between the municipality and the NPDES authority may be appropriate where the municipality identifies high-risk state and federal facilities for the NPDES authority to consider issuing an NPDES permit directly.

In addition, the Agency should lead national efforts to directly reduce some pollutant sources or find product substitutes. For example, federal requirements under the Clean Air Act have resulted in significant decreases in the use of lead in gasoline, which in turn have resulted in decreases in lead concentrations in urban runoff. Other areas of national regulation and/or pollution prevention efforts that have been suggested are reduction in the amount of zinc in tires, reductions in the amount of copper in brake pads, and lower emission standards for particulate emissions for diesel engines (11).

Flexibility in Selecting Measures

Municipal stormwater management programs should be comprehensive efforts that address a wide range of innovative measures in addition to traditional command-and-control requirements. Federal or state permitting programs generally have limited flexibility to directly implement many types of innovative control strategies in a widespread manner. Requiring municipalities to obtain NPDES permits for their municipal systems could create a regulatory framework that could support municipalities' use of innovative controls, such as market-based incentives.

For example, municipalities can fund stormwater programs with a utility rate system that accounts for the impervious area at a site, which is roughly proportional to the amount of stormwater generated at the site. A survey of 54 stormwater agencies with stormwater utilities located in 19 states indicated that 70 percent of the agencies surveyed based their utility on the amount of impervious area at a site, while an additional 17 percent based their utility on the product of area times an intensity of development, which can approximate impervious area (22). Such a rate system can also consider whether stormwater controls are provided at a site. These approaches create market-based incentives for reducing site imperviousness (thereby reducing stormwater volumes and pollutant loads) and for installing and operating stormwater measures. (See U.S. EPA for a list of 21 municipal stormwater utilities that provide credits for onsite stormwater management [23].)

Municipalities have a wide range of tools for ensuring stormwater control measures occur with new development. For example, municipalities can have zoning provisions that establish setbacks for buffer zones, limit the amount of impervious area, require maintaining minimum amounts of open space, and encourage cluster development. Municipalities can also develop watershed management plans that provide for preservation of floodplains, wetlands, shoreline, and other critical areas. In addition, during the building plan approval process, municipalities can designate, through deed modification or other means, an entity or individual who is responsible for maintaining the stormwater management systems of a new development. Controls on siting, installing, and maintaining septic systems and for ensuring proper sanitary sewer connections can reduce pollutant discharges from municipal separate storm sewer systems.

Other innovative approaches to stormwater management include used oil and/or household hazardous waste municipal collection programs. Municipalities can conduct portions of public outreach programs in a more cost-effective way than other levels of government. For example, municipalities can stencil catchbasins to minimize improper dumping of materials and send informational flyers with water or sewer bills.

Another approach is for a municipality to use pollutant trading concepts to select cost-effective controls. One example of pollutant trading is for a municipality to allow a developer to contribute to an offsite regional stormwater measure where onsite measures are not feasible. Other pollutant trading concepts are discussed in Santa Clara Valley Nonpoint Source Pollution Control Program (11) and U.S. EPA (24). It should be noted that some concerns have been raised regarding trading structural controls for nonstructural controls where opportunities to install structural controls can be lost and the continued implementation of nonstructural controls cannot be assured.

Municipalities can also incorporate voluntary components into their municipal stormwater management programs, such as adopt-a-highway litter programs or adopt-a-stream programs. In addition, the development of stormwater programs at the municipal level can encourage high levels of public input from local groups.

Flexibility To Address High-Risk Sources and To Protect Priority Resources and Watersheds

Controlling pollutants in stormwater involves addressing many and diffuse pollutant sources. The nature of the problem calls for focusing on priority sources and emphasizing controls in priority watersheds. Municipalities are in the best position to evaluate local conditions and to determine local priorities for implementing and overseeing control strategies and measures that ensure the water quality impacts of land use activities in its jurisdiction are mitigated. This is particularly true when evaluating the risks of new development.

Urbanization is a gradual process that spans decades and occurs over a wide region. It is composed of hundreds of individual developments that take place over much shorter time frames. The true scope of water resource degradation associated with urbanization may not fully manifest at the watershed scale for many years. This presents the challenge of evaluating the impact of individual development proposals over the long term at the watershed scale (25) and planning appropriately. Such detailed planning can only occur on the municipal level.[8] Detailed efforts to plan and oversee new development could not (and should not) be undertaken at the federal level.

Municipalities typically have planning processes and administrative systems in place to address some aspects of new development. When municipalities plan for new development, the total development of the area can be considered. This can provide a much more comprehensive basis for planning than when developers plan at the site level. Municipalities can accomplish these tasks with a much greater sensitivity to local conditions and in a more equitable and reasonable manner. In addition, municipalities can develop watershed plans that consider the tradeoffs associated with the placement of onsite controls and regional stormwater management approaches. Some municipalities advocate stormwater control strategies that use a mix of regional controls and onsite controls that reflects watershed hydrology. Advantages of this approach are said to include better control of peak flows; reduced impacts to streams and riparian wetlands; improved pollutant removal efficiencies; lower costs; a significantly higher likelihood of adequate maintenance; and recreational amenity values (26).

The ability of EPA or NPDES states to conduct such detailed planning is limited. For example, EPA indicated that a consideration of possible water quality impacts associated with the timing of releases from onsite stormwater management measures involves a complex array of variables, including the nature and locations of other activities within a watershed, and is generally beyond the scope of the Agency's NPDES general permits for stormwater from construction activities (see 57 FR 41202). Municipal consideration of mitigation measures for numerous smaller projects in a watershed may better maintain the integrity of an aquatic ecosystem.

A goal of the stormwater program should be that municipalities have planning procedures to identify and address the potential impacts of development on water resources. NPDES permits for municipal separate storm sewer systems can assist in reaching this goal by ensuring that municipalities consider the impact of stormwater on surface waters. Traditionally, the major objective of installing separate storm sewers has been to remove as much stormwater runoff from developed lands as soon as possible. To achieve this goal, local governments have constructed thousands of miles of curb, gutter, road side ditches, and other storm sewers to convey stormwaters as quickly and as efficiently as possible to the nearest stream (18). Efforts often focus on channelization projects that attempt to make streams more "efficient" at conveying waters downstream. Extensive channelization projects and other stream "improvements," such as concrete-lined walls or heavy riprap, can destroy the habitat value of streams.

A few communities have developed programs where stormwater is managed for multiple purposes, including controlling water quantity (to avoid flooding and stream scour and to maintain stream flows during dry weather by recharging ground water during storms) and improving water quality. A range of alternative stormwater control measures and facilities can be implemented to serve multiple purposes effectively. The natural cycles and processes that occur before land development are used

[8]EPA has recognized that many local governments typically require sediment and erosion plans, grading plans and/or stormwater management plans that are significantly more detailed and are accompanied by a more rigorous review process than those required under EPA-issued general permits (57 FR 41196).

as a guide for managing stormwater after development has occurred, and natural flow patterns and rates of discharge are retained through special stormwater control facilities and measures. Natural processes are incorporated into the design of many "soft" engineered systems, including vegetated buffers, greenways, revegetation of stormwater systems, wetland creation or retention for stormwater management, and onsite retention, detention, or infiltration systems. Policies emerging from these programs include:

- Reducing peak flows and improving stormwater quality through onsite retention.
- Reducing the volume of stormwater leaving the site using natural infiltration.
- Releasing stormwater from onsite facilities at a rate similar to the predevelopment runoff rate.
- Managing for smaller storm events as well as those larger storm events that can cause major floods.
- Protecting wetlands and floodplains as natural stormwater storage areas.
- Making stormwater facilities amenities of the development (such as retaining natural drainage channels or providing attractive landscaping for stormwater management ponds) and encouraging open space and recreational uses.
- Developing programs that relate erosion and sediment controls during construction with stormwater management after construction is completed.

The implementation of this approach typically involves somewhat higher costs for development plan review by local governments but lower costs for stormwater facility construction, and results in lower social costs.

Maintenance of Controls

The installation of structural controls (e.g., wet ponds, infiltration devices) during the construction phase of new development is often cited as a key component to a successful stormwater program. To continue to operate, these devices need to be maintained every 5 to 15 years. Lack of maintenance is often cited as a leading cause of failure of stormwater management devices.

While NPDES permits for stormwater discharges from construction activities disturbing more than 5 acres can require the installation of stormwater measures during the construction phase of a project, permit coverage for residential and commercial sites ends when the site is stabilized. Therefore, NPDES permits for stormwater discharged from construction sites may not be able to ensure the continued maintenance of these sites. Municipalities are in a better position to require or conduct maintenance activities for these devices. For example, municipalities can require maintenance of stormwater management devices through deed modification prior to site development or through ordinances.

Moratorium Sources: Which Municipalities?

Public commentors on previous NPDES stormwater rulemakings have identified a number of principles that are critical to successful implementation of NPDES requirements for a stormwater regulatory program (55 FR 48039):

- Municipalities should be regulated as equitably as possible.
- Major sources of pollutants must be addressed through control, treatment, or prevention.
- The approach must be administratively realistic and achievable.
- New development should be addressed.
- Programs must be coordinated or developed on a regional basis to avoid fragmentation or balkanized programs and to support watershed approaches.
- Regional approaches are necessary to address interrelated discharges into the municipal separate storm sewer system.

Municipalities associated with Census-designated UAs or a subset thereof appear to meet most of the criteria in a way that makes them candidates for consideration for Phase II stormwater requirements. Additional municipal candidates for Phase II requirements are pockets of high growth levels outside of Census-designated UAs and areas with large seasonal activities (e.g., some tourist towns) that are not classified as part of a Census-designated UA because of small year-round populations.

Equitable Treatment/Major Pollutant Sources

Currently, NPDES requirements for discharges from municipal separate storm sewer systems focus on core cities, and generally do not address UAs surrounding core cities in a comprehensive manner. The regulations do address 47 counties that were selected because they had significant populations in unincorporated, urbanized portions of the county. In most UAs, however, areas surrounding core cities are broken into incorporated areas and/or minor civil divisions with populations of less than 100,000. These areas are not addressed by current NPDES requirements even though they may be in a heavily populated county. For example, 400 counties have a population of greater than 100,000 but are not addressed by the current NPDES regulations.

At least three factors are important to consider when determining whether municipalities are being regulated as equitable as possible: 1) demographic patterns associated with per capita income; 2) the pollutant sources that are being addressed; and 3) the ability to control major pollutant sources. Some states have also advocated national NPDES requirements to ensure national consistency and to prevent economic disincentives that make it difficult for states and municipalities to implement progressive stormwater management programs (57 FR 41205).

The per capita income of suburban fringe areas is typically significantly higher than the per capita income of core cities. A 1991 report by the National League of Cities indicates that the per capita incomes of residents in the largest cities is only on average 59 percent of the per capita incomes in the surrounding suburbs. The magnitude of these income disparities was cited as a clear indicator of the disparities in tax bases. The report also suggested that continued demographic shifts are expected to increase these differences (27). In addition, municipal governments associated with core cities often provide a greater range of services than surrounding areas, resulting in higher per capita municipal government costs.

As discussed above, the pollutant sources associated with urban stormwater are diffuse in nature and are associated with widespread areas of development. Census data from 1990 indicate that approximately 46 percent of the total area and 35 percent of the total population of UAs containing a city with a population of 100,000 or more are located outside of the core city in suburban fringe areas.[9] As a rough approximation, suburban fringe areas are generating as much stormwater pollution as core cities with a population of 100,000 or more. Failure to address suburban fringe areas outside of these cities would severely limit the ability of the core city to protect receiving waters.

The equity issue is also related to the types of controls that are available to municipalities. Older, densely developed core cities have limited opportunities to control pollutants in their stormwater (8). Areas with substantial new growth, however, including many suburban fringe areas, have greater opportunities to ensure appropriate stormwater management and mitigate impacts to receiving waters associated with new growth.

Between 1970 and 1980, the population of incorporated cities with a population of 100,000 or more (those with municipal separate storm sewer systems addressed by NPDES regulations before October 1, 1992) increased by only 0.6 million, with much of this increase associated with the addition of the populations of 17 cities that had populations of 100,000 or more for the first time. The land area of most of these cities remained the same, while the populations of many large cities decreased.

Most growth in UAs occurs in areas that were not required to obtain an NPDES permit for their stormwater discharge before October 1, 1992. Between 1970 and 1980, the population of UAs outside of cities with a population of 100,000 or more increased 30 times more (an increase of 18.9 million) than the population of these cities. This growth resulted from both increases in population densities of existing urban lands and by the urbanization of previously rural lands. Factors such as lower costs of land, commercial space, and residential housing continue to cause urban sprawl even in UAs that are not experiencing population growth.

Equity and pollutant source considerations would appear at least to require that NPDES requirements be extended to cover suburban fringe municipalities in Census-designated UAs in which one or more large or medium municipal separate storm sewer systems are already subject to NPDES requirements. Municipalities with a large or medium municipal system should not be held solely responsible for implementing NPDES stormwater requirements when stormwater from suburban municipalities limits the opportunities of the core cities to effectively protect water resources.

Perhaps a more equitable approach would be to expand NPDES requirements to cover municipalities associated with Census-designated UAs of a specified size (e.g., 100,000 or 50,000). This approach would ensure that urban centers of similar size and the largest sources of urban runoff would be subject to program requirements.

Administratively Achievable/New Development

In core cities, urban streams are typically already heavily degraded, with limited opportunities for full restoration. Significant opportunities exist in suburban fringe areas, however, to conduct new development in a way that mitigates impacts on water resources. A basic principle of stormwater controls is that developing controls for new development is much more cost effective (8) and institutionally feasible than retrofitting old development. EPA has also indicated that, where properly planned, stormwater controls can *increase* the property values and satisfy consumer aesthetic needs (56 FR 40989).

Municipalities often oversee the development process. They usually have some form of approval or permit program in place. Developers have incentives to comply, because enforcement can be stringent (e.g., stop-work orders), and the developer usually wants to have a workable relationship with the municipality to ensure that future projects proceed smoothly. In addition, the costs of the controls are not borne by the municipality directly but rather by the developer. Several states with

[9] In the United States, most people served by combined sewers are located in cities with a population of 100,000 or more (57 FR 41349). Thus, the percentage of urbanized population served by *separate* storm sewers in suburban fringe areas is higher than indicated above.

progressive stormwater management programs have initially focused on new development (e.g., Maryland, Florida, and Delaware). This is unlike the approach taken in the 1987 amendments to the CWA, which initially focused on core cities with little or no growth and temporarily excluded suburban municipalities. The November 16, 1990, EPA regulations addressed 47 counties and 173 cities. The counties that were addressed where in a handful of states, primarily Maryland, Virginia, Florida, and California. While the Agency was able to address suburban growth in these states, in most parts of the country the regulations only address core cities and exclude suburban development.

Perhaps the biggest challenge associated with Phase II NPDES stormwater requirements for municipalities is the potentially large number of small municipalities that should be addressed. Census-designated UAs offer advantages over broader classifications of metropolitan areas, such as Standard Metropolitan Statistical Areas (SMSAs),[10] in that UAs do not include significant amounts of rural areas or small urban municipalities that are isolated from larger urban centers. In many parts of the country, however, suburban urban fringe areas are broken into a significant number of small municipal entities (see Table 3). In developing Phase II requirements for municipalities, EPA could consider promoting regional approaches, developing tiered requirements for different sizes of municipalities, and limiting requirements or providing exemptions for very small municipalities. For example, the Agency could consider focusing requirements for small municipalities on a few key program components, such as new development, municipal activities that affect stormwater quality (e.g., road building and maintenance), illicit connections, and public education.

Regional Approaches

As discussed above, regional approaches to stormwater management offer a number of advantages, including providing municipalities with the opportunity to pool resources and to address stormwater management with a more holistic watershed approach. Successful programs must face the challenge that municipalities do not follow watershed boundaries. Currently, the NPDES municipal stormwater program principally focuses on core cities with a population of 100,000 or more.[11] If suburban municipalities fail to develop adequate stormwater programs, the ability of core cities adequately to protect the receiving waters of the core city will be limited. As Tucker (18) states,

> Dealing with drainage across jurisdictional lines is important. . . . The ability to look at urban stormwater management from a regional or metropolitan wide perspective is important. The larger drainageways typically flow from one jurisdiction to another and what happens in one entity can impact others. Planning should be approached on a basinwide basis and not stop at jurisdictional boundaries. . . . Once the Phase II regulations for NPDES permits for municipal separate storm sewers become a reality, more metropolitan areas will seriously consider regional approaches to stormwater management.

Conclusion

Urban stormwater discharges have been shown to be a major source of water quality impairment. Section 402(p)(6) of the CWA requires EPA to identify additional stormwater sources to be regulated to protect water quality. In UAs, pollutants associated with stormwater come from many sources distributed throughout the area of urban development. Commercial and residential areas appear to be significant sources of pollutants, along with certain municipal activities. Municipal governments in UAs must play a significant role in developing and implementing programs that effectively address priority pollutant sources within their jurisdictions. Municipal governments have the critical institutional framework for making the day-to-day decisions to address these problems, to minimize or prevent the risk associated with stormwater from areas undergoing urbanization, and to collect the majority of funds necessary to implement the comprehensive programs needed to address urban stormwater management. The condition of a waterbody is a reflection of watershed management and land use characteristics. To ensure that the waterbody is protected and maintained, citizens must be empowered to work together to that end.

References

1. U.S. Bureau of the Census. 1990. 1990 Census of population.
2. Pitt, R. 1993. Effects of urban runoff on aquatic biota. In: Handbook of ecotoxicology. Lewis Publishers.

[10]Unlike Census-designated urbanized areas, SMSAs, which are identified by the Office of Management and Budget, are based on county boundaries and can contain significant rural areas. Urbanized areas are defined to describe population densities. An urbanized area consists of the contiguous builtup territory around each larger city and thus corresponds generally to the core of the SMSA. SMSAs are defined to describe a large population nucleus and adjacent communities that have a high degree of economic and social integration with that nucleus. This designation has been developed for use by federal agencies in the production, analysis, and publication of data on metropolitan areas (28).

[11]The NPDES storm water program also currently addresses unincorporated portions of 47 counties. However, most large counties, including those in many heavily urbanized areas of the country, are currently not subject to NPDES stormwater requirements. Those counties currently addressed by the NPDES storm water program have large populations in unincorporated areas and only represent a few states, notably, California, Florida, Maryland, and Virginia.

Table 3. Municipalities Associated With Census-Designated UAs Based on 1990 Census Data[a]

Class of UA	No. of UAs	No. of Incorporated Places[b]	No. of MCDs[c]	No. of Counties[d]	Total Population (millions)
All UAs	396	3,624	1,655	703	158.3
250,000 or more	103	2,672	1,022	358	127.5
100,000-250,000	121	490	349	185	18.9
50,000-100,000	172	462	284	258	11.9
Phase I municipalities	Parts of 137	621	0	70	76.2
UA with large or medium MS4	137	2,147	665	280	116.8

[a] Examples of Census-designated UAs and associated 1990 populations:

Brunswick, GA	50,066	Ogden, UT	259,147
Ithaca, NY	50,132[e]	Albuquerque, NM	497,120
San Luis Obispo, CA	50,305	Albany-Schenectady-Troy	509,106
Lafayette-West Lafayette, IN	100,103	Akron, OH	527,863
Sioux Falls, SD	100,843	Oklahoma City, OK	784,425
Jacksonville, NC	101,297	Salt Lake City, UT	789,447
Pensacola, FL	253,558	New Orleans, LA	1,040,226
Sacramento, CA	1,097,005	Shreveport, LA	256,489
San Antonio, TX	1,129,154		

[b] Incorporated places include incorporated cities, towns, villages, and boroughs.

[c] Minor civil divisions (MCDs) include unincorporated towns and townships in 20 states.

[d] County equivalents include counties, parishes in Louisiana, and boroughs in Alaska. Some double counting of counties occurred as portions of several UAs may be in one county. (For example, portions of the Washington UA, Baltimore UA, and Annapolis UA are in Ann Arundel County, Maryland.)

[e] The Ithaca, New York, population does not include student population at Cornell University.

3. Pitt, R., and R. Field. 1991. Biological effects of urban runoff discharges. In: Effects of urban runoff on receiving systems: An interdisciplinary analysis of impact, monitoring, and management. Engineering Foundation Conference, Mt. Crested Butte, CO. New York, NY: ASCE.
4. U.S. EPA. 1990. 55 Federal Register 47990. November 16.
5. Montoya, B. 1987. Urban runoff discharge from Sacramento, California. Report No. 87-1SPSS. California Regional Water Control Board, Central Valley Region.
6. U.S. EPA. 1993. Investigation of inappropriate pollutant entries into storm drainage systems: A user's guide. EPA/600/R-92/238 (January).
7. Schueler, T. 1987. Controlling urban runoff: A practical manual for planning and designing urban best management practices. Washington Metropolitan Council of Government.
8. U.S. EPA. 1983. Results of the Nationwide Urban Runoff Program, Vol. 1. Final report.
9. Cameron, D. 1989. NRDC's poison runoff index for the Washington metropolitan region (November).
10. Pit, R. 1992. Stormwater, baseflow, and snowmelt pollutant contributions from an industrial area. Presented at the 65th Annual Conference, Water Environment Federation, New Orleans, LA (September).
11. Santa Clara Valley Nonpoint Source Control Program. 1992. Source identification and control report (December).
12. Ontario Ministry of the Environment. 1986. Toronto area watershed management strategy study: Humber River Pilot Watershed Project (June).
13. U.S. EPA, Region 5. 1990. Urban targeting and BMP selection: An information and guidance manual for state nonpoint source program staff engineers and managers (November).
14. U.S. EPA. 1992. Environmental impacts of stormwater discharges: A national profile. EPA/841/R-92/001 (June).
15. Congressional Record H10576, Vol. 132. Conference Report. October 15, 1986.
16. U.S. EPA. 1992. Guidance manual for the preparation of part 2 of the NPDES permit applications for discharges from municipal separate stormwater sewer systems. EPA/833/B-92/002 (November).
17. Metropolitan Washington Council of Governments. 1990. Performance of current sediment control measures at Maryland construction sites (January).
18. Tucker, L.S. 1991. Current programs and practices in stormwater management. In: Water and the City: The next century.
19. Mumley, T. 1991. EPA Journal. November/December.
20. Washington State Department of Ecology. 1992. Stormwater management manual for the Puget Sound Basin, Vol. 1. Minimum technical requirements (February).

21. Glanton, T., M. Garrett, and B. Goloby. 1992. The illicit connection–is it the problem? Water Environ. Tech. (September).

22. Benson, R. 1992. Financing stormwater utility user fees—where are we now? Water Environ. Tech. (September).

23. U.S. EPA. 1992. Stormwater utilities: Innovative financing for stormwater management. Draft final report. Office of Policy, Planning, and Evaluation (March).

24. U.S. Department of Commerce/U.S. EPA. 1993. Coastal nonpoint pollution control program: Program development and approval guidance (January).

25. Anacostia Watershed Restoration Team. 1992. Developing effective BMP systems for urban watersheds. Metropolitan Council of Governments.

26. Prince William County. 1993. Prince William County Comprehensive Storm Water Management/Planning and Demonstration Watershed Project. Prince William County, MD.

27. National League of Cities. 1991. City fiscal distress: Structural, demographic, and institutional causes.

28. U.S. Bureau of the Census. 1983. Number of inhabitants, United States summary (April).

R0015691

Municipal Permitting: An Agency Perspective

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This paper presents the U.S. Environmental Protection Agency's (EPA's) perspective regarding the municipal side of the National Pollutant Discharge Elimination System (NPDES) stormwater program. It begins by briefly providing some background information on the stormwater program. It then highlights an EPA review of costs that municipal separate storm sewer systems (MS4s) have incurred or anticipate incurring during the next 5 years. After discussing the types of programs that MS4s proposed in their Part 2 applications, the paper concludes by presenting the current status of the permitting process.

Background

The Water Quality Act (WQA) of 1987 added Section 402(p) to the Clean Water Act (CWA). In Section 402(p), MS4s serving a population of 100,000 or more must obtain an NPDES permit for their stormwater discharges. Section 402(p)(3)(A) specifically provides that permits for these discharges:

- May be issued on a system- or jurisdictionwide basis.
- Shall include a requirement to effectively prohibit nonstormwater discharges into storm sewers.
- Shall require controls to reduce the discharge of pollutants to the maximum extent practicable; controls may include management practices, techniques, system design and engineering methods, and such other provisions as the Administrator or the state determines appropriate for control of such pollutants.

NPDES permits historically have imposed end-of-pipe controls on industrial and publicly owned treatment works discharges. The legislative history of the WQA, however, indicates that Congress does not consider end-of-pipe controls to be necessarily appropriate for stormwater discharges from MS4s. Consequently, in the November 16, 1990, *Federal Register*, EPA published a final rule intended to reflect the unique nature of discharges from MS4s. The final rule establishes permit application requirements and application deadlines for all MS4s covered under Phase I of the stormwater program. For MS4s required to obtain a stormwater permit, EPA established a two-part permit application process. The Part 1 application primarily focuses on a municipality's existing stormwater management activities and includes the following components:

- General information
- Discharge characterization
- Existing legal authority
- Existing stormwater management programs
- Source identification
- Existing fiscal resources

The Part 2 application requires additional information that builds on the information submitted with the Part 1 application. Rather than emphasizing current stormwater management activities, however, the Part 2 application focuses on what future stormwater management activities an MS4 will adopt. Major components of the Part 2 application are similar to those identified above; however, their level of detail is much greater.

Some of the major highlights of the stormwater program involve:

- Obtaining the adequate legal authority to implement an MS4's stormwater management program.
- Developing estimates of annual pollutant loadings and a schedule to submit seasonal pollutant loadings estimates.
- Developing a monitoring program to run throughout the permit term.
- Developing a site-specific and comprehensive stormwater management program.
- Conducting an assessment of the effectiveness of stormwater controls.

- Conducting a fiscal analysis of the costs to implement the applicant's proposed stormwater management program.

The cornerstone of the stormwater program is the requirement that MS4s must develop site-specific and comprehensive stormwater management programs. MS4s should employ all program requirements identified in the final rule. Given their geographical, climatological, and physical differences, however, MS4s can exercise discretion when establishing priorities for their site-specific stormwater management programs. For example, an MS4 in a densely populated urban corridor is not reasonably expected to have the same program priorities as an MS4 servicing an area experiencing rapid development. Later, the paper presents a few different approaches and types of programs that various MS4s are proposing. First, however, is a brief discussion of the present status of the MS4 permitting process.

Present Status of the MS4 Permitting Process

Effects of the 1990 Decennial Census

In the November 16, 1990, *Federal Register*, EPA identified 219 municipalities required to seek coverage under an NPDES stormwater permit. Appendices F and H of 40 CFR 122 identified 73 of these municipalities as large MS4s. Similarly, Appendices G and I of 40 CFR 122 identified 146 municipalities as medium MS4s. EPA based these 219 identifications on the definition of a municipal separate storm sewer system, which incorporates population data from the latest Decennial Census. In this case, the 1980 Census helped identify the 219 MS4s. Recently, however, the results of the 1990 Decennial Census have become available and, consequently, affect more municipalities. EPA is currently drafting a *Federal Register* notice (FRN) that identifies 42 additional municipalities (30 cities and 12 counties) that now meet the definition of a medium MS4 based on the results of the 1990 Census. Sixty percent of the new cities now required to seek NPDES permits are in the state of California, while 33 percent of the new counties are located in the state of Florida.

In contrast to the number of newly identified MS4s, the 1990 Census found that five cities and two counties dropped in population to below 100,000. Although these municipalities no longer satisfy the definition of a medium MS4, two counties and one city still participate in the stormwater program.

Next, the paper discusses municipalities that the appendices of 40 CFR 122 did not originally identify but that nevertheless have been designated as Phase I sources.

Designated MS4s

Section 402(p)(2)(E) and 40 CFR 122.21(b)(4)(iii) and (7)(iii) provide that permitting agencies may use their authority in designating municipalities that operate separate storm sewer systems and serve populations of less than 100,000 as regulated MS4s. EPA has compiled some preliminary information on the number of these municipalities, some of which are volunteering to participate in the program. Based on the best information available to date, it appears that states and EPA regions designated small municipalities as regulated MS4s primarily because they share common watersheds or are interconnected with a nearby regulated MS4. In at least two states, EPA observed that all incorporated cities below a population of 100,000 were designated if they are within the boundary of a regulated MS4 (county); therefore, these municipalities must submit a stormwater permit application. EPA is currently trying to determine what permit application deadlines have been established for these designated MS4s and whether they are participating as coapplicants with a regulated MS4 or are filing as single applicants.

Table 1 summarizes some preliminary data on the number of cities, counties, and special districts that have either been designated or who are voluntarily participating in the program as Phase I stormwater sources.

EPA considers the figures presented in Table 1 preliminary because additional information is still pending from three Regional Water Quality Control Boards (RWQCBs). Some general observations, however, are noteworthy. First, 65 percent of the designated cities in Region 4 are located in the state of Florida. In the case of the 47 designated special districts, 26 are state departments of transportation, 11 are flood control districts,

Table 1. Summary of MS4 Designations by EPA Region

EPA Region	Designated Cities	Designated Counties	Special Districts
1	0	0	0
2	0	0	0
3	13	5	2
4	236	9	6
5	1	0	8
6	0	0	6
7	1	0	2
8	1	0	2
9[a]	127	7	14
10	1	1	7
Total	380	22	47

[a]Additional information pending three RWQCBs in the state of California.

four are state universities, three are port authorities, and three represent a group of water control districts.

Effects of Combined Sewer Overflow Exclusions

The NPDES stormwater regulations allow municipalities to deduct the population served by combined sewer systems from the total population served by the MS4. To date, this provision has exempted 29 municipalities as Phase I sources. An additional eight large MS4s have been reclassified as medium MS4s. Table 2 provides a breakdown of combined sewer overflow (CSO) exclusions by EPA region.

Current Permit Applications

As noted earlier, the NPDES stormwater regulations require MS4s to submit a two-part permit application. Table 3 provides the latest information available on the number of submissions of Part 1 and Part 2 applications. *This table specifically excludes permit application submissions for the states of California and Nevada.*

The next section of this paper summarizes the results of a recent EPA effort to document costs that MS4s have incurred or are expected to incur over a 5-year period. The information represents the most specific information EPA has received to date on stormwater costs associated with the stormwater program.

Review of MS4 Program Cost Data

EPA recently conducted an analysis of Part 2 applications in an effort to gain a better understanding of costs associated with implementing the municipal effort of the stormwater program. EPA is currently completing a review that documents the costs that 20 MS4s expect to incur or have incurred as a result of implementing their stormwater management programs. These costs are based on fiscal information provided in Part 2 permit applications. The primary purpose of this effort is to assist EPA's Office of Water in determining the cost burden that results from developing and implementing programs in response to the NPDES stormwater regulations. To that end, EPA has developed a preliminary draft estimate for the total annual per capita cost to develop and implement the stormwater management program over a 5-year period. Some background information on the analysis may provide a basis for better understanding the results.

Table 2. Summary of CSO Exclusions by EPA Region

EPA Region	Medium MS4s	Medium to Large MS4s	Large MS4s	Total
1	5	1	0	6
2	7	4	2	13
3	2	0	1	3
4	0	0	0	0
5	6	0	2	8
6	0	0	0	0
7	0	2	2	4
8	0	0	0	0
9	0	0	1	1
10	1	1	0	2
Total	21	8	8	37

Table 3. Summary of Part 1 and Part 2 Submissions by EPA Region

EPA Region	Medium MS4s, Part 1	Medium MS4s, Part 2	Large MS4s, Part 1	Large MS4s, Part 2
1	3	0	0	0
2	0	0	5	5
3	10	0	11	10
4	24	0	20	15
5	12	0	5	5
6	7	0	9	7
7	7	0	3	1
8	3	2	3	1
9[a]	2	0	4	3
10	6	0	4	2
Total	74	4	64	49

[a] California RWQCBs have issued permits for 130 applicants. Information is still pending from three RWQCBs. The state of Nevada has issued final permits for its regulated MS4s. Permit application submission figures for EPA Region 9 reflect those applications that are currently under review.

Applications Reviewed

EPA selected the Part 2 applications for this analysis from among those that had been submitted to permitting agencies by the November 16, 1992, deadline. EPA selected municipalities located throughout the country to obtain a more realistic representation of the cost data. Thus, eight MS4s are located in the eastern part of the United States, seven in the central part, and five in the west. Selected municipalities also fall within eight of the nine Rainfall Zones of the United States. The 20 municipalities reviewed are:

- Aurora, Colorado
- Baltimore, Maryland
- Charlotte, North Carolina
- Dallas, Texas
- Denver, Colorado

- Fairfax County, Virginia
- Harris County, Texas
- Honolulu, Hawaii
- Houston, Texas
- King County, Washington
- Lakewood, Colorado
- Norfolk, Virginia
- Philadelphia, Pennsylvania
- Phoenix, Arizona
- Prince Georges County, Maryland
- Seattle, Washington
- Tampa, Florida
- Tucson, Arizona
- Tulsa, Oklahoma
- Virginia Beach, Virginia

Based on the 1990 Decennial Census, the combined populations of these MS4s totaled over 11.3 million. Fifteen percent of these MS4s have populations exceeding 1 million, 75 percent have populations between 250,000 and 1 million, and 10 percent have populations of less than 250,000. With the exception of Aurora and Lakewood, Colorado, all of these MS4s were previously identified as large MS4s in the November 16, 1991, *Federal Register.*

Grouping of Cost Data

This analysis broke down the actual and estimated costs that MS4s reported in their applications into the following eight major program components:

- Public education
- Monitoring
- Commercial and residential
- Construction
- Industrial facilities
- Maintenance of controls
- Improper discharges
- Miscellaneous

EPA selected these categories because they generally reflect the variety of costs reported in the applications and are largely consistent with the categories outlined in the permit application regulations. Each of these eight major categories were further subdivided into specific program components. An underlying objective of this effort was to determine the additional financial burden the stormwater program imposed on municipalities. Whenever possible, therefore, a breakout between new and existing program costs was made for each reviewed application.

Limitations

At this point, it is crucial to note some of the limitations associated with this analysis. First and foremost are limitations with the sample. Applications selected represented mostly large MS4s; therefore, EPA cannot be certain that these results are fully representative of costs that medium MS4s would report. Nearly 68 percent of the regulated MS4s were not required to have submitted their Part 2 applications at the time EPA conducted this analysis. Consequently, this limits the availability of Part 2 applications that the analysis could have included. One other important consideration with regard to the sample selection is that the results may be overstated in instances where MS4s are subject to more stringent local and regional controls or other environmental initiatives for stormwater management.

The second limitation is that, in many instances, MS4s did not include the cost of projects normally included in a capital improvement program (CIP). Although these projects often pertain to flood control, future CIP projects typically will have features that also address stormwater quality. Therefore, although providing the additional benefit of improved stormwater quality may be in response to the stormwater program, the analysis results do not typically reflect these associated costs. In contrast, EPA did not attempt to exclude significant costs that MS4s reported for programs unreasonably attributed to the stormwater program, even though they probably would have existed regardless of the stormwater program.

The third limitation reflects the difficulty in making direct comparisons between applicants. The regulations provide flexibility to the MS4s with regard to proposing stormwater management programs that reduce or eliminate the contribution of pollutants in stormwater discharges to the maximum extent practicable. The diverse approaches to stormwater management that MS4s have proposed reflect this flexibility. MS4s also used a variety of methods to report annual cost data.

Inconsistencies that existed within individual applications account for the fourth limitation. In many instances, the text describing a proposed stormwater management program component often did not correlate with the cost information provided. For example, the application may have indicated that an existing program would cover an activity, but the fiscal analysis section of the application did not provide the costs associated with the existing program. Often, MS4s reported that an existing stormwater management program was "absorbing" a new proposed program. The MS4s, however, provided no separate fiscal data in the application.

Finally, the results of this analysis suggest that in a number of instances MS4s both overreported and underreported costs. EPA did not attempt to exclude any reported costs from this analysis. Consequently, EPA is attempting only to document average costs.

Results

Of the 20 MS4 applications reviewed, the average annual reported cost for both new and existing programs ranged from $211,000 or $0.76 per capita (Tampa Bay, Florida) to $98 million or $190.85 per capita (Seattle, Washington). Table 4 highlights the ranges of average annual costs that municipalities reported.

Using population data from the 1990 Census, EPA calculated a preliminary average annual per capita cost for both new and existing programs of $23.91. Based on information reported by MS4s, it appears that costs for new programs or initiatives typically ranged from 10 to 15 percent of the average annual cost. As noted earlier, EPA reviewed Part 2 applications mostly from large MS4s. As medium MS4 applications become available, EPA anticipates examining cost data from some of these applications as well.

Programs the Part 2 Applications Proposed

Having reviewed some of the cost data, this paper will now present more specific details and examples of the types of stormwater management programs proposed in a number of Part 2 permit applications. The discussions's structure follows the organization of the Part 2 application (e.g., adequate legal authority, source identification, characterization data, and management programs). The discussion's scope is confined to some observations on a sample of eight Part 2 applications.

Legal Authority

According to the stormwater regulations, municipalities must demonstrate that they possess the adequate legal authority to implement their stormwater management activities when they submit their Part 2 applications. In the Part 2 guidance manual, EPA acknowledges that this is not always possible if an MS4 lacks the enabling legislative authority to develop the necessary ordinances. In these cases, applicants need to provide a schedule as to when adequate legal authority will be obtained.

Table 4. Ranges of Average Annual Costs Reported by Municipalities

Average Annual Costs	Number of Municipalities
Less than $1,000,000	4
$1,000,000 to $5,000,000	6
$5,000,000 to $10,000,000	5
Greater than $10,000,000	5

Six municipalities stated that they had obtained the adequate legal authority to carry out the requirements of the stormwater regulations. One municipality anticipated having necessary legal authority by the spring of 1993, and one anticipated having the authority within 2 years. As a general note, municipalities reported existing ordinances that addressed most of the legal authority requirements of the regulations, especially with regard to controlling improper discharges, illegal dumping, and erosion and sediment control provisions. The comprehensive nature of the stormwater regulations, however, required most municipalities to establish new ordinances or update existing ones, particularly for obtaining the necessary authority to conduct monitoring and surveillance of stormwater discharges from private sources.

Several municipalities provided detailed excerpts or, in some cases, the complete text of their comprehensive stormwater ordinances. For example, Seattle, Washington, and Prince Georges County, Maryland, provided the text of their grading, erosion, and control ordinances, while King County, Washington, provided the text of both its water quality ordinance and its pesticide regulation. Ordinances of both Seattle, Washington, and Prince Georges County, Maryland, addressed the requirements of the stormwater regulations in addition to other local or regional initiatives, such as the Puget Sound Water Quality Management Plan and the Chesapeake Bay Preservation Act, respectively.

Source Identification

The principle requirement of the source identification component of the Part 2 application is to identify any previously unknown major outfalls and to compile an industrial inventory. The industrial inventory must then be organized on a watershed basis. Perhaps one of the biggest challenges of the permit application is identifying all major outfalls that comprise the storm sewer system. Several MS4s reported using the analytical capabilities of their geographic information systems (GISs) to identify potential locations of outfalls not previously identified in the Part 1 application. A few applicants specifically noted that this was a particularly effective approach. Although a GIS is not a requirement of the stormwater regulations, EPA recognizes that GISs are well suited for many of the activities associated with stormwater management. Out of the eight applications reviewed, at least six reported having GIS capability, while one applicant anticipated having GIS capability in the near future.

Characterization Data

The characterization data portion of the Part 2 application requires an MS4 to submit the results of wet weather sampling with the application. More specifically, applicants must submit sampling data for five to 10 outfalls from at least three representative storm events. EPA has not had an opportunity to conduct a detailed analysis of this information. Some general observations, however, follow.

First, although many of the applicants reported completing their wet weather sampling requirements, they typically expressed similar difficulties in doing so. MS4s often noted that they had to sample several more than the requisite minimum of three storm events to obtain the number of requisite samples. In one instance, an applicant reported that it took a total of 18 storm events to obtain the requisite number of samples. Applicants also frequently cited that they had to discard samples because a particular storm's duration and rainfall accumulation did not meet the requirements of a representative storm event. Other problems commonly cited included sampling during storm events with frequent starts/stops and the logistics of mobilizing sampling crews at the onset of a storm event. The unpredictability of storm events and the logistics associated with wet weather sampling prompted at least four of the eight MS4s to use automatic samplers.

In at least one instance, an MS4 obtained approval to use available historical data to satisfy the majority of their sampling requirements. In this case, the applicant needed to sample one additional storm event at two sampling sites. Applicants often cited that concentration data compared well with the results of the NURP study. In general, the eight MS4s reported that the results of the analysis of composite samples exhibited characteristic concentrations for metals such as copper, cadmium, zinc, and lead. The sampling data also suggest that the concentration of organic contaminants often fell below detection levels for composite samples. Individual grab samples, however, detected many organic contaminants.

The second major component of this portion of the application requires the municipalities to estimate annual pollutant loadings. EPA allows MS4s the flexibility of selecting an appropriate method to estimate pollutant loadings. A majority of the eight applicants elected to use computer models such as SWMM, P8, and the CDM Nonpoint Source model to estimate annual loadings. A few applicants elected to use the simple method developed by the Metropolitan Washington Council of Governments.

EPA expected that computing pollutant loadings would satisfy at least two objectives. First, loading estimates would raise the level of awareness within municipalities of the relative magnitude of pollutant loadings associated with stormwater discharges. Second, the estimates could be used as part of a screening process when establishing priorities for stormwater management activities. One applicant specifically noted using loading estimates in this manner. Some applicants noted that these estimates had limited value and that other means of representing sampling data would be more appropriate.

The Part 2 application requires applicants to maintain an ongoing monitoring program for the duration of the term of the permit. An approach proposed by the city of Baltimore, Maryland, warrants special mention. Baltimore proposed a comprehensive and phased approach to monitoring which consists of four major components:

- Dry weather stormwater outfall monitoring
- Pollutant source tracking
- Long-term trend monitoring
- Stormwater runoff monitoring

The city identified the following six major goals to its monitoring program:

- *Dry weather screening:* This entails developing a "water quality dry weather flow" database to assist in isolating watersheds that may require further investigation as potential sites of illicit connections.
- *Dry weather source tracking:* This entails conducting investigations to detect and eliminate sources of dry weather flows.
- *Toxicity testing:* A pilot toxicity testing program would evaluate the impact of pollutants on a receiving water ecosystem due to unknown contaminants and synergistic effects.
- *Stream ecosystem database:* A database that describes the biological integrity of the receiving streams could assist in analyzing long-term trends, prioritizing management practices, and assessing the effectiveness of management programs.
- *Stormwater runoff and best management practice (BMP) assessments:* This effort could characterize stormwater runoff quality and assess the effectiveness of BMPs that may be used in the future.
- *Receiving stream water quality database:* This entails establishing dry and wet weather flow water quality databases for major stream systems that can be used for conducting long-term assessments and determining the effectiveness of watershed management programs.

The city's proposal to establish a stream ecosystem database is particularly noteworthy because it would provide the city with a baseline of its existing biological community (e.g., benthic macroinvertebrate population and diversity). It would also provide a basis from which to conduct a long-term assessment of the effectiveness of watershed management activities. More importantly, it would allow the opportunity to gain a greater understanding of the effects of stormwater discharges on a specific aquatic habitat. Finally, the city is closely coordinating its monitoring program with several subwatershed studies to determine the effectiveness of certain BMPs in protecting receiving water quality, including aquatic habitat.

Management Programs

Of course, the cornerstone of the two-part permit application is the requirement that MS4s develop site-specific and comprehensive stormwater management programs. Each applicant must address four major areas in its application:

- A description of structural and source control measures to reduce pollutants in runoff from residential and commercial areas.
- A description of procedures to detect and remove illicit connections and a program to control improper disposal.
- A description of structural and source control measures to reduce pollutants in runoff from industrial areas.
- A description of programs to maintain structural and nonstructural BMPs to reduce pollutants from construction sites.

In most instances, applicants elect to follow the application format established in the November 16, 1990, *Federal Register* to describe their management programs. From an initial review of eight applications, it appears that many MS4s are proposing approaches that entail phasing in components of their programs over the permit term. Applicants not only cited economic reasons for this approach but also the desire to ensure that a particular BMP is effective before it is implemented on a systemwide basis. For example, several applicants reported initiating studies to determine what factors significantly influence the performance of a specific structural control before its use on a systemwide basis. Pending the results of these studies, applicants proposed modifying their watershed management programs accordingly. While a phased approach may be reasonable in some instances, there are cases where the permitting authority may not consider it appropriate.

In one of the reviewed cases, an applicant proposed a phased approached to its illicit connections program. Although EPA acknowledges the effort necessary to detect and isolate the source of an illicit connection, a phased approach appears to overlook the immediate benefits of a fully implemented illicit connections program. This is especially true for municipalities in densely populated urban corridors that have both separate and combined sewer systems.

Implementing a comprehensive stormwater management program is a complex effort that requires the participation of numerous inter- and intragovernmental agencies. Before implementing a program, a municipality needs to establish program priorities. It may be helpful at this point to briefly illustrate one applicant's approach to establishing criteria for prioritizing basins for watershed management activities.

In 1987, King County, Washington, completed a "Basin Reconnaissance Program" that provided the information necessary to establish an initial basin planning prioritization scheme. The county provided a complete set of the results of this effort with its Part 1 application. King County established four major prioritization categories with commensurate criteria for each category. The major categories and criteria are as follows:

- Existing problems
  - Landslides
  - Erosion/Sediment
  - Flooding
- Future problems
  - Unincorporated land in King County
  - Subdivision/Plat activities
  - Population growth
  - Permitted residential units
- Existing resources
  - Stream habitat
  - In-stream resources
  - Wetland value
  - Wetland storage potential
  - Water quality potential
- Urgency/Timeliness
  - Other Agency interest
  - Opportunity to integrate with other programs

For all 37 basins identified, King County assigns a numerical rating to each criterion and a composite score for each major category, then establishes a total basin numerical rating. After completing basin prioritization ranking, the county proceeds with a six-step basin planning process. The first step is the formation of a basin plan team consisting of a project manager, biologists, geologists, water quality specialists, engineers, resource planners, mapping and GIS technicians, and graphics support. In the next step, the team collects data that include information on rainfall, flow levels, geological makeup, geomorphology, habitat complexity and diversity, fish utilization, and water quality. The basin plan team may spend up to 2 years compiling data.

The third and fourth steps entail computer modeling of a basin's hydrology and predicting the effects of alternative land-use activities. The results of the modeling efforts assist in developing a current and future conditions report that documents existing conditions and provides an analysis of future trends.

The fifth step entails drafting a basin plan and conducting public meetings and hearings. After necessary modification, the team finalizes the draft plan and submits it to the King County Council for approval. Following approval, the King County Surface Water Management (SWM) Division is responsible for implementing the basin plan. King County SWM anticipated completing 12 of its 37 basin plans by the end of 1992.

The King County basin planning program reflects a resource-intensive effort and a commitment to reducing the deleterious effects of stormwater discharges. Municipalities that are essentially new to stormwater management may find elements of King County's program not only innovative and informative but also adaptable to their needs.

MS4s proposed some general observations about particular program components. First, a majority of the applications placed a heavy emphasis on minimizing future problems associated with stormwater management, specifically in the area of long-term planning for future development. In several instances, MS4s reported that they had either completed or initiated the development of stormwater management master plans for major watersheds.

Also, MS4s are increasingly requiring approval of erosion and sediment control plans before approving a site plan or allowing construction to begin. Similarly, many MS4s require permanent BMPs (privately financed), such as installation of retention/detention basins for all new developments over a certain size area. MS4s also frequently reported that inspections programs had been or are being established to ensure maintenance of publicly and privately owned BMPs over their useful life. In at least one instance, an MS4 provides an economic incentive to install BMPs by establishing a BMP crediting system for non-single-family residences.

A couple of applicants also reported a substantial commitment to preserving open space. In one case, a municipality reported that it is pursuing a "Greenways" program that could potentially preserve 16,000 acres as open space. To date, 400 acres have been preserved. Similarly, one county has established a stream valley park system. All major streams in the county are to become part of the park system. In this instance, the county has imposed an additional requirement: new development must provide for buffer zones or easements.

Over the long term, approaches like these may minimize the need to construct costly structural controls to remove pollutants from stormwater discharges. Moreover, this preventative approach to stormwater management can potentially reduce the significant costs that some municipalities are incurring to restore degraded stream corridors and wetlands. EPA recognizes that this is a contentious issue. It is encouraging to note, however, the emphasis municipal applicants are placing on community involvement and public outreach programs. The "adopt-a-stream" program and other similar community-based environmental programs, such as household hazardous waste collection, routinely appeared in Part 2 applications.

Paraphrasing one applicant's comment, the goals of a stormwater management program cannot be fully achieved unless there is participation and consensus among those who are affected. Otherwise, past practices will continue to have a detrimental influence on valuable water resources within our communities.

Current EPA Activities in the Area of MS4 Permitting

Several EPA regions and state permitting authorities have supported the formation of an MS4 steering committee to look at specific issues pertinent to MS4 permits. The steering committee is looking at program components and permits that may be suitable as model programs or model permits. It also will assist in determining how to incorporate core elements of a stormwater program into an MS4 permit. Lastly, the steering committee will be exploring alternative mechanisms of exchanging information on stormwater management. The committee will coordinate this particular effort with ongoing outreach activities at EPA.

EPA also is conducting a municipal assessment project (MAP) that continues to examine the progress of the municipal permitting process. This entails compiling information on the status of both permit applications and permit development. Whenever possible, EPA will suggest future improvements or enhancements to the MS4 permitting process. EPA is continuing to compile information on MS4s designated by state permitting agencies and EPA regions. Other objectives of the MAP include examining the Part 2 applications in more detail to identify programs as potential model candidates.

As the permitting process moves from the development of permit applications to permit development, EPA anticipates distributing information on the progress of permit development to permitting authorities. Hopefully, this approach will benefit all those participating in the permitting process.

Municipal Stormwater Permitting: A California Perspective

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Abstract

The California Regional Water Quality Control Board, San Francisco Bay Region (Regional Board), began a program for control of stormwater discharges from urban areas in 1987. The initial focus of the program has been on the municipalities in Santa Clara and Alameda counties. An areawide approach was promoted in which all the cities in each county, the county, and the county flood control agency worked collectively. The Santa Clara and Alameda programs were issued municipal stormwater National Pollutant Discharge Elimination System (NPDES) permits in June 1990 and August 1991, respectively. These efforts have focused on implementation of stormwater management programs rather than on the NPDES permit itself. Essentially, the permit serves as an enforceable mechanism requiring implementation of the programs developed by the municipalities and approved by the Regional Board.

The municipal stormwater management programs all involve similar elements, including public information/participation, elimination of illegal discharges, public agency activities, control of industrial/commercial stormwater discharges, new development management, stormwater treatment, program evaluation, and monitoring. The process of developing these programs has uncovered several issues and problems, mostly nontechnical, which could potentially impede successful implementation. On the other hand, workable solutions to most of these problems have also been identified. The essential ingredient of the process that has enabled progress has been a cooperative, proactive relationship between the Regional Board and municipalities. Continuation of this process is expected to result in a realistic and meaningful municipal stormwater NPDES permit program.

Background

The California Regional Water Quality Control Board, San Francisco Bay Region (Regional Board), is the state water pollution control agency responsible for protection of San Francisco Bay and its tributaries. San Francisco Bay is a highly urbanized estuary and as such receives significant loads of pollutants through discharges of urban runoff. The responsibilities of the Regional Board include water quality control planning, control of nonpoint sources of pollution, and issuance and enforcement of NPDES permits. Using its authorities, the Regional Board began a program for control of stormwater discharges from urban areas in 1987. The initial focus of the program was on the most highly urbanized areas, which include the municipalities in Santa Clara and Alameda counties. An areawide approach was promoted in which all the cities in each county, the county, and the county flood control agency worked collectively.

Santa Clara and Alameda counties developed their programs through a strategic planning process (1). The process followed a series of steps that involved establishing program goals and framework; compiling existing information; assessing water quality problems through collection and analysis of data and modeling of pollutant loads; identifying, screening, and selecting appropriate control measures; and establishing a plan for implementation. This planning process lead to development of a comprehensive stormwater management plan by each program (2, 3). In addition, institutional arrangements, legal authorities, and fiscal resources for implementation were addressed.

The efforts of the Regional Board and the Santa Clara and Alameda municipalities were well under way when the stormwater National Pollutant Discharge Elimination System (NPDES) permit regulations were promulgated in November 1990. The Regional Board found the information that the planning process followed by the two areawide programs provided was equivalent to federal permit application requirements. Consequently, the Regional Board issued municipal stormwater NPDES permits to the Santa Clara and Alameda programs in June 1990 and August 1991, respectively, which required implementation of their stormwater management plans. Issuance of these "early" permits served to recognize the accomplishments of the two programs and to provide a focus on implementation actions while avoiding the time delays and costs associated with the promulgated application requirements. We also have focused attention on the adequacy and effectiveness of the stormwater management plans rather than the permits. Essentially, the permit serves as an enforceable mechanism requiring implementation of the programs developed by the municipalities and approved by the Regional Board.

The efforts of the Santa Clara and Alameda municipalities have provided a meaningful framework for and the essential elements of an effective stormwater management program. A similar approach is being followed by municipalities in the other urban areas of the San Francisco Bay region. The process of developing these programs has uncovered several issues and problems, mostly nontechnical, which could potentially impede successful implementation. On the other hand, workable solutions to most of these problems have also been identified. The following discussion provides a status report of the San Francisco Bay programs, a description of the elements of the stormwater management programs, and insight into the problems encountered and their solutions.

San Francisco Bay Region Municipal Stormwater Programs

In the San Francisco Bay region, nearly all municipalities in urban areas have stormwater management programs and NPDES permits under way or under development. The Regional Board has encouraged, recognized, or required areawide programs in which all municipalities within a watershed or municipal systems that interconnect are managed under one program. In addition, municipal flood management agencies are included as co-permittees. The California Transportation Department (Caltrans) is required to implement a stormwater management program for all storm drain systems within the region. The municipal stormwater programs in the San Francisco Bay region are listed below.

- Santa Clara Valley Nonpoint Source Pollution Control Program, including the county and all cities:
  - Population approximately 1,500,000
  - NPDES permit issued June 1990
- Alameda County Urban Runoff Clean Water Program including the county and all cities:
  - Population approximately 1,250,000
  - NPDES permit issued October 1991
- Contra Costa Cities, County, District Stormwater Pollution Control Program including the county and all cities:
  - Population approximately 800,000
  - Part 1 Application submitted May 1992
  - Part 2 Application due May 1993
- San Mateo County Urban Runoff Clean Water Program, including the county and all cities:
  - Population approximately 650,000 (no city nor the county has population more than 100,000)
  - Combined Parts 1 and 2 Application due May 1993
- Caltrans, including all operation, maintenance, and construction activities:
  - Incomplete application submitted July 1992
  - Complete application due May 1993
- City of Vallejo:
  - Population more than 100,000 (as of 1990 Census)
  - Part 1 Application due March 1993
  - Part 2 Application due March 1994
- Cities of Fairfield and Suisun City Joint Program:
  - Population more than 100,000
  - Part 1 Application due March 1993
  - Part 2 Application due March 1994

Municipal Stormwater Program Elements

The municipal stormwater management programs all involve similar elements except for Caltrans, which will not be discussed here. These include public information/participation, elimination of illegal discharges, public agency activities, control of industrial/commercial stormwater discharges, new development management, stormwater treatment, program evaluation, and monitoring. The activities associated with each of these essential program components are presented below.

Public Information/Participation

This element is considered the most important early action and is the cornerstone of effective pollution prevention. Its objectives are to inform the public, commercial entities, and industries about the proper use and disposal of materials and waste and to correct practices of stormwater runoff pollution control. Activities include development of general and focused information materials and public service announcements. Participation

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activities include citizen monitoring programs, stenciling of storm drain inlets with no dumping signs, and organized creek cleanups.

Elimination of Illegal Discharges

Elimination of illicit connections to the storm drain system and the prevention of illegal dumping are other essential early action elements. The objective is to ensure that only stormwater or otherwise authorized discharges enter storm drains. Activities include inspection of storm drain outfalls, surveillance of storm drain systems, and enforcement actions.

Public Agency Activities

Many public agency activities affect stormwater pollution. Some activities prevent or remove stormwater pollution, while other activities are sources of pollution. The objective of this element is to ensure that routine municipal operations and maintenance activities are initiated or improved to reduce the likelihood that pollutants are discharged to the storm drain system. Activities include street sweeping; maintenance of storm drain inlets, lines and channels, and catch basins; corporation yard management; and recycling programs. Coordination of road maintenance and flood control activities with the stormwater management program is also included.

Control of Industrial/Commercial Stormwater Discharges

Industrial and commercial sources may contribute a substantial pollutant loading to a municipal storm drain system. The objective of this element is to identify and effectively control industrial and commercial sources of concern. Activities include compiling a list of industrial and commercial sources, identifying appropriate pollution prevention and control measures, and inspecting facilities. The focus is not only on facilities associated with industrial activity as defined in the stormwater regulations but on any facility that conducts industrial activities, as well as commercial facilities such as automotive operations and restaurants. This effort is expected to complement federal and state industrial stormwater permitting efforts.

New Development Management

Areas of new development and redevelopment offer the greatest potential for implementation of the most effective pollution prevention and control measures. The objective of this element is to reduce the likelihood of pollutants entering the storm drain system from areas of new development and significant redevelopment, both during and after construction. Activities include review of existing local permitting procedures and modification of the procedures to identify and assign appropriate site design, erosion control, and permanent stormwater control measures.

Stormwater Treatment

The initial focus of the stormwater management programs is on pollution prevention and source control. Treatment of stormwater is expected to be a costly alternative. There may be opportunities, however, for installation or retrofitting of structural controls. The objectives of this element are to study the various treatment alternatives available, to test the feasibility of conducting the activities, and to determine the effectiveness of the treatment through pilot-scale projects. Initial focus has been on existing wetland systems, flood control detention basins, and treatment of parking lot runoff.

Program Evaluation

Stormwater management programs are expected to change as they mature. Consequently, they should have built-in flexibility to allow for changes in priorities, needs, or levels of awareness. The objective of this element is to provide a comprehensive annual evaluation and report of program effectiveness. Measures of effectiveness include quantitative monitoring to assess the effectiveness of specific control measures and detailed accounting of program accomplishments and funds and staff hours expended. The annual report provides an overall evaluation of the program and sets forth plans and schedules for the upcoming year. The annual report is considered a program's self audit and provides a mechanism to propose modifications to the stormwater management plan in response to program accomplishments or failures. The annual report also serves as the key regulatory tool for providing accountability and public review in accordance with the NPDES permit.

Monitoring

Monitoring is an essential component of any pollution control program. The objectives are to obtain quantitative information to measure program progress and effectiveness, to identify sources of pollutants, and to document reduction in pollutant loads. The success of a monitoring program can be measured by the ability to make more informed decisions on a program's direction and effectiveness. Monitoring activities include baseline monitoring of storm drain discharges and receiving waters and focused special studies to identify sources of pollutants and to evaluate the effectiveness of specific control measures. Types of monitoring include water column measurements, sediment measurements, and nonsampling and analysis measurements, such as number of outfalls inspected or amount of material removed by maintenance. Toxicity identification evaluations are an integral component of monitoring programs in the San Francisco Bay area.

Municipal Stormwater Program Problems

The process of developing these programs has uncovered several issues and problems, mostly nontechnical in nature, that could potentially impede successful implementation. The first step towards avoiding or solving these problems is understanding what they are and how they may affect a program. The following discussion provides insight into the more common problems.

Internal Agency Coordination

Municipalities are public agencies, often with multiple departments serving different functions, that are an integral part of stormwater management. The missions and actions of separate departments are often carried out without coordination with other departments. Commitments or actions by planning department personnel that are not coordinated with public works result in problems. All affected departments must participate in development of a stormwater management program. The stormwater program plan also must clearly identify the roles and levels of participation of all involved departments.

External Agency Coordination

In addition to coordination within a municipality, communication and coordination is necessary between adjacent cities, the county, and regional organizations such as flood control and wastewater treatment agencies. Historically, there may have been little need for coordination, or problems encountered by other programs may have created barriers. As with the internal agency issue noted above, all affected agencies must participate in the program development process and clearly understand their implementation responsibilities.

Resistance by Key Individuals

Individuals play a strong role in local government. Consequently, one or more key individuals can make or break a program. Often one individual causes the internal and external coordination problems noted above. Also, in the early development stages of a program, until dedicated personnel are identified, individuals may resist the additional work load required of them to make the program work.

Financial Resources

Without dedicated financial resources, a stormwater management program is destined to fail. Programs that do not start the process to secure dedicated funds early in program development find themselves unable to commit to a meaningful program. The process of establishing a stormwater utility, assessment district, or other funding mechanisms is cumbersome and requires strategic planning.

Legal Issues

Initial review of existing local ordinances may result in the conclusion that sufficient legal authorities already exist. Later on in the development process, however, when specific implementation activities are identified, the existing authority may be found to be too vague or unsuitable. Review of legal issues should be part of the annual evaluation process.

Competing Mandates

Mandates by other programs within a municipality or by external agencies may directly conflict with stormwater program mandates. Examples include fire departments prohibiting inside or covered storage of certain materials or the obvious conflict between eradication of vegetation with herbicides in flood control channels and water quality concerns.

Problem Awareness/Understanding

To solve or manage a problem, one must first understand the problem. Effective pollution prevention requires a new way of thinking that may be foreign to those accustomed to more conventional engineering solutions. A subset of this issue involves those who deny that a problem exists.

Resistance to Maintenance Responsibility

Municipal programs are expected to result in installation of some structural controls, particularly in areas of new development or significant redevelopment. A frequently encountered barrier is that municipalities are not willing to take on the additional maintenance responsibility associated with new structural controls.

Problem Sources Beyond Municipal Authority

Many sources of stormwater pollution involve atmospheric emissions, automobile wear (e.g., brakes, tires), and household products over which a municipality has no control. Transportation related issues are beyond the control of a single municipality. State and federal coordination with local programs is essential.

Lack of Tools To Evaluate Effectiveness

The effectiveness of pollution prevention measures is difficult to quantify. Natural variability in stormwater quality may mask improvements associated with certain control measures. Surrogate measures and analytical tools to evaluate stormwater management program effectiveness should be better defined.

Municipal Stormwater Program Solutions

The efforts of the Regional Board and the municipalities in the San Francisco Bay area have overcome many of the problems noted above. The essential ingredient of the process that has enabled progress has been a cooperative, proactive relationship between the Regional Board and municipalities. A discussion of some of the solutions that have evolved follows.

Carrot and Stick Approach

At the onset of each new municipal program, the Regional Board has made it clear that stormwater pollution is a serious problem that must be dealt with and that the best solutions will only happen at the local level. The carrot has been an offer to the municipalities to control their own destinies rather than waiting for the powers that be in Sacramento or Washington to determine what they can or cannot do. This approach allows the municipalities to identify and select the measures that are workable for them and, most importantly, that are most cost-effective. On the other hand, the Regional Board has also made it clear that participation is not voluntary and that failure to commit to meaningful actions will result in enforcement actions.

Round Table Forum

Contrary to the conventional regulatory approach, in which the regulator demands and the regulatee reacts, the Regional Board has promoted a round table forum in which all involved parties work collectively and cooperatively to identify solutions that address the concerns and means of all involved. This approach has also provided a mechanism for participation by all affected internal and external public agencies.

Regular Meetings

The Regional Board has met in the round table format with municipalities throughout the program development process. Meetings have been held at least monthly. This has allowed for timely and effective decision-making. Focused work groups to address specific problems or program elements have also been formed.

Minimization of Bureaucracy

The stormwater pollution problem is not a conventional problem that can be solved by conventional means. Any program is doomed to fail if it is mired in red tape. To promote innovative solutions, the regulators must be willing to promote innovative regulatory mechanisms.

Flexibility

To truly present a carrot to entice municipalities and promote innovative solutions, the regulator must be willing to be flexible. No one solution exists for stormwater pollution problems. What works in one municipality may not work in another. Also, flexibility provides a reward mechanism for those municipalities who are committed and proactive.

Phased Approach

The phased approach promotes a strategy based on goal setting, identification of actions, planning and preparation for planned actions, small-scale implementation, and finally full-scale implementation. Evaluation is essential to each step. It must be recognized that some actions may be implemented immediately or in the short term, while others may take many years to fully implement.

Pilot Studies

Although many control measures have been demonstrated to be effective, such measures often need testing within the conditions of a specific municipality. Pilot studies also provide an opportunity to identify factors such as operation and maintenance parameters or non-technical factors such as legal issues that may not be apparent. They also provide a mechanism for demonstrating acceptability to concerned parties and should be considered a first step leading to successful wide-scale implementation.

Annual Program Audit

Recurring evaluation is essential. At a minimum, program participants and the regulator should annually evaluate program progress. This comprehensive annual audit should identify program successes as well as failures and should provide a mechanism to steer the program in the most effective direction.

Conclusions

Focusing on the described municipal stormwater program elements and taking a cooperative approach to solving problems have led to the development of successful stormwater management programs by municipalities in the San Francisco Bay area. Although program implementation is in the early stages and total success cannot be claimed, the programs are successful in that they present a workable framework for implementation of meaningful actions. Essential to the process is strategic planning, accountability, and recurring evaluation of program direction, success, and failure.

The NPDES permit issued to a municipality is not going to solve the stormwater pollution problem—it can only serve as a tool to facilitate action. The success of the municipal stormwater permit program will be recognized when municipalities are committed to action, and NPDES permits merely require municipalities to do what they have committed to do.

References

1. Mumley, T.E. 1993. Urban runoff pollution prevention and control planning, San Francisco Bay experiences. In: Proceedings of the U.S. EPA National Conference on Urban Runoff Management, Chicago, IL.

2. Santa Clara Valley Nonpoint Source Pollution Control Program. 1991. Stormwater management plan.

3. Alameda County Urban Runoff Clean Water Program. 1991. Stormwater management plan.

Stormwater Management Ordinance Approaches in Northeastern Illinois

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Abstract

Stormwater drainage and detention is widely regulated by local ordinances in northeastern Illinois. Early ordinances, going back to about 1970, focused exclusively on the prevention of increased flooding and nuisance drainage problems. Recent ordinances address the objectives of preventing flooding and channel erosion, preserving predevelopment hydrology, protecting water quality and aquatic habitat, providing recreational opportunities, and enhancing aesthetic conditions.

The basis for many of the newer ordinances is a model ordinance developed by the Northeastern Illinois Planning Commission. The "Model Stormwater Drainage and Detention Ordinance" calls for "natural" drainage practices to minimize increases in runoff volumes and rates and for detention basins that control the full range of flood events and effectively remove stormwater pollutants.

The model ordinance requires detention designs that limit the 100-year release to 0.15 ft^3/sec/acre and the 2-year release to 0.04 ft^3/sec/acre. These rates are actually lower than the local predevelopment runoff rates and are based on observed capacities of the downstream channel system. Detention design also must incorporate water quality mitigation features, including permanent pools or created wetlands, stilling basins, and the ability to avoid short-circuiting. Further, the model ordinance strongly discourages detention in onstream locations or in existing wetlands.

As multipurpose ordinances are implemented, several issues remain. Some municipal officials are concerned about the aesthetics and maintenance needs of wetland-type detention basins and natural drainage practices, such as vegetated swales. Technical debate continues over the effectiveness of on-line and onstream detention, both from a water quality and flood prevention perspective. Also, the appropriateness of using existing wetlands for stormwater detention remains to be determined.

History

Stormwater drainage and detention has been widely regulated by local ordinances in northeastern Illinois since the early 1970s. Early ordinances were implemented because of a recognition that rapid suburban development was causing more frequent and more damaging flooding and drainage problems. Flooding and drainage problems in the region are exacerbated by the very flat landscape; typical ground slopes range from 0.5 to 4 percent. As a result, even a slight increase in flood volumes and rates can expose large additional areas to flooding.

Most early ordinances required storage of the 100-year rainfall event. These ordinances were based on requirements developed by the Metropolitan Water Reclamation District of Greater Chicago (MWRDGC). MWRDGC requires sewer permits for new development within Cook County, the largest and most populous in the six-county northeastern Illinois region. Many communities in the outer "collar" counties followed MWRDGC's lead and developed similar ordinances.

At the same time that municipalities began to implement stormwater detention controls for new development, most also required via subdivision ordinances that new development be drained by curb and gutter and storm sewer systems. This drainage philosophy was intended to reduce local drainage problems but resulted in increased rates and volumes of runoff.

The quality of urban runoff began to receive some attention in the late 1970s with the completion of the Areawide Water Quality Management Plan by the Northeastern Illinois Planning Commission (NIPC) (1). This plan reported much higher pollutant loads for urban land-use categories compared with rural land uses. As a consequence, the plan recommended that stormwater loadings of suspended solids and biological oxygen demand (BOD) be reduced by 50 percent by appropriate best management practices (BMPs) for all new development. Despite the recommendations of the plan, few changes occurred in the stormwater management strategy of local governments, which addressed exclusively the *quantity* of runoff but not the *quality*.

Assessment of Ordinance Effectiveness

In 1986 and 1987, large areas of northeastern Illinois were besieged by major floods, with total damage estimates exceeding $100 million. In some locales, flood flows exceeded the reported 100-year frequency event. Of particular concern was the observation that large flood damages had occurred in watersheds that had developed extensively since the implementation of detention ordinances in the early 1970s. This lead to the suspicion that detention was not preventing increases in flood flows.

To address these concerns, NIPC was funded by the Illinois Department of Transportation, Division of Water Resources, to investigate the effectiveness of existing stormwater detention ordinances. First, a literature review was performed to assess the effectiveness of detention in various locales around the country. Next, a comprehensive watershed modeling study was performed to evaluate both the effects of urbanization and a range of existing and proposed stormwater detention controls. The study concluded that the detention standards that most communities required were not adequate to prevent increases in flooding due to new development (2). Other local studies initiated by the Soil Conservation Service reached similar conclusions (3). Several specific weaknesses were identified:

- Detention volumes were inadequate to store the intended 100-year design event due to outdated rainfall statistics and/or simplistic hydrologic design techniques.
- Required 100-year release rates were typically based on site predevelopment runoff rates rather than observed instream flood flow rates.
- Because detention outlets were designed to explicitly control only the 100-year event, smaller flood events (e.g., the 2-year event) typically passed through detention facilities with inadequate control.

The study also noted two problems in addition to flooding impacts. The first was increased stream channel erosion, caused in part by the increased magnitude and frequency of small floods. The second was water quality impairment due to inadequately controlled urban runoff.

New Model Ordinance Approach

With the preceding problems in mind, NIPC was contracted to develop an updated model stormwater ordinance. This "Model Stormwater Drainage and Detention Ordinance" (4) was developed with the assistance of a regionwide, multiagency technical advisory committee. The primary purposes of the ordinance are to minimize the stormwater-related effects of development on downstream and local flooding, stream channel erosion, water quality, and aquatic habitat.

The model ordinance is intended to apply to all development, including redevelopment. It requires the submittal of a basic drainage plan consisting of a topographic map, a detailed description of the existing and proposed drainage system, and a description of sensitive environmental features such as wetlands. An advanced drainage plan is required for sites larger than 10 acres. The advanced plan should include flow rates, velocities, and elevations at representative points in the drainage system for events up to the 100-year. The following are some important ordinance standards and criteria:

- *Runoff reduction hierarchy:* The ordinance requires the evaluation of site design practices that minimize the increase in runoff volumes and rates. A preference is stated for, in order, minimization of hydraulically connected impervious surfaces, use of open vegetated swales and channels and natural depressions, and infiltration practices. Traditional storm sewer approaches are discouraged unless other measures are not practical.
- *100-year release rate:* The peak 100-year discharge should not exceed 0.15 ft^3/sec/acre. This release rate is related to the capacity of the downstream channel/floodplain system for extreme flood events. The referenced detention effectiveness evaluation indicated that this release rate should prevent development-related increases in flooding for watersheds up to at least 30 square miles in size (and probably much larger).
- *2-year release rate:* The peak discharge for events up to the 2-year event should not exceed 0.04 ft^3/sec/acre. This release rate is designed to minimize increases in the magnitude and frequency of the instream 2-year event, which is sometimes associated with bankfull flow conditions. This requirement is intended to minimize increases in stream channel erosion. This release rate also will provide extended ponding for small storm events, which will enhance pollutant removal.
- *Detention storage requirements:* The design maximum storage should be based on the runoff from the 100-year, 24-hour event. Storage should be computed based on hydrograph methods, such as TR-55 or TR-20. Design rainfall should be based on the Illinois State Water Survey's Bulletin 70 (5), which supersedes the U.S. Weather Bureau's Technical Paper No. 40 (6). Bulletin 70, which is based on a precipitation database that is more extensive and more current, reports a 100-year, 24-hour rainfall of 7.6 in., while Technical Paper 40 recommends 5.8 in.

- *Water quality design features for detention:* The ordinance indicates a preference for wet detention basins over dry extended detention facilities to maximize pollutant removal potential. For wet basins, the ordinance includes design criteria for depths, shoreline slopes, permanent pool volume, and inlet/outlet orientation. For dry extended detention basins, the ordinance includes design criteria for velocity dissipation at inlets and inlet/outlet orientation.
- *Detention in floodways and stream channels:* The ordinance discourages detention in designated floodways, particularly in onstream locations with upstream drainage areas larger than about 1 to 2 square miles. The principal concerns with onstream detention are that it may be less effective in mitigating stormwater pollutants and it allows stormwater pollutants to be discharged into stream channels without adequate pretreatment.
- *Detention in wetlands:* Use of existing wetlands to accommodate stormwater detention requirements is strongly discouraged. The ordinance requires that all stormwater be stored and routed through a 2-year water quality detention facility (consistent with the previous design criteria) before being discharged to a wetland. The ordinance allows *additional* storage, up to the 100-year event, to be provided in a wetland if it can be shown that the wetland is low in quality and that proposed detention modifications will maintain or improve its habitat and other beneficial functions.

Overall, the new model ordinance is one of the most stringent in the country in its storage and release rate requirements for minimizing the effects of development on downstream flooding. The new ordinance also includes, for the first time, some basic requirements for BMPs to mitigate stormwater quality effects.

Recent Improvements in Local Stormwater Regulations

As an advisory agency, NIPC has no authority to require compliance with its model ordinances. Similarly, there is no comprehensive state requirement for local stormwater regulations. Because of recent experience with devastating floods, however, many communities were eager to consider alternatives to stormwater standards that were a decade or more old.

The process of evaluating new ordinances was facilitated by state legislation, passed after the floods of 1986 and 1987, that authorized northeastern Illinois counties to establish stormwater management committees (SMCs). These committees, with equal representation from county government and municipalities, were authorized to develop comprehensive, binding stormwater management plans. These plans included both watershed-based flood remediation measures as well as uniform, countywide stormwater regulations.

So far, comprehensive countywide ordinances have been implemented in two counties, DuPage (7) and Lake (8). These ordinances address traditional stormwater drainage and detention concerns as well as floodplain management, soil erosion and sediment control, and stream and wetland protection. The ordinances incorporate many standards from the NIPC models and address multipurpose objectives of preventing flooding and channel erosion, preserving predevelopment hydrology, protecting water quality and aquatic habitat, providing recreational opportunities, and enhancing aesthetic conditions. Probably the most remarkable element of these new ordinances is their inclusion of some basic stormwater BMPs that are intended to address both stormwater quantity and quality concerns.

Countywide stormwater planning efforts also have begun in Cook, Kane, and McHenry Counties. Many communities in these counties have individually begun to update their ordinances. Some of the impetus for ordinance updates has come from watershed-based groups, such as the Butterfield Creek Steering Committee. This group developed a comprehensive ordinance for seven watershed communities all faced with similar problems of overbank flooding, stream channel erosion, and water quality degradation (9).

Other communities are updating ordinances based on requirements of the Illinois Environmental Protection Agency (IEPA) as a condition for facility planning area amendments for expanded wastewater service. These requirements are based on provisions of the Illinois Water Quality Management Plan and essentially require that development within new FPA expansions not adversely affect water quality, either due to point or nonpoint sources.

The IEPA also is delegated to implement the new NPDES requirements for stormwater discharges. In particular, as part of its new general permit for construction site activities, IEPA requires the development of a pollution prevention plan that must include provisions for soil erosion and sediment control as well as stormwater BMPs such as detention facilities, vegetated swales and natural depressions, infiltration practices, and velocity dissipation measures (10). While the construction site general permit does not mandate the adoption of ordinances, it does provide further incentive to local governments to begin to add stormwater quality control measures to their existing ordinances.

Regionwide enthusiasm for inclusion of water quality BMPs in stormwater ordinances is still somewhat limited because of a lack of awareness among many stormwater engineers, local officials, and the public of the adverse effects of stormwater runoff on water quality and aquatic life. This perception appears to be at least partly related to the long-term degradation of urban water bodies in the region and the lack of a prominent focal point, such as a Chesapeake Bay or Puget Sound, for viewing stormwater quality impacts.

Some Current Issues

As multipurpose stormwater ordinances are adopted throughout the region, several issues remain. Some municipal officials are concerned about the aesthetics and maintenance needs of wetland-type detention basins and natural drainage practices, such as vegetated swales. Technical debate continues over the effectiveness of on-line and onstream detention, both from a water quality and flood prevention perspective. Also, the appropriateness of using existing wetlands for stormwater detention remains to be resolved.

Perhaps the most important consideration of local government officials regarding stormwater drainage is public acceptance, which generally translates as the avoidance of "nuisance" drainage conditions. Some commonly cited nuisance concerns include extended saturation or ponding on lawns or swales, "weedy" vegetation, mosquito breeding potential, and wet detention areas. These concerns have driven many communities to require highly engineered drainage systems, including curbs and gutters, storm sewers, and concrete channels, which rapidly convey runoff from the site. Some public works officials also argue that engineered drainage systems are less expensive to maintain.

There is growing support, however, in other parts of the country and in a few northeastern Illinois communities for "natural" drainage practices using vegetated swales, channels, and filter strips and created wetlands. In addition to providing significant pollutant removal and runoff reduction benefits, natural practices may be much less expensive to install and, at least to some, are preferred aesthetically over engineered systems. Progress in gaining acceptance of natural drainage systems has been slow in northeastern Illinois. Successful ongoing demonstration projects, innovative new corporate campus developments, and improved public education should be helpful in advancing natural drainage approaches.

Onstream stormwater detention is a desirable alternative to many site design engineers in the region. In a typical situation, such facilities generally do not provide regional detention for the entire upstream watershed; rather, they serve the storage requirements of a development adjacent to the floodplain. As previously mentioned, however, there are significant concerns about the effects and effectiveness of onstream facilities. These facilities alter the free-flowing nature of streams, creating impoundments susceptible to sedimentation and eutrophication. Impoundments can impede the upstream migration of fish and the downstream drift of benthic organisms. Onstream detention essentially uses the stream as a treatment device. Because of typically shorter residence times relative to offline facilities, however, onstream facilities may not be very effective in trapping stormwater runoff pollutants and protecting downstream water bodies. While the appropriateness of onstream detention in northeastern Illinois merits additional debate, currently this debate is not fully considering the potential adverse water quality and habitat impacts of onstream facilities.

Another unresolved issue is the appropriateness of using existing wetlands for stormwater detention. Section 404 permits have been issued for the incorporation of detention into existing wetlands and mitigation wetlands. If a wetland is impounded without the introduction of fill material, a Section 404 permit may not even be required. Limited water quality protection is provided by several new stormwater ordinances and the NIPC model ordinance, which require pretreatment of stormwater before it is discharged into a wetland. Even if stormwater quality effects are reasonably mitigated, however, detention in a wetland can radically affect its hydrology. In particular, detention is likely to pond water more frequently and at greater depths than in a natural wetland. Such alterations can adversely affect sensitive plant communities and wildlife.

Conclusions

Stormwater management ordinances have evolved dramatically in northeastern Illinois since their introduction over 20 years ago. Always a leader in flood prevention, northeastern Illinois now has some of the most stringent standards in the nation for detention volumes and release rates.

Evolving from an early emphasis on local drainage and flood prevention, many ordinances now recognize the importance of water quality mitigation and habitat protection. Some newer ordinances reflect a revised philosophy of stormwater management that takes advantage of natural drainage and storage functions, with the objective of limiting stormwater runoff rates, volume, and quality to predevelopment conditions. Much remains to be learned, however, about effective designs for BMPs such as wetland detention, filter strips, and infiltration practices.

References

1. Northeastern Illinois Planning Commission. 1979. Areawide water quality management plan. Chicago, IL.
2. Dreher, D.W., G.C. Schaefer, and D.L. Hey. 1989. Evaluation of stormwater detention effectiveness in northeastern Illinois. Chicago, IL: Northeastern Illinois Planning Commission.
3. Bartels, R.M. 1987. Stormwater management: When onsite detention reduces stream flooding. In: Proceedings of the Eleventh Annual Conference of the Association of State Floodplain Managers, Seattle, WA (June).

4. Northeastern Illinois Planning Commission. 1990. Model stormwater drainage and detention ordinance. Chicago, IL.

5. Huff, F., and J. Angel. 1989. Frequency distributions and hydroclimatic characteristics of heavy rainstorms in Illinois. Bulletin 70. Urbana, IL: Illinois State Water Survey.

6. Hershfield, D.M. 1961. Rainfall frequency atlas of the United States. Technical Paper 40. U.S. Department of Commerce, Weather Bureau.

7. DuPage County Stormwater Management Committee. 1991. Countywide stormwater and floodplain ordinance. Wheaton, IL: DuPage County Environmental Concerns Department.

8. Lake County Stormwater Management Commission. 1992. Lake County watershed development ordinance. Libertyville, IL.

9. Butterfield Creek Steering Committee. 1990. Model floodplain and stormwater management code for the Butterfield Creek watershed communities. Cook and Will Counties, IL.

10. Illinois Environmental Protection Agency. 1992. NPDES Permit No. ILR100000: Construction site activities. Springfield, IL.

The Lower Colorado River Authority Nonpoint Source Pollution Control Ordinance

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Abstract

Urban development can be managed to control nonpoint source pollution using a variety of methods. The method selected is typically a function of the jurisdictional agency's authority (or lack thereof), the use and desired quality of the receiving waters, and the impact on and acceptance by the public.

The Lower Colorado River Authority (LCRA) is a conservation and reclamation district created by Texas legislation. LCRA is responsible for the conservation, control, and preservation of the waters of the Colorado River and its tributaries within a 10-county area. Given this responsibility but not land-use control authority, LCRA has developed a nonpoint source pollution control ordinance with a technology-based approach.

The ordinance requires a large percentage of the pollutants generated from new development to be removed before stormwater discharge from the property. A technical manual accompanies the ordinance and explains how to calculate the expected increase in pollution and the various management practices a developer may employ to achieve the required pollutant removal standards. The developer and engineer determine what combination of management practices are most compatible with their site and development plan.

This paper provides the methodology and primary features of the ordinance and technical manual. The reasoning behind this approach is explained, with discussion regarding the strengths and weaknesses of a technology-based ordinance.

Introduction

The Lower Colorado River Authority (LCRA) is a conservation and reclamation district created by the Texas legislature in 1934. LCRA is also a self-sufficient public utility company. The authority's responsibilities are many and include energy generation, water supply, flood control, management of certain public lands, and preservation and conservation of the waters of the lower Colorado River.

While given these responsibilities, LCRA has limited authority and can only exercise powers expressly given by the legislature. As such, LCRA cannot regulate land use, impose zoning or site development restrictions, or assess taxes. LCRA can, however, promulgate ordinances to control water pollution within its 10-county statutory area.

With these powers and limitations, LCRA has developed an ordinance to control nonpoint source (NPS) pollution from urban development. The ordinance does not impose any land-use regulations other than to establish a technology-based pollutant reduction standard for new development.

Background

In 1988, the LCRA board of directors approved a water quality leadership policy stating LCRA's goals regarding water quality protection. This policy directed staff to develop a program to control NPS pollution within the 10-county area, commencing with the area of the Highland Lakes.

The Highland Lakes are a chain of seven lakes located west of Austin, Texas. The lakes were created in the 1930s and 1940s for flood control, water supply, and hydroelectric generation. In the early 1980s, the area around the lakes experienced tremendous growth in development activity. This growth prompted concern about the long-term health of the lakes.

A Pollution Control Approach

From the outset, LCRA was limited in the number of options available to manage development for control of NPS pollution. We realized, however, that it must be attacked in several ways. The initial effort was a public education program, the highlight of which was a 30-minute video entitled, "Pointless Pollution: America's Water Crisis," narrated by Walter Cronkite.

Realizing that public education alone would not protect water quality, LCRA staff began addressing the control of NPS pollution through a regulatory program. Lacking land-use control or zoning power, LCRA selected a strategy to reduce the quantity of pollution generated by new development that would otherwise be received by the lakes.

In December 1989, the LCRA board of directors adopted the Lake Travis NPS Pollution Control Ordinance, the first of its kind ever promulgated by a river authority in the state of Texas. In March 1991, a similar ordinance was passed to cover the upper Highland Lakes, which includes Lakes Buchanan, Inks, LBJ, and Marble Falls.

A Nonpoint Source Control Ordinance

The main strategy of the Lake Travis NPS Pollution Control Ordinance is to establish a set of pollution reduction performance standards. Pollution reduction would be through three methods: 1) removal of a specified percentage of the projected increase in annual NPS pollution load; 2) streambank erosion protection via stormwater detention requirements; and 3) employment of erosion controls during construction.

Pollution Reduction Standards

LCRA's primary goal was to develop a pollution prevention strategy to protect the lakes. At the same time, consideration was given to producing feasible standards that would not prevent development activity.

The basic requirement of the ordinance is the removal of 70 percent or more of the increased pollution generated over background or undeveloped conditions. Higher removal rates are required for steeply sloped property or land located adjacent to the lakes. The required removal rates were chosen first from a water quality standpoint, but also were considered feasible. Analysis of existing developments and the anticipated performance of best management practices (BMPs) showed possibilities of significant land-use restriction if higher removal standards were employed. Additionally, members of LCRA's board of directors represent their respective counties or service areas, a majority of which are predominantly rural. While the board adopted an environmental leadership policy, its concern about imposing regulations that could adversely affect local economic development was clear.

Streambank Erosion Control

Urbanization of a site or area can have a great impact on the downstream conveyance system. As pavement and rooftops replace the natural soil and vegetative cover, the magnitude and frequency of runoff increases dramatically.

Just as runoff from an undeveloped watershed has carved out a stream channel over time to convey typical runoff events, the increased volume and frequency of runoff from an urbanized area will reconfigure the streambank to create a larger conveyance system. The result is erosion of streambanks transporting sediment to receiving water bodies, degrading of undercut streams, removal of aquatic habitat, and loss of public and private property.

The approach LCRA has taken to control streambank erosion is to require detainment of postdeveloped runoff to predeveloped runoff conditions for the 1-year design storm. Stream morphology is generally dictated by the 2-year storm event.

To simplify the permitting process, the technical manual provides the required detention volume in inches of runoff as a function of impervious cover. These detention volume requirements can be incorporated into the use of BMPs to meet the pollutant removal performance standards.

Temporary Erosion Control

The ordinance requires erosion and sedimentation to be controlled throughout the development process. For permitted activities, an erosion control plan is required for review and approval. Activities not requiring a permit, such as the construction of a single-family home, also require erosion controls to be in place until revegetation occurs.

The technical manual provides guidance for appropriate erosion controls. These strategies include minimization of area cleared; physical controls such as silt fences, brush berms, and rock berms; downstream vegetative buffers; diversion of upstream flow; flow spreading; contour furrowing; loose straw or jute netting for soil protection; and use of structural BMPs as sedimentation basins during construction.

Technical Manual

The ordinance is accompanied by a technical manual that provides explanation and guidance for the applicant or engineer. Included in the technical manual are permitting procedures, pollutant loading calculations, and design standards and efficiencies of management practices.

Types of Pollution

Urbanization causes numerous forms of pollution. Analysis of all pollutant elements through a permitting program would encumber both the applicant and review body. LCRA has classified these forms of pollution into three distinct groups important to the protection of the lakes: sedimentation, eutrophication, and toxins. LCRA *then selected* an *indicator* pollutant to represent these categories. Indicator pollutants are total suspended solids (TSS) for sedimentation, total phosphorus (TP) for eutrophication, and oil and grease (O&G) for toxins.

- TSS consist of colloidal and settleable particulate matter. In alkaline waters such as those of the Highland Lakes, metals tend to precipitate and become particulate matter. In addition, some organic compounds such as chlordane and polychlorinated biphenyls tend to be adsorbed onto sediment particles.
- TP can be indicative of other nutrients. While the nitrogen cycle is different, plant and microbial uptake occurs for both elements.
- O&G, while encompassing both nontoxic and toxic organic compounds, represents petroleum hydrocarbon pollutants, including carcinogens such as benzene and toluene and chlorinated compounds such as pesticides and herbicides.

These indicator pollutants are used to represent the array of pollutants generated. It is reasonable to assume that removal of these indicator pollutants will result in removal of other pollutants not specifically analyzed.

Pollutant Loads

A mass loading equation is used to calculate the pollutant load under existing and developed conditions. This determines the increase in pollution generated over background conditions. The equation is a product of annual runoff volume and the average stormwater pollutant concentration.

The pollutant load is calculated in pounds per year and is represented as follows:

$$L = A * RF * Rv * C * K,$$

where L = annual pollutant load (pounds)
A = area of development (acres)
RF = average annual rainfall (inches)
Rv = average runoff-to-rainfall ratio
C = average pollutant concentration (mg/L)
K = unit conversion factor (0.2266)

The runoff-to-rainfall ratio equation used is as presented in the Metropolitan Washington Council of Governments document *Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMPs.* This regression equation simplifies the runoff-to-rainfall relationship to a function of impervious cover as follows:

$$Rv = 0.05 + (0.009 * IC),$$

where IC is impervious cover in percent

Background and developed pollutant concentrations for the indicator pollutants are provided. These values were acquired primarily from screening local and national reports. The average pollutant concentrations used for indicator pollutants under background and developed conditions are shown in Table 1.

Table 1. Average Pollutant Concentrations for Indicator Pollutants

	Background (mg/L)	Developed (mg/L)
TSS	48	130
TP	0.08	0.26
O&G	0	15

The manner in which this information is supplied within the technical manual results in reasonable estimates of a development's potential pollution impact while making calculations simple and consistent.

Selection of Management Practices

The technical manual provides design criteria and estimated removal efficiencies for BMPs. The manual is intended to provide guidance to the applicant in selecting BMPs. The applicant must select the BMPs that will enable the development to meet the criteria of the ordinance. The basic strategy for selecting BMPs is to match the pollutant removal requirements with site and development characteristics. Consideration must be given to drainage area, soil type, and topography to select BMPs effectively.

The technical manual provides the expected removal efficiencies for BMPs with a performance history. Most of this data is based on criteria presented in nationally published documents. For structural BMPs, a percent removal efficiency is provided for each indicator pollutant. This is then multiplied by the percent of the total average annual runoff volume to be captured by the proposed BMP. The product is the expected removal efficiency of that BMP. This is done for each indicator pollutant. The analysis and performance standard for O&G is applied only to developments other than single-family residential use. The focus on O&G is on commercial land and parking lots instead of single-family residential neighborhoods. Efficiencies used for each BMP are shown in Table 2.

Other BMPs for which removal efficiencies are provided include vegetated filter strips, street sweeping, and pollution source removal credit for using an integrated pest management plan.

The manual promotes the use of innovative practices as long as the applicant can document the potential effectiveness of the practice. LCRA may also require, by ordinance,

Table 2. **Expected Removal Efficiencies of Selected BMPs**

Best Management Practice	Pollutant TSS	TP	O&G
Sedimentation basin	60	20	10
Sand filtration	70	33	30
Extended detention	70	60	30
Retention basin	80	80	80
Infiltration practices	80	80	80

that innovative BMPs be monitored at a cost borne by the applicant. Some innovative practices include water quality catch basins (oil/grit separators), peat/sand filters, zeolite filters, and wet ponds. While wet ponds have a proven track record in portions of the United States, their performance, and more particularly their maintenance requirements, in semiarid regions warrants further scrutiny.

BMPs in Series

Based on the removal efficiencies of known BMPs and the removal requirements of the ordinance, development with moderate or high impervious cover may need to provide BMPs in series to meet the ordinance performance standards. One of the unknowns at this juncture is how BMPs operate in series. LCRA currently assumes that the total removal is the sum of the individual BMP removal performances. This is an assumption that warrants further analysis from monitoring BMPs in series.

Example of Ordinance Application

A commercial establishment desires to develop 200,000 ft^2 of retail space and is looking at a 23-acre undeveloped site in the Austin, Texas, area. What would be required for the development to meet LCRA's NPS ordinance?

The site plan layout shows parking for 1,200 vehicles. With access drives and loading areas, the impervious cover provided for vehicular traffic is about 400,000 ft^2. The proposed total impervious cover is 600,000 ft^2, or 60 percent of the site area.

The average annual rainfall in Austin is 32.5 in. Applying the pollutant load calculations shown in the technical manual,

$$L = A * RF * Rv * 0.2266 * C,$$

yields the average pollutant concentrations shown in Table 3.

With a pollutant removal standard for the site of 70 percent:

Table 3. **Pollutant Concentrations for Austin Example Site**

	Background (mg/L)	Developed (mg/L)
TSS	407	12,992
TP	0.68	26.0
O&G (calculated for paved area only, at 100% IC)	0	963

- TSS removal = (12,992 - 407) * 0.70 = 8,810 lb
- TP removal = (26.0 - 0.68) * 0.70 = 17.7 lb
- O&G removal = (963 - 0) * 0.70 = 674 lb

The applicant proposes a weekly street sweeping program for general maintenance of the area. The pollutant removal efficiencies assumed for this practice with a vacuum-type sweeper are 20 percent for TSS, 10 percent for TP, and 15 percent for O&G.

The site is gently sloping and does have adequate soil for percolation. Infiltration is desirable; however, it must be preceded by a sediment removal practice according to the technical manual.

To meet the streambank erosion control criteria, a site with 60 percent IC must provide detention for 1 in. of runoff. Therefore, structural BMPs should be sized to also meet this criteria.

The designer decides to try a sedimentation basin followed by an infiltration basin. With 60 percent IC, a 1-in. capture volume will collect 89.7 percent of the average annual runoff based on historical rainfall data and runoff/rainfall relationships. The removal efficiencies of these ponds are the product of the BMP efficiency and percent of average annual runoff captured, as shown in Table 4.

Table 4. **Remove Efficiencies of Sedimentation Basin and Infiltration Basin BMPs**

Sedimentation Basin	Infiltration Basin
TSS - 0.60 * 0.897 = 53.7 %	TSS - 0.80 * 0.897 = 71.6 %
TP - 0.20 * 0.897 = 17.9 %	TP - 0.80 * 0.897 = 71.6 %
O&G - 0.10 * 0.897 = 9.0 %	O&G - 0.80 * 0.897 = 71.6 %

To test whether the above controls would meet the ordinance's performance standard requirements, the following equation is used:

$$\text{Total BMP Series Eff.} = [1-((1-E_1)*(1-E_2)*(1-E_3))]*100$$

where

E_1 = removal efficiency of first BMP
E_2 = removal efficiency of second BMP
E_3 = removal efficiency of third BMP

TSS Eff. (total) = [1-((1-0.2)*(1-0.537)*(1-0.716))]*100 = 89.5 percent

TP Eff. (total) = [1-((1-0.1)*(1-0.179)*(1-0.716))]*100 = 79.0 percent

O&G Eff. (total) = [1-((1-0.15)*(1-0.09)*(1-0.716))]*100 = 78.0 percent

Therefore, the above controls would meet the performance standard requirements of the ordinance. Had infiltration not been a viable option, other potential solutions include 1) a street sweeping program with a 1-in. volume extended detention basin followed by 8.4 acres of vegetative filter strip (fair condition, 2- to -7 percent slope) or 2) a street sweeping program with three extended detention ponds, each of 2-in. capture volume.

Administration

Maintenance Agreements

Maintenance of BMPs is critical to their long-term performance. Without maintenance, the effective life of a BMP may be limited to a couple of years. Relying on good faith or volunteer efforts has not shown to be an effective way to maintain these pollution controls.

The ordinance requires that a NPS Best Management Practice Maintenance Permit be issued upon acceptable completion of construction. Whether through a homeowner's association or through the land owner as an individual, a maintenance association must be formed. The maintenance association is to post financial security or create a fund for the purpose of maintaining all BMPs implemented to meet the ordinance.

Enforcement

A necessary portion of any regulatory program is the ability to impose penalties for not complying with the regulations. The ordinance contains a violations section that allows financial penalties to be imposed for violations of a provision of the ordinance.

Case Application

The ordinance is relatively new, and there have been few opportunities to evaluate its effectiveness. Two projects of note have shown the impact that the ordinance has had on development.

LCRA Office Complex

The first project of note is construction of LCRA's general office buildings. While not located in an area under the purview of the ordinance, LCRA chose to make a leadership statement by applying ordinance standards to the office complex.

The offices are located on 11.7 acres of land and consist of 250,000 ft^2 of office space with close to 600 parking spaces. Site IC is approximately 55 percent. Due to site constraints, innovation had to be applied to achieve the performance standards of the ordinance.

A series of BMPs are employed on the site, including a full integrated pest management and xeriscape plan, a street sweeping program, five surface ponds composed of extended detention ponds, a peat/sand filter, and an enhanced (partial wet pond) extended detention pond. There are also subsurface treatment devices that include off-line water quality catch basins conveying to a sand filtration system beneath a parking lot and peat/sand filtering system under an open-space front yard area. Infiltration practices could not be used due to soil conditions. LCRA has acquired grants from the U.S. Environmental Protection Agency to monitor the effectiveness of some of the innovative practices being applied on this project.

The total construction cost associated with the NPS controls on this project was $250,000. This represents about 1.5 percent of the total project cost.

Sun City Development

The Del Webb Corporation is in the planning stages of developing a 2,400-acre active adult community west of Austin, Texas. The project is within the jurisdiction of the Lake Travis NPS Pollution Control Ordinance. Del Webb is presently going through a master plan approval phase with LCRA.

The development is predominantly single-family residential and entails 4,200 single-family homes with recreational amenities. The overall proposed IC for the site is slightly less than 30 percent. The project has incorporated in the preliminary design 60 to 70 structural BMPs to meet the performance requirements of the ordinance. Over 90 percent of the runoff from the development will convey to a structural BMP of some form. The structural practices proposed include extended detention ponds, wet ponds, retention ponds, sedimentation ponds, and infiltration practices. These structural facilities take up 5 percent of the total land area.

In addition, the development includes a roadway system that has vegetated filter strips throughout and grass-lined swales for stormwater conveyance. Commercial areas include a street sweeping program, and areas left as native open space receive credit for pollution reduction as low-maintenance landscapes.

The cost of meeting the performance standards of the ordinance has been estimated by the applicant to be about $1,300 per single-family home. It is quite possible that an economy of scale is realized, as studies before ordinance implementation estimated a per-unit cost of almost twice this amount for developments of similar net density.

Pros and Cons

The quality of any development management strategy has to be measured on the basis of what it achieves versus the impacts it may create.

Strengths of a Technology-Based Approach

A technology-based approach to control NPS pollution from urbanization has several strengths. The first is the transferability of this approach to other jurisdictions. Creating pollution reduction strategies of this kind can be applied on a city, county, watershed, or statewide basis. The only variables may be in the selection of BMPs that are compatible with a region and the percentage of annual runoff captured based on rainfall patterns.

Implementing land-use restrictions from a density or IC standpoint can be difficult due to public opposition. The technology-based approach gives the landowner the freedom to determine the highest use of the land with consideration given to the increasing costs of providing and maintaining additional BMPs to compensate for dense development. It is theoretically possible for a landowner to use every square inch of land for development purposes if the developer is willing to incur the increased cost of subsurface stormwater treatment or even mechanical treatment.

The standards for achieving compliance with a technology-based ordinance are clear. The approach is simple, with straightforward calculations. This cookbook approach minimizes staffing requirements for review of applications.

Density or IC limitations are a best management practice. More pollution could be discharged, however, from a less dense development with no other BMPs than from a more intense development with BMPs. There is also concern that density controls contribute to urban sprawl, which may result in poorer water quality on a regional basis and may adversely affect air quality through increased vehicular operating time.

Finally, there is no question that implementation of this technology-based practice mitigates some of the water quality impacts associated with urbanization.

Weaknesses of a Technology-Based Approach

The sole use of a technology-based pollution reduction strategy has weaknesses as well. First and foremost is the full reliance on this new technology to maintain a high level of pollution removal over the long term. Recognition of the requirements for maintaining these facilities at their expected performance standards over the long term has yet to occur.

Notwithstanding the urban sprawl issue, there is no question that on a site-specific basis the reduction of IC and maintenance of land in a natural vegetative state are more foolproof means of reducing pollution from that site.

The technology-based approach only considers water quality issues. Land use is at the disposal of the landowner. There are locations where aesthetics, views, and protection of existing vegetation and habitat are equally as important as the quality of water. This ordinance does not directly address these other considerations.

Conclusion

LCRA considers the NPS ordinance to be an excellent beginning in protecting the quality of the waters of the Highland Lakes and Colorado River. Close to a million people rely on the Highland Lakes for drinking water supply and countless thousands for recreational and aesthetic purposes.

LCRA is committed to evaluating the effectiveness of this ordinance. Depending on the actual development that takes place around the Highland Lakes, the actual pollution removal achieved, and the change in water quality evidenced, more or less restrictive standards or alternate practices may be required. The effectiveness of the ordinance must be analyzed as development takes place to ensure good water quality.

There are limitations in our knowledge of BMPs and of pollution generation from various land uses. The current version of the technical manual is already in need of revision to account for research performed over the last few years. The calculations do not adequately address certain land uses, such as golf courses, nurseries, or parks, due to the low IC yet high maintenance associated with these land uses, particularly as they pertain to pesticides and nutrients.

Finally, it is LCRA's desire to ultimately connect the pollution removal standards of the ordinance to established water quality standards of the receiving waters. There is much work to be performed before a full understanding of the dynamics of the lakes and Colorado River permit us to achieve this goal.

New Development Standards in the Puget Sound Basin

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Abstract

The Puget Sound Water Quality Management Plan (PSWQMP) calls for all counties and cities in the Puget Sound drainage basin to adopt ordinances that require stormwater control for new development and redevelopment. Ordinances were to be adopted by July 1, 1994. The PSWQMP also directed the Washington Department of Ecology to prepare technical guidance and a model ordinance to assist local governments in implementing these standards.

In response, the Department of Ecology has prepared several sets of minimum requirements that are applied based on the type and size of proposed development. These include:

- Simplified erosion and sediment controls and a small parcel erosion and sediment control plan for small developments (under 5,000 ft^2 impervious surface), single-family homes, and land-disturbing activities under 1 acre.
- A set of 11 minimum requirements for proposed new development of large parcels (5,000 ft^2 impervious surface and greater) and/or land-disturbing activities over 1 acre. The requirements include erosion and sediment control, and source control and treatment best management practices designed to prevent or minimize impacts to receiving waters. A stormwater site plan is also required for this level of development.
- The same 11 requirements apply to large parcels with less than 1 acre of land-disturbing activities except that the small parcel erosion and sediment requirements are substituted for the large parcel erosion and sediment controls.

If redevelopment is proposed, the same minimum requirements apply, subject to a set of thresholds and criteria for applying the minimum requirements to all or part of the site.

Introduction

Puget Sound, which is located in western Washington State, has been the focus of a comprehensive water quality improvement effort in recent years—especially since documentation of liver tumors in English sole and toxics in sediments and with increasing closures of shellfish beds (1). Initial efforts culminated in 1986, with the publication of the *Puget Sound Water Quality Management Plan* (PSWQMP) and subsequent amendments in 1989 and 1991 (2). In 1991, Puget Sound was listed as an Estuary of National Significance under Section 320 of the federal Clean Water Act.

The section of the PSWQMP that covers stormwater management calls for all counties and cities in the Puget Sound drainage basin to adopt ordinances that require stormwater control for new development and redevelopment by July 1, 1994. The plan also requires all local governments in the basin to adopt operation and maintenance programs for new and existing public and private stormwater systems. Local governments located within census-defined urbanized areas have additional requirements that include:

- Identification and ranking of significant pollutant sources.
- Corrective actions for problem drains.
- A water quality response program.
- Assurance of funding.
- Local coordination.
- Public education.
- Compliance measures.
- An implementation schedule.
- As a last resort in problem areas, retrofitting of control measures.

The PSWQMP also directed the Washington State Department of Ecology (Ecology) to prepare a best management practices (BMPs) technical manual (3) and a program guidance manual containing model ordinances and other supplemental guidance (4) to assist local governments in implementing plan requirements. The guidance prepared for new development and redevelopment consists of several sets of minimum requirements that are applied depending on the type and size of proposed development. In summary, these include:

- Simplified erosion and sediment controls (ESCs) and a small parcel ESC plan for small developments (under 5,000 ft^2 impervious surface), detached single-family homes and duplexes, and land-disturbing activities under 1 acre.
- A set of 11 minimum requirements for proposed new development of large parcels (5,000 ft^2 impervious surface and greater) and/or land-disturbing activities over 1 acre. The requirements include ESC and source control and treatment BMPs designed to prevent or minimize impacts to receiving waters. A stormwater site plan is also required for this level of development.
- The same 11 requirements apply to large parcels with less than 1 acre of land-disturbing activities except that the small parcel ESC are substituted for the large parcel ESCs.

If redevelopment is proposed, the same minimum requirements apply, subject to a set of thresholds and criteria for applying the minimum requirements to all or part of the site.

The BMP manual that Ecology prepared contains a full description of the minimum requirements and technical guidance on how to meet them. In essence, development sites are to demonstrate compliance with the requirements by preparing and implementing a stormwater site plan that includes an appropriate selection of BMPs from the manual.

Two major components of a stormwater site plan are an ESC plan and a permanent stormwater quality control (PSQC) plan. The ESC plan is intended to be temporary in nature to control pollution generated during the construction and landscaping phase only, primarily erosion and sediment. The PSQC plan is intended to provide permanent BMPs for the control of pollution and other impacts from stormwater runoff after construction is completed. For small sites, this is met by implementing a small parcel erosion and sediment control (SPESC) plan.

Further details of these plans are contained in the *Stormwater Management Manual for the Puget Sound Basin* (3).

The following sections describe the minimum requirements as they apply to local governments in the Puget Sound basin and have been adapted directly from the technical manual (3). The description also includes several associated requirements specific to Washington laws; therefore, some modifications would be needed for application of the minimum requirements to areas outside of Washington. The model ordinance that was prepared as guidance for enacting the minimum requirements is contained in the program guidance manual (4). The full guidance package may be ordered from Ecology by calling (206) 438-7116. The current cost of the technical manual is $24.85 plus postage, and of the program guidance manual is $28.00 plus postage.

Definitions

The following definitions are useful to the understanding of the minimum requirements:

- *Approved manual:* A technical manual that is substantially equivalent to the *Stormwater Management Manual for the Puget Sound Basin* (3). (The PSWQMP requires all counties and cities located in the Puget Sound basin to adopt a manual that is the same or substantially equivalent to this manual by July 1, 1994.)
- *New development:* Development consisting of land-disturbing activities; structural development, including construction, installation or expansion of a building or other structure; creation of impervious surfaces; Class IV general forest practices that are conversions from timber land to other uses; and subdivision and short subdivision of land as defined in RCW 58.17.020. All other forest practices and commercial agriculture are not considered new development.
- *Redevelopment:* On an already developed site, the creation or addition of impervious surfaces; structural development including construction, installation, or expansion of a building or other structure, and/or replacement of an impervious surface that is not part of a routine maintenance activity; and land-disturbing activities associated with structural or impervious redevelopment.
- *Impervious surface:* A hard surface that either prevents or retards the entry of water into the soil mantle as under natural conditions prior to development, and/or a hard surface area that causes water to run off the surface in greater quantities or at an increased rate of flow from the flow present under natural conditions prior to development.
- *Land-disturbing activity:* Any activity that results in a change in the existing soil cover (both vegetative and nonvegetative) and/or the existing soil topography. Land-disturbing activities include, but are not limited to, demolition, construction, clearing, grading, filling, and excavation.
- *Source control BMP:* A BMP that is intended to prevent pollutants from entering stormwater. Examples include covering an activity, controlling erosion,

directing wash water to a sanitary sewer, and altering a practice that results in pollution prevention.

Exemptions

Commercial agriculture and forest practices regulated under Title 222 WAC, except for Class IV general forest practices that are conversions from timber land to other uses, are exempt from the provisions of the minimum requirements. All other new development is subject to the minimum requirements.

Small Parcel Minimum Requirements

The following new development shall be required to control erosion and sediment during construction, to permanently stabilize soil exposed during construction, to comply with Small Parcel Requirements 1 through 5, and to prepare a SPESC plan:

- Individual, detached single-family residences and duplexes.
- Creation or addition of less than 5,000 ft^2 of impervious surface area.
- Land-disturbing activities of less than 1 acre.

Supplemental Guidelines

The objective of these requirements is to address the cumulative effect of sediment coming from a large number of small sites. The SPESC plan is meant to be temporary in nature to deal with erosion and sediment generated during the construction phase only. Local governments may choose to apply additional permanent, site-specific stormwater controls to small parcels.

Small Parcel Requirement 1: Construction Access Route

Construction vehicle access shall be limited to one route whenever possible. Access points shall be stabilized with quarry spall or crushed rock to minimize the tracking of sediment onto public roads.

Small Parcel Requirement 2: Stabilization of Denuded Areas

All exposed soils shall be stabilized by suitable application of BMPs, including but not limited to sod or other vegetation, plastic covering, mulching, or application of ground base on areas to be paved. All BMPs shall be selected, designed, and maintained in accordance with an approved manual. From October 1 through April 30, no unworked soils shall remain exposed for more than 2 days. From May 1 through September 30, no unworked soils shall remain exposed for more than 7 days.

Small Parcel Requirement 3: Protection of Adjacent Properties

Adjacent properties shall be protected from sediment deposition by appropriate use of vegetative buffer strips, sediment barriers or filters, dikes or mulching, or by a combination of these measures and other appropriate BMPs.

Small Parcel Requirement 4: Maintenance

All ESC BMPs shall be regularly inspected and maintained to ensure continued performance of their intended function.

Small Parcel Requirement 5: Other BMPs

As required by the local plan-approval authority, other appropriate BMPs to mitigate the effects of increased runoff shall be applied.

Application of Minimum Requirements for New Development and Redevelopment

New Development

All new development that includes the creation or addition of 5,000 ft^2 or greater of new impervious surface area and/or land-disturbing activities of 1 acre or greater shall comply with Minimum Requirements 1 through 11 below and be in agreement with a stormwater site plan.

All new development that includes the creation or addition of 5,000 ft^2 or more of new impervious surface area and land-disturbing activities of less than 1 acre shall comply with Minimum Requirements 2 through 11 below and the Small Parcel Minimum Requirements listed above. This category of development requires preparation of a stormwater site plan that includes a SPESC plan.

Redevelopment

Where redevelopment of 1 acre or greater occurs, new development Minimum Requirements 1 through 11 apply to that portion of the site that is being redeveloped, and source control BMPs shall be applied to the entire site, including adjoining parcels if they are part of the project.

Where one or more of the following conditions apply, a stormwater site plan shall be prepared that includes a schedule for implementing Minimum Requirements 1 through 11 below to the maximum extent practicable for the entire site, including adjoining parcels if they are part of the project:

- Existing sites greater than 1 acre in size with 50 percent or more impervious surface.
- Sites that discharge to a receiving water that has a documented water quality problem.

- Sites where the need for additional stormwater control measures has been identified through a basin plan or other local planning activities.

Note: An adopted and implemented basin plan (Minimum Requirement 9) may be used to develop requirements that are tailored to a specific basin.)

Minimum Requirement 1: Erosion and Sediment Control

All new development and redevelopment that includes land-disturbing activities of 1 acre or more shall comply with Large Parcel ESC Requirements 1 through 15 below. Compliance shall be demonstrated through implementation of a Large Parcel ESC plan.

All proposed developments where land-disturbing activities 5,000 ft^2 and greater but less than 1 acre are planned shall implement the Small Parcel Minimum Requirements above, as well as Minimum Requirements 2 through 11 below.

Large Parcel ESC Requirement 1: Stabilization and Sediment Trapping

All exposed soils shall be stabilized by suitable application of BMPs. From October 1 to April 30, no unworked soils shall remain exposed for more than 2 days. From May 1 to September 30, no unworked soils shall remain exposed for more than 7 days. Prior to leaving the site, stormwater runoff shall pass through a sediment pond or sediment trap, or other appropriate BMPs shall be employed.

Supplemental Guidelines. This criterion applies both to soils not yet at final grade and soils at final grade. The type of stabilization BMP used may differ depending on the length of time that the soil is to remain unworked.

Soil stabilization refers to BMPs that protect soil from the erosive forces of raindrop impact, flowing water, and wind. Applicable practices include vegetative establishment, mulching, plastic covering, and the early application of gravel base on areas to be paved. Soil stabilization measures should be appropriate for the time of year, site conditions, and estimated duration of use. Soil stockpiles must be stabilized or protected with sediment trapping measures to prevent soil loss, including loss to wind.

These requirements are especially important in areas adjacent to streams, wetlands, or other sensitive or critical areas.

Large Parcel ESC Requirement 2: Delineated Clearing and Easement Limits

In the field, clearing limits and/or any easements, setbacks, sensitive/critical areas and their buffers, trees, and drainage courses shall be marked.

Large Parcel ESC Requirement 3: Protection of Adjacent Properties

Properties adjacent to the project site shall be protected from sediment deposition.

Supplemental Guidelines. This may be accomplished by preserving a well-vegetated buffer strip around the lower perimeter of the land disturbance; by installing perimeter controls such as sediment barriers, filters or dikes, or sediment basins; or by using a combination of such measures.

Vegetated buffer strips may be used alone only where runoff in sheet flow is expected. Buffer strips should be at least 25 ft wide. If at any time the vegetated buffer strip alone is found to be ineffective in stopping sediment movement onto adjacent property, additional perimeter controls must be provided.

Large Parcel ESC Requirement 4: Timing and Stabilization of Sediment Trapping Measures

Sediment ponds and traps, perimeter dikes, sediment barriers, and other BMPs intended to trap sediment on site shall be constructed as a first step in grading. These BMPs shall be functional before land-disturbing activities take place. Earthen structures such as dams, dikes, and diversions shall be seeded and mulched according to the timing indicated in Large Parcel ESC Requirement 1.

Large Parcel ESC Requirement 5: Cut and Fill Slopes

Cut and fill slopes shall be designed and constructed in a manner that minimizes erosion. In addition, slopes shall be stabilized in accordance with Large Parcel ESC Requirement 1.

Supplemental Guidelines. Consideration should be given to the length and steepness of the slope, the soil type, upslope drainage area, ground-water conditions, and other applicable factors. Slopes that are found to be eroding excessively within 2 years of construction must be provided with additional slope stabilizing measures until the problem is corrected.

Large Parcel ESC Requirement 6: Controlling Offsite Erosion

Properties and waterways downstream from development sites shall be protected from erosion due to increases in the volume, velocity, and peak flow rate of stormwater runoff from the project site.

Large Parcel ESC Requirement 7: Stabilization of Temporary Conveyance Channels and Outlets

All temporary onsite conveyance channels shall be designed, constructed, and stabilized to prevent erosion from the expected velocity of flow from a 2-year, 24-hour frequency storm for the developed condition. Stabilization adequate to prevent erosion of outlets, adjacent streambanks, slopes, and downstream reaches shall be provided at the outlets of all conveyance systems.

Large Parcel ESC Requirement 8: Storm Drain Inlet Protection

All storm drain inlets made operable during construction shall be protected so that stormwater runoff shall not enter the conveyance system without first being filtered or otherwise treated to remove sediment.

Large Parcel ESC Requirement 9: Underground Utility Construction

The construction of underground utility lines is subject to the following criteria:

- Where feasible, no more than 500 ft of trench shall be opened at one time.
- Where consistent with safety and space considerations, excavated material shall be placed on the uphill side of trenches.
- Trench dewatering devices shall discharge into a sediment trap or sediment pond.

Large Parcel ESC Requirement 10: Construction Access Routes

Wherever construction vehicle access routes intersect paved roads, provisions must be made to minimize the transport of sediment (mud) onto the paved road. If sediment is transported onto a road surface, the roads shall be cleaned thoroughly at the end of each day. Sediment shall be removed from roads by shoveling or sweeping and shall be transported to a controlled sediment disposal area. Street washing shall be allowed only after sediment is removed in this manner.

Large Parcel ESC Requirement 11: Removal of Temporary BMPs

All temporary erosion and sediment control BMPs shall be removed within 30 days after final site stabilization is achieved or after the temporary BMPs are no longer needed. Trapped sediment shall be removed or stabilized on site. Disturbed soil areas resulting from removal shall be permanently stabilized.

Large Parcel ESC Requirement 12: Dewatering Construction Sites

Dewatering devices shall discharge into a sediment trap or sediment pond.

Large Parcel ESC Requirement 13: Control of Pollutants Other Than Sediment on Construction Sites

All pollutants other than sediment that occur on site during construction shall be handled and disposed of in a manner that does not cause contamination of stormwater.

Large Parcel ESC Requirement 14: Maintenance

All temporary and permanent erosion and sediment control BMPs shall be maintained and repaired as needed to ensure continued performance of their intended function. All maintenance and repair shall be conducted in accordance with an approved manual.

Large Parcel ESC Requirement 15: Financial Liability

Performance bonding or other appropriate financial instruments shall be required for all projects to ensure compliance with the approved ESC plan.

Minimum Requirement 2: Preservation of Natural Drainage Systems

Natural drainage patterns shall be maintained and discharges from the site shall occur at the natural location to the maximum extent practicable.

Supplemental Guidelines

Natural drainage systems provide many water quality benefits and should be preserved to the fullest extent possible. In addition to conveying and attenuating stormwater runoff, these systems are less erosive, provide ground-water recharge, and support important plant and wildlife resources. Effective use of the natural system can maintain environmental and aesthetic attributes of a site as well as be a cost-effective measure to convey stormwater runoff.

Creating new drainage patterns requires more site disturbance and can upset the stream dynamics of the drainage system, thus tending to increase erosion and sedimentation. Creating new discharge points can create significant streambank erosion problems because the receiving water body typically must adjust to the new flows. Newly created drainage patterns seldom, if ever, provide the multiple benefits of natural drainage systems. Where no conveyance system exists at the adjacent downstream property line and the discharge was previously unconcentrated flow or significantly lower concentrated flow, then measures must be taken to prevent downstream impacts. Necessary drainage easements may need to be obtained from downstream property owners.

Minimum Requirement 3: Source Control of Pollution

Source control BMPs shall be applied to all projects to the maximum extent practicable. Source control BMPs shall be selected, designed, and maintained according to an approved manual.

An adopted and implemented basin plan (Minimum Requirement 9) may be used to develop source control requirements that are tailored to a specific basin; however, in all circumstances, source control BMPs shall be required for all sites.

Objective

The intention of source control BMPs is to prevent stormwater from coming in contact with pollutants. A cost-effective means of reducing pollutants in stormwater, source control BMPs should be a first consideration in all projects.

Minimum Requirement 4: Runoff Treatment BMPs

All projects shall provide treatment of stormwater. Treatment BMPs shall be sized to capture and treat the water quality design storm, defined as the 6-month, 24-hour return period storm. The first priority for treatment shall be to infiltrate as much as possible of the water quality design storm, if site conditions are appropriate and ground water quality will not be impaired. Direct discharge of untreated stormwater to ground water can cause serious pollution problems. All treatment BMPs shall be selected, designed, and maintained according to an approved manual.

Stormwater treatment BMPs shall not be built within a natural vegetated buffer, except for necessary conveyance as approved by the local government.

An adopted and implemented basin plan (Minimum Requirement 9) may be used to develop runoff treatment requirements that are tailored to a specific basin.

Supplemental Guidelines

The water quality design storm (the 6-month, 24-hour design storm, in this instance) is intended to capture more than 90 percent of annual runoff.

Infiltration can provide both treatment of stormwater, through the ability of certain soils to remove pollutants, and volume control of stormwater, by decreasing the amount of water that runs off, to surface water. Infiltration can be very effective at treating stormwater runoff, but soil conditions must be appropriate to achieve effective treatment while not affecting ground-water resources. Methods currently in use, such as direct discharge into dry wells, do not achieve adequate water quality treatment.

Minimum Requirement 5: Streambank Erosion Control

The requirement below applies only to situations where stormwater runoff is discharged directly or indirectly to a stream, and must be met in addition to the requirements in Minimum Requirement 4, Runoff Treatment BMPs.

Stormwater discharges to streams shall control streambank erosion by limiting the peak rate of runoff from individual development sites to 50 percent of the existing condition, 2-year, 24-hour design storm while maintaining the existing condition peak runoff rate for the 10-year, 24-hour and 100-year, 24-hour design storms. As the first priority, streambank erosion control BMPs shall utilize infiltration to the fullest extent practicable, only if site conditions are appropriate and ground-water quality is protected. Streambank erosion control BMPs shall be selected, designed, and maintained according to an approved manual.

Stormwater treatment BMPs shall not be built within a natural vegetated buffer, except for necessary conveyance as approved by the local government.

An adopted and implemented basin plan (Minimum Requirement 9) may be used to develop streambank erosion control requirements that are tailored to a specific basin.

Supplemental Guidelines

This requirement is intended to reduce the frequency and magnitude of bankfull flow conditions, which are highly erosive and increase dramatically as a result of development. Conventional flood detention practices do not adequately control streambank erosion because only the peak rate of flow is decreased, not the frequency nor duration of bankfull conditions.

Reduction of flows through infiltration decreases streambank erosion and helps to maintain base flow throughout the summer months. Infiltration should only be used, however, where ground-water quality is not threatened by such discharges. The use of an artificial treatment system, such as an aquatard, should be considered in areas with highly permeable soils. Treatment of the water quality design storm must be accomplished before discharge to these soils. If highly permeable soils are present, they should be utilized for streambank erosion control by infiltrating flows greater than the water quality design storm.

Minimum Requirement 6: Wetlands

The requirements below apply only to situations where stormwater discharges directly or indirectly through a conveyance system into a wetland, and must be met in addition to the requirements in Minimum Requirement 4, Runoff Treatment BMPs:

- Stormwater discharges to wetlands must be controlled and treated to the extent necessary to meet state water quality standards.
- Discharges to wetlands shall maintain the hydroperiod and flows of existing site conditions to the extent necessary to protect the characteristic uses of the wetland. Prior to discharging to a wetland, alternative discharge locations shall be evaluated, and natural water storage and infiltration opportunities outside the wetland shall be maximized.
- Created wetlands that are intended to mitigate the loss of wetland acreage, function, and value shall not be designed to also treat stormwater.
- For constructed wetlands to be considered treatment systems, they must be constructed on sites that are not wetlands managed for stormwater treatment. If these systems are not managed and maintained in accordance with an approved manual for a period exceeding 3 years, these systems may no longer be considered constructed wetlands.
- Stormwater treatment BMPs shall not be built within a natural vegetated buffer, except for necessary conveyance as approved by the local government.

An adopted and implemented basin plan (Minimum Requirement 9) may be used to develop requirements for wetlands that are tailored to a specific basin.

Objective

This requirement seeks to ensure that wetlands receive the same level of protection as any other state waters. Wetlands are extremely important natural resources that provide multiple stormwater benefits, including ground-water recharge, flood control, and streambank erosion protection. Development can readily affect wetlands unless careful planning and management are conducted. Stormwater discharges from urban development due to pollutants in the runoff and also due to disruption of natural hydrologic functioning of the wetland system severely degrade wetlands. Changes in water levels and the duration of inundations are of particular concern.

Minimum Requirement 7: Water Quality Sensitive Areas

Where local governments determine that the minimum requirements do not provide adequate protection of water quality sensitive areas, either on site or within the basin, more stringent controls shall be required to protect water quality.

Stormwater treatment BMPs shall not be built within a natural vegetated buffer, except for necessary conveyance as approved by the local government.

An adopted and implemented basin plan (Minimum Requirement 9) may be used to develop requirements for water quality sensitive areas that are tailored to a specific basin.

Supplemental Guidelines

Water quality sensitive areas are areas that are sensitive to a change in water quality, including but not limited to lakes, ground-water management areas, ground-water special protection areas, sole source aquifers, critical aquifer recharge areas, well head protection areas, closed depressions, fish spawning and rearing habitat, wildlife habitat, and shellfish protection areas. Areas that can cause water quality problems, such as steep or unstable slopes or erosive stream banks, should also be included. Water quality sensitive areas may be identified through jurisdiction-wide inventories, watershed planning processes, local drainage basin planning, and/or on a site-by-site basis.

Minimum Requirement 8: Offsite Analysis and Mitigation

All development projects shall conduct an analysis of offsite water quality impacts resulting from the project and shall mitigate these impacts. The analysis shall extend a minimum of one-fourth of a mile downstream from the project. The existing or potential impacts to be evaluated and mitigated shall include, but not be limited to:

- Excessive sedimentation.
- Streambank erosion.
- Discharges to ground-water contributing or recharge zones.
- Violations of water quality standards.
- Spills and discharges of priority pollutants.

Minimum Requirement 9: Basin Planning

Adopted and implemented watershed-based basin plans may be used to modify any or all of the Minimum Requirements provided that the level of protection for surface or ground water achieved by the basin plan will equal or exceed that which would be achieved by the Minimum Requirements in the absence of a basin plan. Basin plans shall evaluate and include, as necessary, retrofitting of BMPs for existing development and/or redevelopment in order to achieve watershed-wide pollutant reduction goals. Standards developed from basin plans shall not modify any of the above requirements until the basin plan is formally adopted and fully implemented by local government. Basin plans shall be developed according to an approved manual.

Supplemental Guidelines

While Minimum Requirements 3 through 7 establish protection standards for individual sites, they do not evaluate the overall pollution impacts and protection opportunities that could exist at the watershed level. For a basin plan to serve as a means of modifying the Minimum Requirements, it must be formally adopted by all jurisdictions that have responsibilities under the basin plan, and construction and regulations called for by the plan must be complete; this is what is meant by an "adopted and implemented" basin plan.

Basin planning provides a mechanism by which the onsite standards can be evaluated and refined based on an analysis of an entire watershed. Basin plans are especially well suited to develop control strategies to address impacts from future development and to correct specific problems whose sources are known or suspected. Basin plans can be effective at addressing both long-term cumulative impacts of pollutant loads and short-term acute impacts of pollutant concentrations, as well as hydrologic impacts to streams and wetlands.

In general, the standards established by basin plans will be site-specific but may be augmented with regional solutions for source control (Minimum Requirement 2) and streambank erosion control (Minimum Requirement 4).

Minimum Requirement 10: Operation and Maintenance

An operation and maintenance schedule shall be provided for all proposed stormwater facilities and BMPs, and the party (or parties) responsible for maintenance and operation shall be identified.

Minimum Requirement 11: Financial Liability

Performance bonding or other appropriate financial instruments shall be required for all projects to ensure compliance with these requirements.

Exceptions

Exceptions to Minimum Requirements 1 through 11 may be granted prior to permit approval and construction. An exception may be granted following a public hearing, provided that a written finding of fact is prepared that addresses the following:

- The exception provides equivalent environmental protection and is in the public interest, and the objectives of safety, function, environmental protection and facility maintenance, based upon sound engineering, are fully met.
- Special physical circumstances or conditions affecting the property are such that strict application of these provisions would deprive the applicant of all reasonable use of the parcel of land in question, and every effort to find creative ways to meet the intent of the minimum standards has been made.
- The granting of the exception will not be detrimental to the public health and welfare, nor injurious to other properties in the vicinity and/or downstream nor to the quality of state waters.
- The exception is the least possible exception that could be granted to comply with the intent of the Minimum Requirements.

Supplemental Guidelines

The Plan Approval Authority is encouraged to impose additional or more stringent criteria as appropriate for its area. Additionally, criteria that may be inappropriate or too restrictive for an area may be modified through basin planning (Minimum Requirement 9). Modification of any of the Minimum Requirements that are deemed inappropriate for the site may be done by granting an exception.

The exception procedure is an important element of the plan review and enforcement programs. It is intended to maintain a flexible working relationship between local officials and applicants. Plan Approval Authorities should consider these requests judiciously, keeping in mind both the need of the applicant to maximize cost-effectiveness and the need to protect offsite properties and resources from damage.

References

1. PSWQA. 1988. State of the Sound report. Puget Sound Water Quality Authority, Olympia, WA (May).
2. PSWQA. 1992. Puget Sound water quality management plan. Puget Sound Water Quality Authority, Olympia, WA (February).
3. Washington State Department of Ecology. 1992. Stormwater management manual for the Puget Sound basin. Publication No. 91-75 (February).
4. Washington Department of Ecology. 1992. Stormwater guidance manual for the Puget Sound basin. Publication Nos. 92-32 (Vol. I) and 92-33 (Vol. II) (July).

Ordinances for the Protection of Surface Water Bodies: Septic Systems, Docks and Other Structures, Wildlife Corridors, Sensitive Aquatic Habitats, Vegetative Buffer Zones, and Bank/Shoreline Stabilization

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Introduction

Local government can substantially protect surface water bodies by enacting and enforcing appropriate ordinances. As part of its Surface Water Improvement and Management (SWIM) Program, the Southwest Florida Water Management District (SWFWMD) in consultation with advisory committees developed a list of seven issues that needed ordinance models. As a result, the SWFWMD outlined and funded a project for model ordinance development. The scope of the project included preparing model ordinance language to address seven specific issues, drafting individual papers addressing the ecological and legal significance of each issue, and developing a decision model for local government planners to use in determining the applicability or need for ordinance adoption. The private consulting firm Henigar and Ray, Inc., of Crystal River, Florida, developed under contract the model ordinances, issue papers, and decision model.

This paper highlights the results of and recommendations for ordinances addressing six of the seven project issues:

- Placement and maintenance of individual septic systems
- Regulation of docks and other appurtenance structures
- Establishment of wildlife corridors
- Protection of environmentally sensitive habitats
- Vegetative buffer zones
- Erosion control and bank stabilization

The seventh issue, "Stormwater Management and Treatment," is covered in other papers in this publication.

Because any ordinance is likely to face challenges, often from a number of opposing camps, issue papers were drafted to support an ecologically and legally defensible argument. While legal information contained in the detailed issue papers focuses on the Florida experience, the ecological arguments are valid over a much larger geographic area.

It is not possible to consider in detail the products of this project; however, this paper attempts to transfer the flavor and scope of information available on each of the issues. The paper provides an overview on the need/justification for a particular ordinance, mentions some of the technical issues that should be considered, and recommends necessary components of a viable ordinance. (The U.S. Environmental Protection Agency [EPA] is currently condensing the body of this work [1].)

Project History

The State of Florida passed the SWIM Act in 1987 establishing a program similar to the Clean Lakes Program but encompassing all surface waters (i.e., estuaries, rivers, springs, lakes, and swamps [2]). The Act mandated that each of the state's five water management districts develop a list of priority water bodies and begin developing management plans for each of them. Once a management plan received approval, monies from the SWIM Trust Fund could help implement projects outlined in the specific management plan for each water body.

During plan development for a number of water bodies, several advisory committees suggested that drafting and enacting ordinances at the local government level (municipality or county), particularly with regard to land development issues, could do much to protect water bodies from degradation. Such ordinances would be proactive in that they would avoid or minimize anticipated deleterious impacts. SWIM staff at the SWFWMD in consultation with various members of advisory committees identified the seven issues that required model ordinances.

Although passage of the SWIM Act gave the state's water management districts no new regulatory authority, the SWFWMD felt it was appropriate to develop model ordinances for consideration by local governments. Because enactment of ordinances that affect development are likely to invoke challenges, SWFWMD deemed it necessary not only to develop model ordinance language but also to develop "issue papers" detailing the ecological justifications for a given ordinance. Issue papers would also review similar ordinances already enacted in Florida and elsewhere (i.e., establish precedence) and consider the legality of enacting a particular ordinance. Henigar and Ray, Inc., employed the appropriate technical and legal authorities to draft the issue papers and ordinance language. The project resulted in a series of seven issue papers, five model ordinances, a decision model (planning document), and a report summarizing "The Law of Surface Water Management in Florida."

Placement and Maintenance of Individual Septic Systems (3)

Almost invariably when potential sources of pollutants to a water body are discussed, the topic of septic tanks arises. Many people assume that their septic systems are operating effectively simply because failure is not obvious (i.e., blocked plumbing, standing water over the drain field). As Brown (4) has pointed out, a system's technical failure (the inability to effectively process the waste) goes unnoticed; as long as the homeowner is not inconvenienced, the system usually remains unrepaired.

Septic systems can fail for two basic reasons: poor design or poor maintenance. Design includes not only the tank and drain field layout, but also the soils and hydrologic character of the site. Maintenance implies a periodic check and cleaning of the tank and possibly the drain field, and a consideration of the substances discharged to the system.

Effective treatment in the drain field requires soils of the proper permeability. For example, soils that are too permeable permit the tank effluent to travel too rapidly away from the drain field and do not allow for proper biologic treatment in the biomat. Alternately, impermeable soils become clogged with effluent, causing lateral or upward seepage. In the latter case, the homeowner may be inconvenienced, but in the former the owner may assume everything is working fine.

Soil absorption fields must lie above the surficial water table. If not, the system will cease to function effectively. An unsaturated zone ensures a desirable effluent velocity away from the drain field and good aeration in the zone where aerobic decomposition should occur. A typical onsite sewage disposal system (OSDS) ordinance might require, for example, a minimum of at least 24 in. between the bottom of the absorption (drain) field and the seasonal high water table. Virtually every Health and Rehabilitative Services (HRS) worker in Florida who is familiar with OSDS permitting can cite at least one example of a drain field totally submersed underwater during Florida's summer wet season.

Design, siting, and construction of a proper OSDS do not ensure proper long-term operation. Maintenance is absolutely necessary. The typical OSDS owner is often unknowledgeable regarding proper OSDS maintenance. In fact, many owners are unaware that septic tanks should be pumped out periodically to remove accumulated septage. Ayers and Associates (5) reported that it is "relatively common for homeowners to have never serviced the septic tank during their occupancy in the home."

Water conservation within the home can reduce waste flow and attendant pollutant load. This extends the life of the drain field, reduces system failures, and saves money by increasing the time between needed pumpouts. Low-flow toilets and shower heads and "graywater" reuse are examples of water conservation measures that can reduce potable water consumption. Siegrist (6) reported that eliminating the use of garbage disposals in connection with OSDSs could decrease the total suspended solids load by as much as 37 percent.

A host of findings in the literature support the development of ordinances to regulate septic systems. Interestingly, Cooper and Rezek (7) found that most of the heavy metals in the typical OSDS effluent stream originated from pigments used in cosmetics. In addition, EPA (8) found that compounds from septic tank cleaning solvents (i.e., methylene chloride and trichloroethane) actually hinder septic tank operation by killing bacteria that promote decomposition. Bicki et al. (9) concluded that nitrate-nitrogen contamination of ground water by OSDSs is a national problem and that high concentrations in many areas pose a health risk to infants. Yates and Yates (10) documented the extreme distances that certain microorganisms can move and remain viable. Certain viruses, because of their small size and long survival times, were found as far as a mile from their source in karst areas, an especially significant subsurface geologic feature in Florida.

Certain authors have also correlated septic tank density (allowable units per acre) with ground-water contamination (10, 11). Recommended acceptable densities vary greatly, with densities being a function of soils, depth to water table, and distance from surface water bodies.

Any entity considering a local ordinance to regulate septic tanks can, based on the literature, consider several options that might be more restrictive (protective) than existing regulations. These can relate to soils, depth to ground water, densities, and distance to surface water. These options may take the form of pumpout and inspection requirements, alternative septic systems, prohibitions (e.g., no garbage disposals), and even "moratoriums" in already contaminated or totally unsuitable areas.

Regulation of Docks and Appurtenance Structures (12)

Czerwinski and McPherson (12) thoroughly defined the various classes of docks and marinas (e.g., private single family, multislip residential, and commercial marinas). The intended use and size of a facility are important from both an impact and a regulatory standpoint, but space does not allow us to consider these in detail; the interested reader should consult the original document or the condensation being prepared by Simpson (1). To be effective, an ordinance must clearly define what is to be regulated. It is advantageous to include definitions within the body of the ordinance to avoid ambiguity that could seriously limit ordinance effectiveness.

The potential need to adopt an ordinance on a local level may be determined by considering projected increases in the number of registered boats in an area. As an example, in Florida there are approximately 48 boats per thousand residents. This reflects a 300-percent increase in the number of registered boats since 1964. Florida ranks fourth nationally in the number of registered boats, and the Florida Department of Natural Resources has projected a 48-percent increase to 712,349 boats by the year 2005 (13).

Environmental impacts associated with docks and appurtenance structures (e.g., boathouses, gazebos, and diving platforms) can be direct or indirect. Direct impacts relate to areas adjacent to and covered by these structures, and would typically include the transitional zone between the upland, wetland, and open water. The "littoral zones provide many valuable ecological functions, including flood storage, erosion and sedimentation control, filtration of surface water runoff, and essential habitat for flora and fauna" (12). Indirect effects, which are due to the attendant use of these structures, include effects attributable to outboard exhausts, fuel spills, sanitation facilities, and prop scour.

When regulating these structures, the actual construction materials should be considered. The list is long and varied. Wood is probably the most widely used material, particularly for single-family facilities. Whereas untreated wood is no match for the aquatic environment, chemically treated wood may last for 15 to 20 years without replacement. Chemicals used in treatment processes include ammoniacal copper arsenate (ACA), chromated copper arsenate (CCA), creosote-coal tar (CCT), acid copper chromate (ACC), chromated zinc chloride (CZC), fluorochrome arsenate phenol (FCAP), pentachlorophenol (which provides a clean, paintable surface), and creosote-petroleum solutions (14). "Although the pertinent regulatory agencies . . . test and register these substances as generally safe for use," Czerwinski and McPherson (12) concluded that "research conducted in preparation of this paper revealed little data or information on the biologic effects of wood preservatives on (nontarget) aquatic and marine organisms."

Other construction materials include steel, aluminum, reinforced concrete, fiberglass, and polyvinyl chloride (PVC). Styrofoam (expanded bead foam polystyrene) is still common in floating docks, although it may not be the most suitable floatation material available today. Unfortunately, bead foam polystyrene tends to break up easily, has a long life, and may be ingested by and be harmful to wildlife. In addition, chlorofluorocarbons are used in the manufacturing process. Safer but more expensive alternatives such as petroleum-resistant polystyrene and sealed solid (as opposed to extruded) foam are available.

Docks and appurtenance structures should not interfere with navigation. In Florida, for example, a dock is not considered a navigation hazard if it does not exceed 20 to 25 percent of the distance across the water body, is limited to the minimum distance necessary to provide reasonable access to navigable waters (which is generally defined to be approximately 4 ft below mean or ordinary low water), and does not infringe upon the main navigational channel or upon the riparian rights of adjacent property owners. For safety reasons, docks may be required to be fitted with navigational aids (e.g., lights or reflectors).

Turbidity and sedimentation problems can result from construction activities. Such impacts, however, are likely to be small compared with other activities unless the construction requires a large area and considerable time, as might be the case with commercial marinas. Florida water quality regulations, however, do not allow turbidity in excess of 29 nephelometric turbidity units above background in any case, and regulatory agencies may require the installation of turbidity screens or other protective barriers. Turbidity problems more likely arise indirectly from effects such as prop scour as boats make use of docking facilities.

Shading of the water column and the littoral shelf can also affect the environment. Shading may not be a problem in areas where a tree canopy already exists, but obviously it can affect areas previously unshaded. Czerwinski and McPherson (12), however, cite no scientific studies on the direct effects of shading by docks or appurtenance structures. Employing some simple siting and design criteria can avoid or at least lessen any potential detrimental effects. Suggestions include:

- Siting in areas already shaded or in areas low in light-dependent resources requiring protection.
- Elevating structures in areas high in light-dependent resources (e.g., grass beds).
- Substantially elevating accessways, boardwalks, or other appurtenance structures that are not as water dependent.
- Spacing of planking to allow sunlight to penetrate (e.g., leaving 1-in. gaps between boards).

Another obvious effect is that installation of docks and attendant structures directly alters the shoreline. In Florida, for example, a lakefront resident desiring access may remove a 25-ft wide band of vegetation to open water without a permit and without revegetating the area. These areas frequently suffer clearing in association with docks and similar structures. Depending on lot size, then, it is conceivable that residents may remove as much as half of the shoreline vegetation for access without needing a permit.

Fortunately regulatory agencies may have the ability to consider the cumulative impacts of projects in deciding whether to issue a permit. Florida's Department of Environmental Regulation, by virtue of its "dredge and fill" responsibilities, requires a permit to construct a dock or other structures that affect wetlands. "Therefore, these agencies have the authority to review, suggest alternatives ... or deny projects based upon the 'foreseeable,' future cumulative impacts. However, the ability to deny a project based upon future, anticipated cumulative impacts can be subjective and is cautiously exercised due to the potential for legal challenge. This is most likely to be a supportable factor in project review when specific endangered species concerns are at issue" (12).

Of course, not all shoreline changes are detrimental. For example, a dock could expose previously densely vegetated areas, thus creating open sandy areas that can provide valuable fish bedding areas. Docks and related structures can also provide cover or serve as substrate for aquatic organisms.

Most indirect environmental effects ascribable to docks and appurtenance structures result from recreational boating activity. These include potential effects from outboard motor exhaust contaminants, prop dredging, sanitation devices, fuel and oil spills, and antifouling boat paints. Rather than consider most boating impacts in detail here, the reader can refer to the review by Wagner (15).

Antifouling paints, which prevent fouling of hulls by marine organisms (e.g., barnacles), pose an unusual problem. Traditional coatings contain lead, copper, and organotin compounds. For antifouling, the organotins are especially effective because they continuously release active ingredients into the water. One of the organotins, tributyltin (TBT), has gained recent notoriety. EPA, due to the results of documented acute and chronic effects, has proposed maximum concentrations of 26 and 10 parts per trillion in fresh and marine water, respectively, for the protection of fish and other aquatic organisms. They have further proposed restricting sales of TBT to certified commercial pesticide applicators for use only on vessels greater than 65 ft in length.

The concepts of cumulative impacts and carrying capacity are important considerations. They are, however, difficult to implement with respect to docks and other water-dependent structures. Czerwinski and McPherson (12) did not cite studies that defined how one might set scientifically defensible limits. This is clearly an area needing research. Although often discussed and debated, regulation is difficult on this premise due to the lack of quantifiable data.

Docks and water-dependent structures should be located so as to minimize adverse environmental impacts. Where possible, authorities should encourage multislip facilities over the use of many individual docks. Approval of docks should include criteria for preserving a portion of the remaining unaffected shoreline, such as conservation easements or shoreline buffers. Another helpful measure may be to consider construction of boat ramps in lieu of docks; a careful analysis, however, is necessary to ensure consideration of increases in boat traffic and of the need for appropriate provisions to limit ramp usage.

The Need for, Rationale for, and Implementation of Wildlife Dispersal Corridors (16)

The SWIM Act was careful to stress the state's desire to restore or preserve the natural systems associated with its surface water bodies as well as its water quality. There is a growing awareness among resource managers that preserving fauna and flora involves strategies that stretch beyond watershed and governmental boundaries. The need to implement a system of faunal corridors may be the hardest issue to grasp in this paper, and it is doubtful that the authors can do more than introduce the topic. In fact, to a resource manager with a background in water-related issues, the issue paper developed by Harris (16) may appear exhaustive and rhetorical and is almost certain to pose unfamiliar questions and problems.

Model ordinance language proposed with regard to this topic (i.e., faunal corridors) was unlike the others developed. Accordingly, we have referred to the work as an "article" rather than an ordinance. The proposed article

> serves only to provide a means by which the boundaries and natural amenities of a WCSD [Wildlife Corridor Special District], as well as nonnatural

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characteristics and associated implications, can be identified. Once the WCSD has been identified, and a strategy for its protection and management developed, an ordinance is required to actually create the WCSD. Due to the many site-specific characteristics involved in defining the areal extent, physical characteristics and management implications of the WCSD, such an ordinance is impossible to develop in a "generic" form that would be applicable to all jurisdictions and geographic areas in which the ordinance potentially would be used. This Article does, however, provide general guidelines for the creation of a WCSD, while also providing a method by which virtually all information needed for a WCSD-creation ordinance can be collected.

Harris (16) suggested that it is not possible to appreciate the need for implementing a system for faunal movement corridors without first comprehending three major issues:

> "1. Throughout most of North American history, humans and their developments have occurred as localized entities in an expansive and interconnected matrix of undeveloped natural ecosystems; now, it is the natural systems that occur as localized entities in a matrix of human development.
>
> "2. The second issue is the current biological diversity crisis. Without a keen awareness of the breadth of the dimensions and rapidity at which biological diversity (biodiversity) is currently being eroded there can be no grasp of the gravity of the remedial actions that must be taken.
>
> "3. The third critical issue concerns the need of plants and animals to move; without carefully weighing the value of plant and animal movement corridors against other alternative conservation actions it is not possible to achieve balance and perspective in approaching these concerns."

Harris (16) makes a semantical distinction between the terms "wildlife" and "faunal," with faunal relating specifically to native animal species. Although it is important to appreciate how others may apply these terms, this paper applies them more or less interchangeably.

The need for implementing a system of faunal corridors is recent. Depending on the degree of development in an area, the need becomes more pressing in some areas than others. The need appears great in Florida. Historically, human developments have occurred as islands in a matrix of natural ecological communities; now, however, the pattern has changed, with unaltered natural communities occurring as islands in a predominately human-altered environment.

As noted by Harris (16), "a confusing paradox to many is the fact that habitat fragmentation may enhance local wildlife diversity while simultaneously reducing native biotic diversity at a somewhat larger scale." Harris explains this paradox is due to the action of the following mechanisms:

- Populations lose genetic integrity due to being sequestered within patches (i.e., islands).
- "Forest-interior" and "area-sensitive" species that cannot exist within small habitat patches are lost.
- Weedy species that are characteristic of disturbed environments increase in abundance.
- Important ecological processes are disrupted.

Geographic separation of populations and gene pools can, over geologic time, lead to new species. Spatial separation, however, which creates small isolated populations preventing gene flow, can lead to elimination of populations and even extinction of species. As an example, Harris (16) cites the following statistics on the degree of inbreeding depression that has already occurred in isolated populations of the Florida panther:

- Of all the Florida panthers known to exist in the wild today, less than a dozen are reproductively unrelated.
- The percentage of infertile spermatozoa in all male Florida panthers examined in recent years exceeds 90 percent.
- Of all the male Florida panthers examined, only about 50 percent have two distended testicles, and "it remains a matter of speculation if or when the highly inbred males might exhibit bilateral cryptorchidism and be unable to reproduce at all."

Roads are a significant fragmenting force because, unlike the passive fragmentation caused by areas such as farm fields, roads possess an active mortality-causing force—the associated traffic. Lalo (17) has estimated that nationally trucks and automobiles kill as many as 100 million vertebrates annually. Over 146,000 deer were killed on U.S. highways in 1974 (18). Adams and Geis (19) and Voorhees and Cassel (20) present statistics showing that within the contiguous 48 states and within individual states, the amount of land set aside in the form of national parks, wildlife refuges, and game management areas is smaller than the land that roads and rail right-of-ways occupy. Vehicles, including boats, represent one of the most significant sources of mortality for all of Florida's large threatened, rare, and endangered vertebrates. These include the panther, key deer, black bear, eagle, crocodile, and manatee. Data cited by Harris (16) even suggest that the number of road kills increases in direct proportion to vehicle speed.

Roads create barriers in several ways:

- They alter light, wind, temperature, humidity, evaporation rates, and noise level as they create a different microclimate in and near the right-of-ways.
- Exhaust fumes cause avoidance by some species, and heavy metals accumulate in those that occur adjacent to roadways (21).
- Pesticides used to maintain right-of-ways affect non-target plants and animals as well.

Right-of-ways have led to the creation of a different type of ecological community. Harris (16) cites numerous examples of opportunistic predators that "run roadsides" in search of prey.

Over the last 20 years, there has been an increasing realization that habitat fragments, even relatively large fragments, are not adequate protection for many species; if these species are to be protected, corridors must connect these habitat fragments. Simple green belts are not sufficient because corridors of non-native habitat welcome "weedy" species. Interconnecting corridors must be consistent with the habitats they are connecting to avoid "edge effects"; the wrong types of corridors could conceivably hasten the spread of exotic or weedy species. Currently in Florida, considerable funds are being spent to "Save Our Rivers" and protect the water quality of streams. Careful consideration and planning could ensure that these programs accomplish a dual function by protecting our biological diversity as well. As Harris (16) states, "When sufficiently wide, streamside management zones serve as critically important habitat for many rare and endangered native species. But unless the streamside zones connect larger tracts of habitat or protected areas they may function simply as long narrow fragments of habitat."

Corridors are necessary to keep small fragmented populations from being expatriated, to preserve biodiversity, and ultimately to allow populations to adapt to major climatic and geologic changes. Because of the geographic scope involved, corridors are an issue that will require cooperation and coordination between local, regional, and state governments and agencies.

Protecting Environmentally Sensitive Aquatic Habitats (22)

Aquatic habitats include lakes, rivers, streams, estuaries and bays, springs, and wetlands. These habitat areas are typically subject to a variety of differing agency jurisdictions. Quite commonly, though, ordinances developed at the local level protect wetlands (including marshes, swamps, bogs, ponds, and wet prairies). Local wetland resource areas promote the local quality of life as well as the quality of the environment. The advantages include hydrologic functions (flood control, runoff velocity control, ground-water and surface-water recharge), water quality benefits (erosion and sedimentation control and removal of pollutants such as nutrients and heavy metals), and wildlife habitat benefits (food source, breeding, nesting, spawning, and wildlife protection) (23).

When wetlands are allowed to remain in their natural state, they maximize multiple benefits and achieve ecological stability. Anthropogenic changes, however, can affect the natural function and resultant benefits of the wetland, such as change the quality of the water entering the wetland, the hydrologic cycle of the wetland, and the physical structure of the wetland (24). Several sources can affect the quality of water entering the wetland, including point and nonpoint pollution, nutrient enrichment, and sedimentation (25). The hydrologic cycle of the wetland can be disrupted by well pumping, channelization, sedimentation, upstream diversions, increased surface flows, and decreased ground-water base flows. In addition, filling, dredging, and channelization can affect the physical structure of the wetland (26).

By identifying the sources of impacts to these valuable areas, one can begin to develop the necessary elements of a local ordinance that would help to restore and maintain ecological integrity. An ordinance should address the wetland system from a holistic perspective, not as isolated areas. Some recommendations for a wetlands protection ordinance include the following:

- Consider individual and cumulative impacts on aquatic habitats from anthropogenic alterations. Environmentally sensitive systems can degrade from the accumulation effect of many individual human activities (27).
- Develop specific performance standards. Performance standards will allow local governments to use environmentally sensitive lands in a manner that minimizes negative impacts (28).
- Develop financial incentives that encourage local property owners to protect aquatic habitats. If environmentally sensitive areas are to be protected through long-term management of private lands, land owners must be compensated accordingly (29).
- Develop mechanisms by which local government facilitates the property owner's efforts to protect aquatic habitats. If proper channels exist for conservation easements and reduced tax assessments, voluntary efforts to protect environmentally sensitive areas may increase (29).
- Coordinate state and federal permitting processes. Coordination at the local level will ensure compliance with all requirements that serve to protect, enhance, or restore environmentally sensitive areas.

- Identify state and federally exempted activities that contribute to the degradation of aquatic habitat, and regulate those activities locally.
- Develop an appropriate definition of aquatic habitat. An adopted definition will define the areas of jurisdiction for local, state, and federal regulations; few definitions, however, adequately describe all environmentally sensitive areas (29). Local definitions can provide greater protection for those areas not adequately protected by state or federal regulations.
- Develop a long-term plan for the protection of aquatic resource areas, and develop management objectives that will provide the desired level of protection.
- Provide for local enforcement. Taking responsibility for local environmentally sensitive areas ensures maximum protection.

Along with the above requirements, additional elements can be considered:

- Create a mechanism to develop site-specific upland buffer zones.
- Create a mechanism to implement fixed-distance upland buffer zones.
- Create a mechanism to implement no construction/no disturbance zones.
- Allow for restoration of disturbed areas at ratios greater than 1:1.
- Incorporate endangered, threatened, and special-concern species into upland buffer zone consideration.
- Encourage the use of creative site planning to preserve and protect sensitive aquatic habitats.

Vegetative Buffer Zones (30)

A transition zone is an area between a water body (e.g., wetland, lake, river) and upland areas. The area of land that a transition zone occupies varies and is greatly influenced by topography. In areas of major topographic changes, the transition zone tends to be small (1 to 2 ft). In areas where topographic changes are slight, the transition zone tends to increase in size substantially (30 to 50 ft).

Vegetative transition zones provide multiple benefits to the surrounding area. First, they are ecologically complex, as the assemblage of plants and animals can be characteristic of the nearby water body as well as the upland area. Within these areas, substantial ecological diversity can occur (31-33). Second, transition zones help maintain a balanced hydrologic cycle by retarding the flow of surface runoff volumes through absorption and by allowing for infiltration into the ground water. Vegetative transition zones also play a major role in the maintenance of the quality of the nearby water resource. Processes such as deposition, absorption, and transformation help remove pollutants such as sediment, phosphorus, nitrogen, and heavy metals from overland flows. Also, when vegetation is present, it tends to reduce the temperature of storm flows, thereby maintaining water body temperatures (34, 35).

When activities related to urbanization disturb vegetative transition zones, the benefits realized can be diminished or even lost. With the removal of the complex ecological area, habitat values decrease, resulting in a loss of species diversity and richness (36, 37). Urbanization activities can also disrupt the hydrologic balance of the nearby water bodies. Typically, surface water hydrology changes to reflect the increase in the volume and rate of surface flows. This causes increased streambank erosion adjacent to the disturbed area as well as downstream. Streambank erosion reduces water clarity, destroys benthic habitat, interferes with aquatic plant transpiration processes, and reduces stream storage capacity. Removal of vegetative transition zones affects ground-water flow by reducing the overall infiltration rate of surface water to ground water. The decrease in surface water recharge can affect the hydroperiod of nearby wetlands, which are heavily dependant on ground-water discharge, and nearby stream base flows. Removing transition zones also affects water quality by allowing pollutants to enter the watercourse untreated. One of the most obvious water quality impacts is the increase in sedimentation to the receiving waters (30).

Because vegetative transition areas provide such valuable ecological benefits, protection measures need to be implemented to ensure their preservation. The size of these areas, however, tends to be site specific and requires individualized management approaches. Therefore, local ordinances are the most effective and adaptive tool to facilitate preservation.

In developing an ordinance for vegetative transition zones, efforts should maximize the benefits to wildlife, habitat, hydrology, and water quality. Methodologies have been developed to "engineer" vegetative transition areas in a supportable, defensible manner. In general, the recommendations for vegetative transition areas are:

- Minimize disturbances of vegetative transition zone when possible through the use of site fingerprinting. Limiting the extent of disturbance will greatly reduce the potential of negative water quality impacts.
- Develop local requirements for "no-build" and "no-disturbance" zones. Protective buffer zones can be implemented in such a way to allow for construction while minimizing the impact of development.
- Encourage alternative land use planning that can protect vegetative transition areas. Planning techniques

are valuable tools that can afford long-term protection and management of vegetative areas.

- Develop criteria for vegetative transition areas based on defensible procedures. This is an important step that will implement vegetation protection measures in a nonbiased manner. Based on identifiable and scientific procedures, arguments can be made for successful long-term implementation.

Examples of recommendations for vegetative transition follow:

- Area size of 30 to 550 ft may be necessary when ground-water drawdown is an issue (using surficial aquifer data and structure drawdown calculations).
- Area size of 75 ft for coarse sand, 200 ft for fine sand, and 450 ft for silty soils should be considered to protect water quality (utilizing Technical Release [TR] 55, local soils data, and soil deposition formula).
- Area size of 322 ft for fresh and saltwater marshes, 550 ft for hardwood swamps, and 732 ft for bordering sandhill communities to protect wildlife habitat (based on indicator species and 50 percent other present species).

Providing for Erosion Control and Bank/Shoreline Stabilization (38)

Banks and shorelines are those areas that occur along streams, lakes, ponds, rivers, wetlands, and estuaries where water meets land. The topography of banks and shorelines can range from very steep to very gradual. These areas can be considered a subset of the vegetative transition areas.

Banks and shorelines provide many benefits to the environment, including prevention of erosion, storage and attenuation of runoff, and provision of valuable habitat for fish and wildlife (39). Stabilization, which prevents erosion, occurs below the water line via root systems, as well as above the water line through absorption of raindrop energy and overland flow velocity. Both physical characteristics and stability of the bank and/or shoreline accomplish the storage and attenuation of runoff. The provision of habitat is also accomplished through physical stability and the unique physical characteristics of the bank and/or shoreline. Often, ecological zones will be apparent and consistent with the shoreline, and provide special habitat for various plant and animal species (29).

As water bodies continue to support human activities both on and near the water, impacts will occur to the bank and shoreline area. Flows of increased water movement from activities such as boating can cause erosion, damage to vegetation, and increased turbidity in aquatic habitat areas (40). Urbanization commonly results in a change in the surface water hydrology, increasing storm volumes and rates of discharge. This movement of storm flows through water channels tends to erode and undercut banks and shorelines over time. The resultant erosion reduces water quality through increased turbidity as well as destruction of existing bank and shoreline habitat and smothering of downstream habitat areas (29, 41).

Bank and shoreline stabilization is an important element necessary to protect multiple ecological benefits. Ordinances that recognize this can be developed to address local management needs. Bank and shoreline stabilization typically should include an array of approaches as outlined below:

- Promote nonstructural methods such as revegetation and preservation of vegetation because they are an inexpensive and beneficial approach. Studies have shown that nonstructural practices can provide multiple benefits to bank and shoreline areas where implemented. Also, construction costs are substantially lower than traditional structural methods (41, 42).
- Limit use of structural methods to when erosive forces are significant. Public perceptions and aesthetics have led to the construction of structural methods in areas where nonstructural methods could have worked. Structural methods should be the last option when addressing bank or shoreline erosion.
- Develop an appropriate definition for banks and shorelines. Good definitions provide jurisdictional boundaries to those attempting to implement protection measures.
- Develop a long-term comprehensive plan for the protection of banks and shorelines. Comprehensive planning will ensure that bank areas and shorelines remain in their natural state.

Additional recommendations for the protection and preservation of banks and shorelines can include:

- Meet environmental goals through shoreline stabilization regulations that are performance based (not numerical).
- Allow for flexibility to integrate structural and nonstructural methods.
- Address instability caused by water-based and land-based activities.
- Develop financial incentives that encourage the local property owner to employ nonstructural techniques.
- Prohibit the use of noxious plants while encouraging the use of native plant species.
- Provide design standards.

Conclusion

While much of the information considered in this paper was gathered with a focus on Florida, we feel it can be extrapolated to other states. Although ordinances can be enacted to address singular issues, it is better to develop a more comprehensive approach to development review. This kind of approach can eliminate potential duplicity while maximizing environmental benefit. The issues addressed above range widely, but environmental integrity and preservation are common themes. Enactment of an ordinance rarely occurs without challenge, but its chance of passage can only be increased by a scientifically justifiable and legally defensible argument.

References

1. Simpson, J. 1994. Developing local ordinances: Seven issues related to nonpoint source management. Herndon, VA: Olem Associates. In press.
2. Kelly, M.H. 1990. Florida's SWIM program for lake, wetland, and estuarine management. In: Enhancing states' lake/wetland programs. Chicago, IL: Northeastern Illinois Planning Commission. pp. 159-166.
3. Martin, R., and J.K. McPherson. 1991. Placement and maintenance of individual septic systems (onsite disposal systems). Crystal Lake, FL: Henigar and Ray, Inc.
4. Brown, R.B. 1990. Soils and onsite wastewater disposal. Soil Sci. 41:1-11.
5. Ayers and Associates. 1987. Onsite sewage disposal system research in Florida: Impact of Florida's growth on the use of onsite sewage disposal systems. Report to the Florida Department of Health and Rehabilitative Services, Tallahassee, FL.
6. Siegrist, R.L. 1977. Waste segregation to facilitation onsite wastewater disposal alternative. In: Home sewage treatment. Proceedings of the Second National Home Sewage Treatment Symposium. Publication No. 5-77. St. Joseph, MI: American Society of Agricultural Engineering.
7. Cooper, I.A., and J.W. Rezek. 1977. Septage disposal in wastewater treatment plants. In: McClelland, N.I., ed. Individual onsite wastewater systems. Ann Arbor, MI: Ann Arbor Science Publications.
8. U.S. EPA. 1986. Septic systems and ground-water protection: A program manager's guide and reference book. EPA/440/6-86/006.
9. Bicki, T.J., R.B. Brown, E.E. Collins, R.S. Mansell, and D.F. Rothwell. 1984. Impact of onsite sewage disposal systems on surface and groundwater quality. Report to the Florida Department of Health and Rehabilitative Services, Tallahassee, FL.
10. Yates, M.V., and S.R. Yates. 1989. Septic tank setback distances: A way to minimize virus contamination of drinking water. Ground Water 27:202-208.
11. Brown, R.B., and T.J. Bicki. 1987. Onsite sewage disposal: Influence of system densities on water quality. Soil Sci. 31:1-10.
12. Czerwinski, M.G., and J.K. McPherson. 1991. Regulation of docks and appurtenance structures. Crystal River, FL: Henigar and Ray, Inc.
13. Florida Statistical Abstract. 1989. University of Florida, Bureau of Economic and Business Statistics.
14. Webb, D.A., and L.R. Gjovik. 1988. Treated wood products: Their effect on the environment. American Wood Preservers Association.
15. Wagner, J.J. 1991. Assessing impacts of motorized watercraft on lakes: Issues and perceptions. Proceedings of a National Conference on Enhancing States' Lake Management Programs, May 17-18, 1990. Chicago, IL: Northeastern Illinois Planning Commission. pp. 77-93.
16. Harris, L.D. 1991. The need, rationale, and implementation of wildlife dispersal corridors. Report submitted to the Southwest Florida Water Management District, Brooksville, FL.
17. Lalo, J. 1987. The problem of road kill. Am. Forests 72:50-52.
18. Feldhamer, G.A., J.E. Gates, D.M. Harman, A.J. Loranger, and K.R. Dixon. 1986. Effects of interstate highway fencing on white-tailed deer activity. J. Wildlife Mgmt. 50:497-503.
19. Adams, L.A., and A.D. Geis. 1981. Effects of highways on wildlife. Report No. FHWA/RD-81/067. Washington, DC: U.S. Department of Transportation.
20. Voorhees, L.D., and J.F. Cassell. 1980. Highway right-of-way mowing versus succession as related to duck nesting. J. Wildlife Mgmt. 44:155-163.
21. Scanlon, P.F. 1987. Heavy metals in small mammals in roadside environments: Implications for food chains. Science and Total Environment 59:317-323.
22. Cook, C., J.K. McPherson, and R. McCormick. 1991. Protecting environmentally sensitive aquatic habitats. Crystal River, FL: Henigar and Ray, Inc.
23. Zedler, J.B., R. Lnagis, J. Cantilli, M. Zalejko, K. Swift, and S. Rutherford. 1988. Assessing the functions of mitigation marshes in Southern California. In: Urban wetlands. Proceedings of the National Wetland Symposium, Oakland, CA. pp. 323-330.
24. Lewis, R.R. 1988. Restoring altered urban wetlands: Management problems and recommended solutions. In: Urban wetlands. Proceedings of the National Wetland Symposium, Oakland, CA.
25. Huber, W.C., P.L. Brezonik, J.P. Heaney, R.E. Dickinson, S.D. Preston, D.S. Dwornik, and M.A. DeMaio. 1982. A classification of Florida lakes. Publication No. 72. Tallahassee, FL: University of Florida, Water Resources Research Center.
26. Association of Wetlands Managers. 1988. Urban wetlands. Proceedings of the National Wetland Symposium, Oakland, CA.
27. Estevez, E.D., J. Miller, J. Morris, and R. Hamman. 1986. Executive summary of the Conference on Managing Cumulative Effects in Florida Wetlands, Sarasota, FL, October 1985. New College Environmental Studies Program Publication No. 37. Madison, WI: Omnipress.
28. Kusler, J.A. 1983. Our national wetland heritage: A protection guidebook. Environmental Law Publication.
29. Thurow, C., W. Toner, and D. Erley. 1977. Performance controls for sensitive lands: A practical guide for local administrators. American Society of Planning Officials.
30. Brown, M.T., J.K. McPherson, and R. McCormick. 1991. Vegetative buffer zones. Crystal River, FL: Henigar and Ray, Inc.
31. Allen, D.L. 1962. Our wildlife legacy. New York, NY: Funk and Wagnalls.
32. MacArthur, R.H., and E.R. Planka. 1966. An optimal use of a patchy environment. Am. Natl. IOU 916:603-609.
33. Ranney, J.D. 1977. Forest island edges: Their structure, development, and importance to regional forest ecosystem dynamics. Publication No. 1069. Oak Ridge, TN: Oak Ridge National Laboratory, Environmental Sciences Division.
34. Hewlett, J.D. 1982. Principles of forest hydrology. Athens, GA: University of Georgia Press.
35. Borman, F.G. et al. 1968. Nutrient loss acceleration by clearcutting of a forest ecosystem. Science 159:882-884.

36. Faaborg, J. 1980. Potential uses and abuses of diversity concepts in wildlife management. Trans. Missouri Acad. Sci. 14:41-49.

37. Noss, R.F. 1983. A regional landscape approach to maintain diversity. BioScience 33(11):299-309.

38. Shaw, S.K., J.K. McPherson, and F. Flannery. 1991. Providing for erosion control and bank/shoreline stabilization while maintaining the natural shoreline and its associated biota. Crystal River, FL: Henigar and Ray, Inc.

39. Keown, M.P. 1983. Streambank protection guidelines for land-owners and local governments. Vicksburg, MS: U.S. Army Engineer Waterways Experiment Station.

40. Liddle, M.J., and H.R.A. Scorgie. 1980. The effects of recreation on freshwater plants and animals: A review. Biol. Conserv. 17:183.

41. Allen, H.H. 1990. Biotechnical reservoir shoreline stabilization. U.S. Army Corps of Engineers, Environmental Impact Research Program, Wildlife Resource Note 8(1):1.

42. McComas, S., D. Jansen, J. Marter, and D. Roseboom. 1986. Shoreline protection. In: Lake and reservoir management, Vol. II. Proceedings of the Fifth Annual Conference and International Symposium on Applied Lake and Watershed Management. pp. 421-425.

Urban Runoff Pollution Prevention and Control Planning: San Francisco Bay Experiences

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Abstract

The California Regional Water Quality Control Board, San Francisco Bay Region, began a program for control of urban runoff pollution in 1987. The initial focus of the program has been on the municipalities in Santa Clara and Alameda counties. Both county programs followed a similar methodology consisting of the following steps: establish program goals and framework; compile existing information; assess water quality problems through collection and analysis of data and modeling of pollutant loads; identify, screen, and select appropriate control measures; and establish a plan for implementation. The Alameda program had the benefit of lagging behind the Santa Clara program by about 1 year. This provided the Alameda program with the advantage of streamlining efforts based on the successes of the Santa Clara program.

The experiences of these programs provide even further insight into streamlining and optimizing the planning process. Understanding the benefits of each step of the planning process enables a municipality to focus limited resources on the more critical factors affecting development of an implementation plan. For example, a municipality may weigh the cost of obtaining new data to make more informed decisions with the risk associated with making assumptions in the selection and implementation of control measures in lieu of data acquisition. Lessons learned to date are now being utilized by other municipalities in the San Francisco Bay area, leading towards timely and cost-effective development of urban runoff management programs.

Introduction

The California Regional Water Quality Control Board, San Francisco Bay Region (Regional Board), is the state water pollution control agency responsible for protecting the beneficial uses of San Francisco Bay and its tributaries. San Francisco Bay is a highly urbanized estuary and, as such, receives significant loads of pollutants through discharges of urban runoff. The Regional Board began a program for control of urban runoff on a watershed basis in 1987. The goals of the Regional Board's program are to protect beneficial uses through attainment of water quality standards in waters of the region and to reduce pollutants in urban runoff to the maximum extent practicable. These two goals reflect a dual water quality and technology based approach and serve to integrate specific regulatory programs such as the stormwater National Pollutant Discharge Elimination System (NPDES) permit program. The Regional Board has promoted an areawide approach, with the initial focus of the program on the municipalities in Santa Clara and Alameda counties. This has led to the development of a pseudowatershed-based program in each county.

The Regional Board program goals also serve as the primary goals of the specific municipal urban runoff programs. We recognize, however, that attainment of such broadly defined goals can only be achieved through a carefully planned strategy. Both county programs followed a similar strategy consisting of the following steps: establish program goals and framework; compile existing information; assess water quality problems through collection and analysis of data and modeling of pollutant loads; identify, screen, and select appropriate control measures; and establish a plan for implementation. Normally, such steps would proceed in sequence. With an understanding of the purpose of each step and its relation to the others, however, one may consider a nonsequential or parallel process. The Alameda program commenced approximately 1 year after the Santa Clara program and had the advantage of being able to streamline efforts based on the successes of the Santa Clara program. The lessons learned by the Santa Clara and Alameda programs provide valuable insight for optimizing the planning process.

The Regional Board served as a facilitator in the development of both the programs, but it has been the cooperative, proactive approach of the municipalities that has resulted in the development of a technically sound and cost-effective urban runoff program. The following discussion reflects the experiences and accomplishments of the Regional Board and the Santa Clara and Alameda programs.

Planning Strategy Steps

Program Framework

Development of an effective urban runoff management program first requires an effective framework that involves participation by all pertinent municipal agencies. Initiation of both county programs began with creation of a task force with participants from city and county public works, city and county planning, sewage treatment works, and flood control. The task force served as a forum for communication among the involved agencies, as well as an oversight body to track all the steps of the planning process. Specific activities included establishment of program goals, development of a memorandum of agreement among the participating agencies, designation of a lead agency for anticipated contracts, and development of a work plan for the planning strategy. The work plan identified the specific tasks and timelines of the planning strategy, identified responsible parties and consultant needs, and identified the financial resources necessary for completion of the planning process.

Both programs relied on extensive consulting services for preparation of the planning process work plan and implementation of the planning tasks. Although the programs benefited from this approach, an overreliance on outside help may result in insufficient awareness and expertise within the ultimate implementation agencies of the urban runoff management program. An effective approach should use new or existing municipal personnel as much as possible throughout the planning process. Outside services may play a valuable role, but they will be most effective when specific technical or other needs have been identified and communication and cross training with municipal staff are provided.

Compilation of Existing Information

Identification and compilation of existing information are essential early steps in the process. The Alameda and Santa Clara programs benefited from these steps for several reasons, including that they provided a learning experience on the importance of the relationship of land-use information to water quality. Much pertinent information already existed, and many existing municipal activities were involved in the management of urban runoff and pollutant sources. This information was critical to the identification of monitoring, modeling, and mapping needs, and to the selection of appropriate control measures.

Neither of the programs chose to focus resources on detailed mapping efforts. Rather, available maps were used to compile information. Development of more detailed maps, specifically geographical information systems, was deferred to the implementation phase of the program when funding mechanisms would be in place and the cost could be better justified.

Monitoring and Modeling

Both the Santa Clara and Alameda programs conducted comprehensive monitoring and modeling programs (1, 2). The objectives of these programs were to characterize existing water quality conditions within storm drains and urban creeks and to estimate urban runoff pollutant loading. The programs included hydrologic monitoring, wet and dry weather water quality monitoring, sediment monitoring, and toxicity monitoring using acute and chronic bioassays. Data were compiled and used to calibrate and verify the Storm Water Management Model for estimating pollutant loads. The load estimates were also used to compare the relative contributions of treated wastewater and urban runoff discharges to the bay.

Results of both monitoring programs were similar. Heavy metal concentrations in receiving waters increased during wet weather. The metals primarily detected were cadmium, copper, lead, nickel, and zinc. Pesticides and petroleum hydrocarbons were prevalent in sediments. Metal concentrations were distinctly different for discharges from open space, commercial/residential, and industrial areas. It was also determined that annual urban runoff pollutant loads were equal to or greater than treated wastewater discharges, depending on the amount of precipitation.

Each of the monitoring and modeling programs cost from $1 to $2 million. Much valuable information was gained, and there were strong driving forces for obtaining the pollutant load information. Future programs may not have this level of available resources during the planning process, however. Municipalities must weigh the cost of obtaining new data to make more informed decisions with the risk associated with making assumptions in the selection and implementation of control measures in lieu of data acquisition. Newly developing programs in the San Francisco Bay Area are taking this latter approach, in part benefiting from the information developed by the Santa Clara and Alameda programs.

Selection of Control Measures

The process of selecting appropriate urban runoff pollution control measures involves three steps: 1) compilation of candidate control measures, 2) consideration of the candidate measures based on screening criteria, and 3) selection of control measures (3). The key to the success of the process was establishing meaningful selection criteria. The selection criteria addressed pollutant control effectiveness, reliability, and sustainability; capital, operation, and maintenance costs; public and agency acceptability; consistency with regulatory requirements; and legal and environmental liability.

An inventory of candidate control measures was developed through a review of technical literature and other urban runoff control programs. In addition, technical and managerial personnel from other state, county, and city agencies were interviewed. This initial screening produced a list of 92 separate candidate control measures. Upon application of the established screening criteria, the list was reduced to 59 control measures. The final step involved consideration of the overall costs of implementing all the control measures, with priority given to pollution prevention and source control measures over structural or treatment based controls. This final step ultimately lead to the selection of 41 separate control measures for implementation.

The Alameda program had the advantage of following the Santa Clara program. Consequently, the Alameda program streamlined the process by capitalizing on the efforts and progress of the Santa Clara program. The Alameda program also factored in the requirements of the storm water NPDES regulations. As more programs are developed, we expect the selection process to become even more streamlined, particularly in areas of similar land use and climatic conditions such as the San Francisco Bay area.

Implementation Plan

The final stage of the planning process is to develop a plan for implementation of control measures. The implementation plan should provide a clear framework of stated goals, tasks to achieve them, an evaluation process, and a mechanism for modification of the plan based on program successes and failures. The task forces of the Santa Clara and Alameda programs played a critical role in the development of their implementation plans. The multiagency involvement on the tasks forces allowed for a consensus-building process that resulted in establishing responsible agencies and institutional arrangements for implementation.

The Regional Board did not intend to require immediate implementation of all control measures. Through involvement with the respective task forces, high-priority, early-action measures were identified, and schedules for phased implementation of the remaining measures were established. For example, targeted early actions included a public information program and surveillance for illegal discharges. Improved operation and maintenance activities are being implemented under a phased schedule where the efficiency of various inlet cleaning procedures are being evaluated on a pilot scale first (4, 5).

Development of a comprehensive and effective implementation plan for an urban runoff control program is the most critical and difficult step in the planning process. The difficulties encountered are generally nontechnical in nature and involve legal, financial, and institutional limitations. The key to avoiding or overcoming such limitations is recognizing them early in the planning process and integrating their solution into the planning process. For example, the planning process work plan should include tasks to address legal authorities, funding mechanisms, and institutional arrangements, rather than waiting until a technical implementation plan is drafted. In essence, development of the implementation plan should commence with initiation of the planning process.

Conclusions

Development of an effective urban runoff control program requires a well-defined planning strategy. The experiences of the Regional Board and the Santa Clara and Alameda programs provide insight on how to efficiently proceed through the planning process. Understanding the benefits of each step of the planning process enables a municipality to focus limited resources on the more critical factors affecting development of an implementation plan. These factors include a multiagency task force; clear goals and a work plan for the planning process; compilation of all available information, with a strong emphasis on review of other programs; strategic focus of monitoring, modeling, and mapping resources; criteria for selection of control measures; and the foresight to commence development of the implementation plan at the beginning of the planning process. Lessons learned to date are now being used by other municipalities in the San Francisco Bay area, leading to timely and cost-effective development of urban runoff management programs.

References

1. Woodward-Clyde Consultants. 1991. Santa Clara Valley nonpoint source study, Vol. I: Loads assessment report. Santa Clara Valley Nonpoint Source Pollution Control Program.
2. Woodward-Clyde Consultants. 1991. Loads assessment report. Alameda County Urban Runoff Clean Water Program.
3. Woodward-Clyde Consultants. 1989. Santa Clara Valley nonpoint source study, Vol. II: Control measure report. Santa Clara Valley Nonpoint Source Pollution Control Program.
4. SCVNSPCP. 1991. Storm water management plan. Santa Clara Valley Nonpoint Source Pollution Control Program.
5. ACURCWP. 1991. Storm water management plan. Alameda County Urban Runoff Clean Water Program.

Whole Basin Planning: Practical Lessons Learned From North Carolina, Delaware, and Washington

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Abstract

Governments at all levels are broadening their view of water quality protection and are developing and implementing innovative strategies to achieve greater water resources protection. Many of these efforts center on "whole basin planning," which encourages active coordination across the full range of resource management programs to maximize the efficiency of program planning and administration, data collection and analysis, pollution prevention and control implementation, habitat protection and restoration, permitting, and enforcement.

Basin planning consists of two phases. The first develops the design of the state- or multistate-specific framework under which basin planning will be performed. The second phase implements the basin planning process. North Carolina, Delaware, and Washington have each employed a consensus-building, workshop-based process to develop planning frameworks. Delaware and Washington are currently in the framework design phase. North Carolina implemented basinwide planning in 1991. Preliminary results are encouraging, with improvements to the state's monitoring program, data management, analysis and assessment, and water quality program administrative functions being demonstrated.

Several aspects of the framework development process as employed in these three states stand out as practical suggestions for other states and federal and local agencies considering basin planning:

- Clearly define the state-specific objectives to be achieved.
- Encourage stakeholder involvement at the agency staff level.
- Allow time for discussion of ideas and iterations during framework development.
- Build in flexibility to the process development and basin planning processes.
- Define issues to address in order to translate objectives for basin planning into specific tasks.
- Implementing basin planning, the states found, does not necessarily lead to disruption of existing programs.

What Is Whole Basin Planning?

There is a growing awareness in the United States that point source water pollution control programs have been successful, but that nonpoint sources, groundwater contamination (1, 2), and habitat degradation (3) continue to diminish the quality of the nation's water supply. Point source chemical controls, while largely effective, have not led to the achievement, maintenance, nor protection of the three supporting components of clean water provided in Section 101(a) of the Clean Water Act (CWA): chemical, physical, and biological integrity. Nonchemical stressors resulting from nonpoint source pollution (e.g., "clean sediment," increased stream temperature, highly modified flow regimes) can lead to direct and indirect impacts on physical and biological integrity. A broad perspective on water resources management is required to reduce and eliminate such stresses. Government agencies at federal, state, and local levels are widening their views of water quality protection and are developing and implementing innovative strategies to achieve greater water resources protection. Many of these efforts center on the concept of a "whole basin planning" (WBP) approach, which realigns water pollution control programs to operate in a more comprehensive and coordinated fashion.

The underpinnings of basin planning can be found in federal legislation, notably numerous sections of the CWA (Table 1). Section 303(e) explicitly requires each

Table 1. *Sections of the CWA That Support Basin Planning* (Adapted From Craeger et al. [4])

Section	Applicable Content
201(c)	To the extent practicable, waste treatment management shall be on an areawide basis.
208	Several clauses of this section call for areawide planning, reporting, and pollutant control.
303(d)	Subsection 1A. Each state shall identify waters within its boundaries which are water quality limited. The state shall establish a priority ranking for such waters.
303(d)	Subsection 1C. States shall establish TMDLs for the identified water quality limited waters.
303(e)	Establishes a continuing planning process that includes effluent limits and compliance schedules, applicable areawide waste management plans (§208) and basin plans (§209), TMDLs per §303(d), revision procedures, authority for intergovernmental cooperation, implementation including compliance schedules, residual waste disposal controls, and a prioritized inventory and ranking of waste treatment construction needs.
319(a)	Nonpoint source management program, state assessment reports.
319(b)	Nonpoint source management program, state management plans.
319(b)	Section 4. States shall develop and implement management programs on a watershed basis.
320	Comprehensive management plans to be developed over large geographic area for estuaries in National Estuary Program.

state to develop an areawide planning process for all navigable waters in the state to address a broad range of water quality issues. Sections 303(d) and 319 implicitly require or support basin planning. Section 303(d) requires states to define total maximum daily loads (TMDLs), as well as associated wasteload allocations for point sources and load allocations for nonpoint sources, to ensure the attainment of water quality standards within all surface waters. Section 319 requires watershed-based nonpoint source management programs. Section 320 establishes the National Estuary Program and requires the development of management plans for estuaries included in the program. The estuarine zone is broadly defined as extending to the upstream limit of historic anadromous fish migration or head of tide. Thus, the management plans must be prepared for broad geographic areas. In addition to the CWA, the Coastal Zone Act Reauthorization Amendments of 1990 (CZARA) included Section 6217, which requires coastal states with approved coastal management programs to develop Coastal Nonpoint Source Control Programs. During a review of state coastal zone boundaries required by Section 6217, National Oceanic and Atmospheric Administration will use U.S. Geological Survey (USGS) mapping units as the basis for examining state delineations of coastal watersheds (5). Section 6217 requirements provide implicit support for whole basin planning.

In a recent paper discussing integrated basin management, Downs et al. (6) identify five main facets that should be included when addressing the physical and biological attributes of river basins (Figure 1). Explicit incorporation of water, channels, land, ecology, and human activities management into the planning, design and implementation phases of aquatic resources management increases the likelihood that cumulative, incremental losses to resource quality and quantity will be identified and addressed. Whole basin planning encourages active coordination across the full range of resource management programs to maximize efficiency of program planning, data collection and analysis, pollution prevention and control implementation, habitat protection and restoration, permitting, and enforcement. Mitchell (7) recommends a two-stage strategy to achieve truly coordinated management of resources in river basins. The first, conceptual stage is an identification of the widest possible range of issues and variables. The second, operational stage involves an integrated, focused approach that concentrates on the issues identified as most significant.

The U.S. Environmental Protection Agency (EPA) has recognized the value of taking a wider view of water quality protection. Through the Office of Water, EPA encourages states to implement watershed protection and basin planning and has formulated three main principles to guide its support for state efforts in this area (8):

- Risk-based geographic targeting
- Stakeholder involvement
- Integrated solutions

Risk-Based Geographic Targeting

"Risk" in the context of whole basin planning refers to indication of impairment to human health, ecological

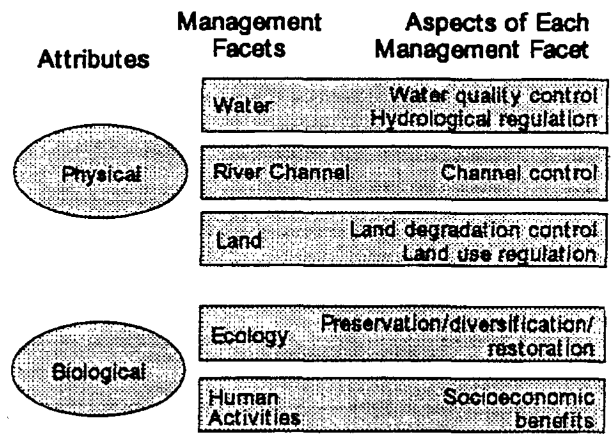

Figure 1. Facets of river basin management to include in basin planning (adapted from Downs et al. [6]).

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resources, designated uses of the waterbodies, or a combination of these, resulting from manmade pollution and natural processes, based on a review of environmental data. A probabilistic approach, as is used in ecological risk assessment (9), has not been applied in basin planning. Phillips (10), however, argues for a probabilistic approach to targeting nonpoint source pollution control in a watershed context. Basin planning establishes a framework within which a more probabilistic risk assessment can be performed.

Problems that may pose risks in a watershed include:

- Industrial wastewater discharges.
- Municipal wastewater, stormwater, or combined sewer overflows.
- Waste dumping and injection.
- Nonpoint source runoff or seepage.
- Accidental toxics releases.
- Atmospheric deposition.
- Habitat alteration, including wetlands loss.
- Flow alterations.

Specific stressors within watersheds are targeted based on their potential to produce impairment to human health, ecological resources, or designated uses. Under a whole basin planning framework, the highest risk stressors within watersheds are identified using, for example, water quality and biological monitoring data, land use information, information on location of critical resources, and tools such as water quality models and geographic information systems (GIS). The stressors with the greatest potential to yield impairments are targeted for integrated assessment and corrective action involving cooperative efforts between multiple jurisdictions and interest groups. The targeting process may range from qualitative ranking to computerized techniques that incorporate various numeric criteria and weighting factors (11). Difficult management problems may not be completely addressed over the course of one basin planning cycle (5 years is being used in North Carolina). This can be used to advantage, however, by breaking the identified problems into components that can be solved, or for which measurable progress toward a solution can be made during a cycle.

The basin planning process itself can be broken into phases with near- and long-term goals. For example, near-term goals could include coordinating the permitting and monitoring schedules by basin, promoting public participation in basin planning, and expanding and improving wasteload allocation analyses and evaluation of nonpoint sources. Long-term goals could include optimizing the distribution of assimilative capacity within basins and developing and implementing basinwide management strategies.

Stakeholder Involvement

All parties with a stake in the specific local situation should participate in problem analysis and creation of solutions. The involvement of potentially affected parties ("stakeholders") during the development of basin plans is crucial to the success of those plans. The manner in which stakeholders are involved may vary from state to state, but a key activity for them, regardless of location, is to reach consensus on goals and approaches for correcting a watershed's problems, specific actions necessary to achieve those goals, and processes for coordinating implementation activities and evaluating the efficacy of problem solutions. The potential pool of stakeholders can be very broad and should be tailored to individual basins. Potential basin plan participants include members of:

- State environmental, public health, agricultural, and natural resources agencies.
- Local/regional boards, commissions, and agencies.
- EPA water and other programs.
- Other federal agencies (e.g., U.S. Department of Agriculture—Soil Conservation Service, U.S. Department of the Interior, U.S. Army Corps of Engineers).
- Indian tribes.
- The public.
- Private wildlife and conservation organizations.
- Industry.
- The academic community.
- The farming community.

Integrated Solutions

The basin approach provides a framework to design the optimal mix of water quality management strategies by integrating and coordinating across program and agency boundaries. Integrated solutions implemented by basin management teams use limited resources to address the most significant water quality problems without losing sight of and planning for other factors contributing to the degradation of the resource. Integration through the basin approach provides a means to achieve the short- and long-term goals for the basin by allowing the application of resources both in a timely and geographically targeted manner. Integrated solutions are possible because of a framework that encourages an interdisciplinary and interagency team to develop the most appropriate plan rather than impose predetermined solutions.

Whole Basin Planning in Three States

Before basin planning (the second, operational stage in Mitchell's construct [7]) per se is implemented, it must be preceded by a process to design the framework within which it will operate (Mitchell's first, conceptual stage [7]). This design process will be specific to each state that implements whole basin planning due to differences in target resources (e.g., a large number of rivers and streams versus lakes), the objectives of implementing basin plans (e.g., a water quality permitting focus versus an aquatic resources management focus), and differing organizational structure and implementation constraints. We draw on experiences in North Carolina, Delaware, and Washington during the framework design stage of basin planning and identify several practical lessons that can be applied by other states, EPA regions, or other government units.

North Carolina

The Framework

North Carolina Division of Environmental Management (NCDEM) Water Quality Section considered an National Pollutant Discharge Elimination System (NPDES) basin permitting strategy as early as 1989. However, due to resource limitations, NCDEM was unable to develop a framework document describing the strategy to submit to the North Carolina Environmental Management Commission for approval. NCDEM submitted a request for funding to the EPA Office of Policy, Planning and Evaluation, Water Policy Branch, for a facilitator to assist with the development of a basin approach for North Carolina. This consensus-building process was initiated in 1990.

The Process

The first step in the process involved a series of individual interviews with several members of the NCDEM Water Quality Section staff, including all branch chiefs. The benefits of expanding the focus from solely a NPDES permitting strategy to more comprehensive involvement of the water quality program soon became apparent. It was also clear that there was broad-based support for the basin approach but that individual views of that approach varied in several critical areas. The goal of the consensus process was to successfully synthesize those individual views.

The next step involved a series of small group meetings to begin outlining a framework for the basin approach. The results of these group meetings formed the basis for a "straw outline" compiled by the facilitator. The straw outline was used to provide structure for a "development" workshop attended by a large portion of the Water Quality Section staff. The purpose of the workshop was to finalize the outline and identify consensus positions. Workshop results were used to produce a draft internal document describing the North Carolina Whole Basin Water Quality Management Framework.

The draft framework document was distributed within the Water Quality Section for review and comment. The revised document was circulated to a broader audience, including other state and federal agencies and selected academics. The draft framework document was presented at an implementation workshop, which included broader agency and public participation than previous meetings. The document was revised once again based on comments received at the implementation workshop and submitted to the North Carolina Environment Management Commission (EMC) for approval. The EMC approved the basin approach in 1991.

The framework document has been revised twice since its approval by the EMC. These changes reflect needed refinements recognized during the implementation and development of specific basin plans. These revisions have expanded the focus of basin plans and incorporate broader elements of the water resources program in North Carolina to ensure that the state's basin planning objectives are being appropriately addressed.

The final consensus basin approach established a rotating basin schedule for NPDES permitting, monitoring, and nonpoint source program implementation. These activities are performed for each basin on a 5-year cycle, with several basins moving through the planning cycle together. A general sequence of tasks over the 5-year planning cycle is illustrated in Figure 2. North Carolina basin plans are viewed as reports to the public, policymakers, and the regulated community. Revisions to the framework are addressing an insufficient public outreach program for the development of specific basin plans. Basin plans report on the current status of surface waters in the basin, identify major water quality concerns and issues, summarize projected trends in development and water quality, identify long-range management goals for the basin, present recommended management options, and discuss implementation plans (12). The plan also presents potential changes in

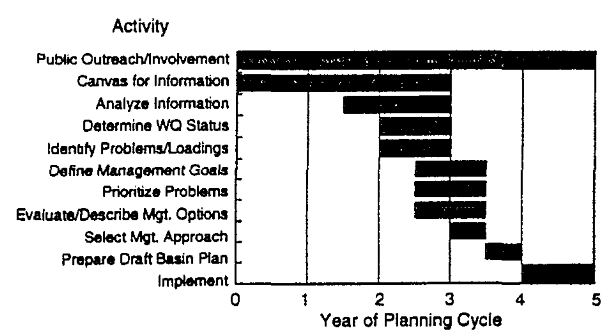

Figure 2. General sequence of planning tasks.

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discharger waste limits and recommendations for reductions in nonpoint source loadings. North Carolina Basinwide Water Quality Management Plans do not, however, currently target specific physical habitat restoration issues or projects.

Barriers to Implementation

A major impediment to the development and implementation of the North Carolina basinwide approach has also been the greatest source of strength: the CWA. The strength comes from the merger of traditionally regulatory programs, having strong legal precedence for enforcement, with voluntary compliance programs, which have a strong public involvement component. Each approach has enhanced the application of the other.

The barriers result from the manner in which the CWA has been implemented, using a programmatic approach with specific grant and entitlement programs. This has led to a lack of coordination and integration in addressing water quality issues that require comprehensive strategies. The program funding requirements reduce the flexibility of the state to commit funds to targeted water quality issues.

Next Steps

A useful reform of the grants process would give states with defined basin frameworks authority to establish water quality priorities within basins. This approach would also reduce redundant application and reporting requirements that are fulfilled with the basin plans. Flexibility in this regard would enhance the North Carolina approach. EPA is currently using a trial block grant funding program with North Carolina.

Delaware

The Framework

The Delaware Department of Natural Resources and Environmental Control (DNREC) identified a need to focus existing water resources programs on priority watersheds. Basin planning will provide DNREC with the ability to assess pollution, living resources, and habitat problems, and manage Delaware's resources in a comprehensive manner (13). The department's perspective on basin planning, explicitly incorporating living resources and habitat degradation, from the outset of the process is significant from several standpoints. By including a wide range of basin management facets (Figure 1), DNREC will be more likely to proactively identify potential cost savings (e.g., combining aspects of current water quality and fisheries monitoring activities), watershed stressors with multiple impacts (e.g., loss of vegetated riparian buffer zones, which increases nonpoint source delivery to waterbodies and degrades aquatic and terrestrial habitat), and solutions with benefits to multiple resource categories (e.g., riparian zone revegetation, which reduces nonpoint source loadings and improves habitat). It is less likely that DNREC will need to "retrofit" the basin planning process at a later stage.

The Process

DNREC's framework design process began with a series of interviews of department staff by a facilitator to gain a better understanding of their goals for basin planning in Delaware. Following completion of these interviews in late summer 1992, a workshop was held for DNREC staff in September 1992 to provide detailed background information on whole basin planning and to begin to identify existing roles and responsibilities of the various functional units within the department. The workshop provided an opportunity for department staff to identify perceived needs for basin planning in Delaware and to begin an initial formulation of goals and objectives (14).

A second workshop was held in January 1993 with DNREC staff and representatives from other state, local, and federal agencies. The goal of this session was to establish commitment and direction for basin planning in the state. The 3 months between the first and second workshops proved to be a very fertile incubation period for agency staff to consider the design of a planning approach. Key outcomes of the discussions were:

- Identification of a strategy of sequential involvement of a larger group of participants as the framework planning effort proceeds.
- Firm commitment by agency staff to build the planning process from the bottom up, together with the stakeholders who will actually implement it, rather than imposing the plan without their input.
- A clear statement that an expanded definition of "clean water" (i.e., inclusive of biological resources, physical habitat, and watershed linkages) would ensure that Delaware's basin approach is consistent with the goals and objectives of programs and agencies other than DNREC water programs. Maintaining the focus on "clean water" will allow the regulatory components of the basin approach to remain firmly grounded in legal and policy precedents provided by the CWA.
- Detailed discussion of whether to 1) proceed with immediate implementation of WBP in all basins at once, or 2) proceed incrementally, implementing the strategy in a single basin and then assessing the results and modifying the framework as appropriate.
- Tentative delineation of basin management units that combine groups of Delaware's 35 watersheds (Figure 3).

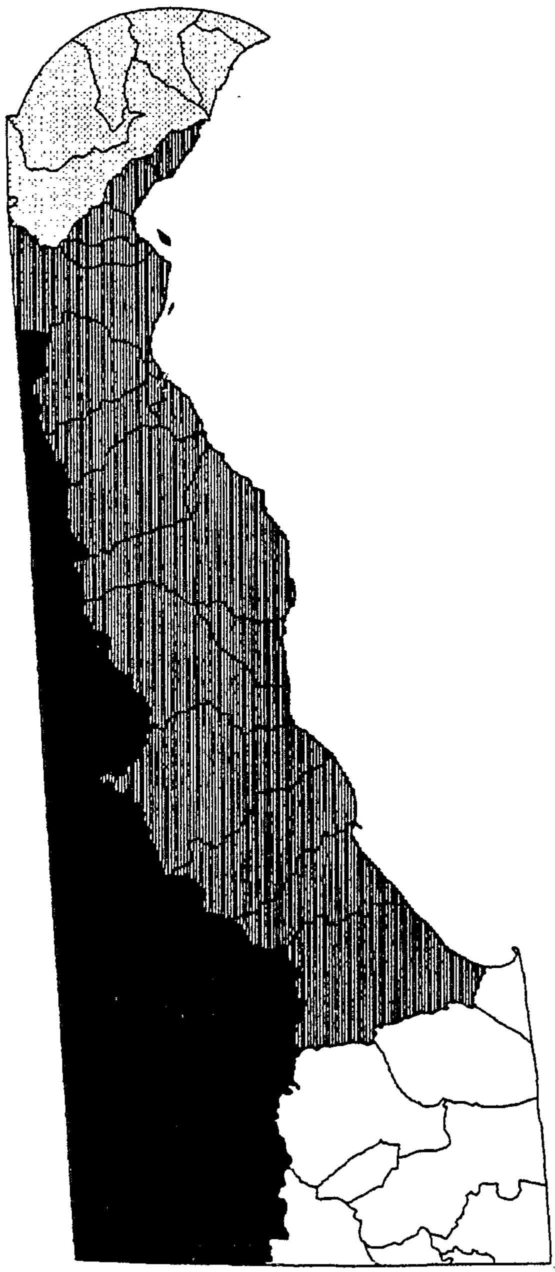

Figure 3. **Tentative delineation of basin management units in Delaware.**

Workshop participants identified a wide range of issues to address during the formulation of the basin planning framework. Review groups were established to explore these issues in greater detail and prepare specific components of a planning framework document. Topical areas being examined by these groups are:

- Implementation, coordination, and institutional barriers
- Management units, data management, and monitoring
- Public outreach and education

Next Steps

The review groups will be the focus of planning activities for several months. Following completion of their deliberations, a framework design workshop will be convened to review the components of the planning process proposed by the groups, to make appropriate modifications, and to establish a draft basin planning framework for subsequent review by stakeholders.

Washington

The Framework

The Washington State Department of Ecology (DOE) Water Quality Program (WQP), Environmental Investigations and Laboratory Services (EILS), and Central Programs are currently developing the water quality component of a broader DOE basin approach to natural resource management. The process is the culmination of a long-term planning program that satisfies a state-sponsored Efficiency Commission requirement and also fulfills the requirements of a Memorandum of Understanding between EPA Region 10 and DOE. The development of the basinwide water quality management program framework document is not yet final. Therefore, the summary description offered here is subject to change. The development of the basinwide approach in Washington was also assisted by an independent facilitator.

The Process

The Washington basin approach for water quality management involves coordinating issuance of wastewater discharge permits and nonpoint source planning conducted by the WQP and Central Program's Industrial Section (to the extent practicable). It also involves water quality monitoring, intensive field investigations, and TMDL development conducted by DOE's Environmental Investigations and Laboratory Services Program. Other programs within DOE also have developed or are developing basin approaches for their areas of responsibility (e.g., Coastal Zone Management, wetlands). All of the basin approaches within DOE will be merged into one resource management program at a later date.

Beginning in mid-1993, each of the WQP's four regions committed one basin per year to this geographically targeted, risk-based approach. The 64 Water Resource Inventory Areas (river basins) will be lumped into 20 basin management units. Each of the four regions will complete a basin water quality management plan each year. All of the basin management units across the state will be completed in a 5-year cycle. Each basin will be revisited every 5 years to restart the cycle of data collection, assessment, public outreach, planning, and implementation. Basin management teams are active in each basin management unit every year of the 5-year basin management cycle. Basins are simply staggered at different steps in the cycle. The Washington approach is viewed as a long-term commitment to a stable management structure that allows DOE to build on previous efforts.

Integration of the DOE program with local planning agencies is a key issue in Washington. DOE is placing a strong emphasis on stakeholder involvement through a public outreach program that is active at each step of the basin cycle. The roles and responsibilities of all of the participants on the basin planning team have not been finalized. DOE, however, is looking for a mechanism that promotes public and other agency involvement in all phases of the basin planning process. The exception would be when the regulatory activities of the basin planning team might directly affect a participant.

Next Steps

EPA flexibility is needed in numerous program components to facilitate DOE's transition to the basin approach, including:

- Using extended/expired permits to achieve synchronization of permits within basins, and because certain permits will receive a low priority ranking for risk of waterbody impairment.
- Allowing basin plans to fulfill various CWA reporting requirements (e.g., 305(b), 319).
- Using basin plans as both numeric and qualitative TMDLs.
- Administering staff/financial resources among various program components (e.g., number of inspections and audits).
- Focusing on the results of the water quality program rather than specific intermediate evaluation criteria.
- Recognizing that certain state discharge permits (e.g., ground water) may take precedence for management over certain NPDES permits.

EPA Region 10 and DOE are working together to resolve these issues to the extent possible within the current configuration of the CWA. The elimination of all institutional barriers between EPA regional offices and states may require some amendment of the CWA as part of its reauthorization.

Washington is continuing to resolve internal implementation barriers by establishing a cross-program work group to address issues that were identified at the development workshop. DOE also considers the basinwide water quality management framework document that is developed through this current consensus process the first phase of DOE's transition to basin resource management.

How Is Whole Basin Planning Working?

North Carolina

Although only one state is actually performing basin planning, the results so far are encouraging. EPA's Office of Water, Watershed Branch, sponsored a survey of the staff of the NCDEM Water Quality Section after basin planning was initiated there. Potential improvements and increased efficiency in North Carolina's water quality program were suggested in several areas.

Monitoring Program

Following implementation of basin planning, NCDEM was able to increase the number of water quality sampling stations and parameters measured. The respondents attributed this increase to the ability to optimize sampling strategies under a basin approach. The ambient water quality monitoring network has been maintained. NCDEM staff anticipate further improvements to the monitoring network as a result of increased coordination with other resource agencies and the larger role of the regulated community in the monitoring program.

Data Management, Analysis, and Assessment

During development of a basin planning approach, North Carolina identified major improvements to data management and analysis (both hardware and software) as being crucial to the success of the approach. Improved capabilities in this area are expected to reduce the Water Quality Section's reliance on North Carolina's central computing services and significantly reduce the Section's computing costs. Cost savings will be used to upgrade in-house hardware and software, which will in turn allow ready access to monitoring and geographic data needed to support basin planning.

Of particular note to municipalities is the ability to fund a staff position with the Water Quality Section to assist in the development of basin plans from the perspective of fulfilling municipal stormwater planning and control requirements. North Carolina cities will benefit from this arrangement by being able to reduce or eliminate redundant monitoring and modeling.

Significant improvements have been made in assessing water quality issues. The development of a framework for basin planning included integration of analysis time requirements with monitoring schedules, thus monitoring now more directly supports water quality modeling. By shifting to a basin focus, modeling is performed for a greater length of stream segments in the state. This expansion allows consideration of more innovative solutions to water resources management issues, such as pollutant trading, and enhances the state's ability to prepare TMDLs.

Administration

North Carolina's basin approach was designed to avoid agency reorganization. The approach has led to changes in roles and responsibilities for staff and branches within NCDEM. Staff resources have been shifted to place a greater emphasis on data acquisition and assessment. Information flow and coordination of activities between branches has significantly increased. A basin coordinator position was created to ensure the timely flow of information throughout the preparation of basin plans. In addition to improved communication and coordination within the NCDEM, there is increased cooperation with other local, state, and federal agencies.

Potential Benefits to the Regulated Community

Basin planning has not been in place long enough to have provided directly measurable benefits to the regulated community. However, the Water Quality Section identifies several anticipated benefits. Consolidation of dischargers into consortia along stream reaches will provide an economy of scale with respect to permit monitoring requirements. Dischargers in management units are expected to be able to combine permit monitoring activities and cooperate in the preparation of assessments. NCDEM also expects permits to be more stable because of the expanded spatial and temporal scope of assessments performed during the basin planning cycle. Basin planning allows more comprehensive assessment of existing and proposed pollution sources, and is more effective in accounting for future impacts. Thus, permit conditions would need to be updated less frequently, potentially reducing costs to both NCDEM and permittees. Increased accuracy in the assessment of a basin's assimilative capacity will allow better identification of the level and types of controls necessary to achieve and maintain desired aquatic resources quality. Basin planning will help lead to the selection of an optimal set of pollution control methods, potentially reducing costs.

Neuse River Basinwide Plan

North Carolina has implemented basinwide planning beginning with the Neuse River basin (Figure 4). Basinwide plans will be prepared for the remaining 16 basins in the state over the next 5 years and will be updated at 5-year intervals.

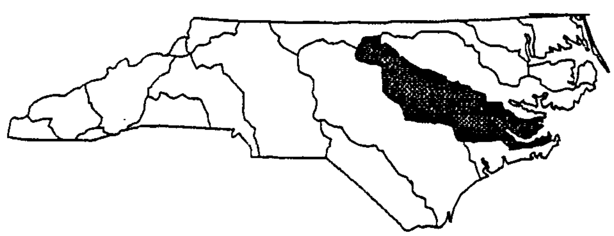

Figure 4. North Carolina basins (Neuse River highlighted).

North Carolina's basinwide planning process has as primary goals "to identify and restore full use of presently impaired waters, to identify and protect highly valued resource waters, and to manage problem pollutants throughout the basin so as to maintain full use of unimpaired waters while accommodating population increases and economic growth" (12). NCDEM identified near- and long-term objectives for its basinwide planning process that apply to the preparation of basin plans (illustrated conceptually in figure 2). Near-term objectives are defined as those fully or partially achievable during the initial 5-year planning cycle. They include implementing management strategies to significantly reduce point and nonpoint source pollution and making measurable improvements toward addressing major issues identified in each of the basin plans. Longer-term objectives include refining the recommended basinwide management strategies during subsequent planning cycles based on the results of monitoring and implementation activities from the initial round of planning (12).

The Neuse River basinwide plan is a comprehensive document that can serve as a model for other states considering basin planning. An outline of the contents of the document is provided in Table 2.

Practical Lessons From Framework Development

As noted earlier, several states are in the process of developing a whole basin planning framework, or have completed the framework and implemented basin planning. Several aspects of the framework development process in these states stand out as practical suggestions for other state, federal, and local agencies that may be considering basin planning:

- *Clearly define the specific objectives to be achieved:* This will determine the scope of the programs to be involved. The objectives are a positive statement of the issues to be addressed and resolved through the basin approach. This step eliminates uncertainty regarding the focus of the consensus process. Basin planning entails a considerable shift in thinking and practice regarding the manner in which resources will be managed. It moves agencies (and other stakeholders) from programmatic-based management to resource-based management. This shift does not necessarily require agency reorganization, but it does require emphasis on and sustained commitment to extensive communication and information sharing across programmatic lines.
- *Encourage stakeholder involvement at agency staff level:* The basin approach allows redefinition of functional relationships without formal reorganization.

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Table 2. Neuse River Basinwide Plan

Introduction	Purpose of the Neuse Basin Management Plan Guide to Use of Document Introduction to the Basinwide Management Approach Basinwide Responsibilities Within NCDEM Water Quality Section
General Basin Description	Physical and Geographic Features Land Use, Population, and Growth Trends Major Surface Water Uses and Classifications
Sources and Causes of Water Pollution in the Neuse Basin	Introduction Defining Causes of Pollution Point Sources of Pollution Nonpoint Sources of Pollution
Water Quality Status in the Neuse Basin	Sources and Types of Water Quality and Biological Data Narrative Water Quality Subbasin Summaries Neuse River Mainstem Methods for Determining Water Quality "Use Support" Ratings
Existing Point and Nonpoint Source Control Programs	Introduction Integrating Point and Nonpoint Source Pollution Control Strategies Point Source Pollution Control Through North Carolina's NPDES Permitting Program Nonpoint Source Control Programs
Basinwide Goals, Major Water Quality Concerns and Recommended Management Strategies for the Neuse Basin	Major Water Quality Concerns and Priority Issues Recommended Management Strategies for Oxygen Demanding Wastes Management Strategies for Nutrients Toxics
Basinwide Plan Summary and Future Initiatives	Overview of Neuse Basinwide Goals and Objectives Neuse NPDES Permitting and TMDL Strategies Nonpoint Source Control Strategies and Priorities Future Modeling Priorities Future Monitoring Priorities Future Programmatic Initiatives

The more broadly based the transition effort, the less confusion in the implementation of the approach. The basin approach also "flattens" organizations by shifting more decision-making responsibility to basin teams. Therefore, staff involvement is critical to development of the basin approach. Staff made many valuable contributions to the process and more eagerly embraced the approach in those states where staff participation was encouraged.

- *Allow time for adequate, thorough discussion of ideas and iterations during the development of the process framework.* Development of a basin planning process is complex and, as noted above, requires a shift in agency thinking and practice. Although no hard-and-fast guidance can be given on the specific lengths of time that are needed for each of the phases of the framework development process, experience in three states suggests that a minimum of 12 to 18 months should be allowed. By allowing adequate time for agency staff to thoroughly explore potential requirements of basin planning and issues identified during the preparation of a planning framework, a much stronger process will result.

- *Build in flexibility to the development process as well as the whole basin planning process itself:* The three states discussed in this paper have all employed a consensus-building, workshop-based process to develop planning frameworks. On occasion, workshops have been rescheduled at the last minute when it became clear that adequate numbers of participants would not be available because of scheduling conflicts. Also, workshop agendas underwent substantial modification at the session when it became clear that participants needed more in-depth discussion of basin planning concepts or particular issues they had identified. These conditions should not be viewed in a negative light—they are almost certain to occur in a consensus process, and the ability to respond with flexibility is essential to maintaining the momentum generated earlier in the process.

- *Define issues to address in order to translate objectives for basin planning into specific tasks:* Identification of certain core issues is essential for translating state-specific basin planning objectives to specific tasks that will be accomplished in the development of basin plans. Some issues that have been commonly identified across several states thus far include cross-program coordination, roles and responsibilities in the existing resource management scheme versus modifications necessary to implement basin planning, policy and regulatory implications at the state and federal level, and human and capital resources needs.

As noted above, basin planning emphasizes cross-program communication and coordination. Institutional and regulatory constraints, which vary from state to state, may lead to some disruption of existing programs during the transition period. Such disruptions can be minimized by carefully considering the steps needed to move from programmatic to resource-based management during the framework development process.

Acknowledgments

EPA and state funding have supported the work described in this paper. EPA Contract 68-C9-0013, Work Assignment WA 3-151, to Tetra Tech, Inc., has supported the first author. We wish to thank the following individuals for their support and insights on basin planning: Don Brady, EPA Office of Wetlands, Oceans, and Watersheds, Watershed Branch; Bill Painter, EPA Office of Policy, Planning, and Evaluation, Water Policy Branch; Trevor Clements, North Carolina Department of Natural Resources and Community Development, Water Quality Section, Technical Services Branch; Bob Zimmerman, Delaware Department of Natural Resources and Environmental Control, Division of Water Resources, Surfacewater Management Section; and Dan Wrye, Washington Department of Ecology, Water Quality Program, Alternative Strategies Unit.

References

1. U.S. EPA. 1992. The quality of our nation's water: 1990. EPA/841/K-92/001. Washington, DC.
2. U.S. EPA. 1992. National water quality inventory: 1990 report to Congress. EPA/503/9-92/006. Washington, DC.
3. Judy, R.D., P.N. Seeley, T.M. Murray, S.C. Svirsky, M.R. Whitworth, and L.S. Ischinger. 1984. 1982 National fisheries survey, Vol. I. Technical report: Initial findings. U.S. Fish and Wildlife Service. FWS/OBS-84/06.
4. Creager, C.S., J.P. Baker, and North Carolina Division of Environmental Management, Water Quality Section. 1991. North Carolina's basinwide approach to water quality management: Program description. Report No. 91-08. Prepared for the North Carolina Department of Environment, Health, and Natural Resources, Division of Environmental Management, Water Quality Section, and U.S. EPA Office of Policy, Planning, and Evaluation. Raleigh, NC.
5. NOAA and U.S. EPA. 1991. Coastal nonpoint pollution control program: proposed program development and approval guidance. National Oceanic and Atmospheric Administration and U.S. Environmental Protection Agency. Washington, DC.
6. Downs, P.W., K.J. Gregory, and A. Brookes. 1991. How integrated is river basin management? Environ. Mgmt. 15(3):299-309.
7. Mitchell, B. 1987. A comprehensive-integrated approach for land and water management, occasional paper 1. Centre for Water Policy Research. University of New England, Armidale, New South Wales, Australia.
8. U.S. EPA. 1991. The watershed protection approach: An overview. EPA/503/9-92/002. Washington, DC.
9. U.S. EPA. 1991. Summary report on issues in ecological risk assessment. Prepared for U.S. EPA Risk Assessment Forum. EPA/625/3-91/018. Washington, DC.
10. Phillips, J.D. 1989. Nonpoint source pollution risk assessment in a watershed context. Environ. Mgmt. 13(4):493-502.
11. U.S. EPA. 1989. Selecting priority nonpoint source projects: You better shop around. EPA 506/2-89/ 003. Washington, DC.
12. NCDEM. 1992. Neuse River basinwide water quality management plan (draft). North Carolina Division of Environmental Management. Raleigh, NC.
13. Clark, T. 1992. The watershed approach to resource management. Memorandum from the Department of Natural Resources and Environmental Control. Dover, DE.
14. Creager, C.S., and M.L. Bowman. 1992. Summary of whole basin planning approach scoping meetings with Delaware DNREC staff, September 8-9, 1992. Prepared for the Department of Natural Resources and Environmental Control, Division of Water Resources, Dover, DE.

Application of Urban Targeting and Prioritization Methodology to Butterfield Creek, Cook and Will Counties, Illinois

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Abstract

This paper describes the applicability of a methodology, developed by a consultant for the U.S. Environmental Protection Agency, to select, target, and prioritize best management practices (BMPs) in an urban watershed. The methodology was demonstrated in the Butterfield Creek watershed in South Cook County, Illinois. This watershed was selected because there are no major point sources of discharge to the creek, thus the impacts due to nonpoint sources alone could be addressed.

The methodology considered watershed land use, contributing nonpoint sources, and stream use attainment to identify priority areas for BMPs and then to prioritize those areas. The primary focus of the methodology, as originally developed, was to reduce problematic pollutant loads via appropriate BMPs. One shortcoming of the procedure was that it was limited to pollutant loads and, therefore, was not readily able to address other factors, such as the physical habitat impairments that affect many urban streams. Several enhancements were added to the methodology to address this situation. Also, the watershed configuration made interpretation of the prioritization results less straightforward.

The targeting methodology was enhanced in this application by presenting stormwater runoff rate as an additional targeted factor. Similarly, BMP selection and quantification were enhanced by representing the control of stormwater runoff rate by detention retrofitting.

Introduction

Purpose

The purpose of this paper is to report on a demonstration of a methodology developed by Woodward-Clyde Consultants for the U.S. Environmental Protection Agency (EPA) to select, target, and prioritize best management practices (BMPs) in an urban watershed (1). This methodology considers watershed land use, contributing nonpoint sources, and stream use attainment to identify priority areas for BMPs. The primary focus of the methodology, as developed, is to reduce problematic pollutant loads via appropriate BMPs. The methodology does not, however, address other constraints to stream use attainment, such as hydrologic destabilization and loss of physical habitat.

Butterfield Creek was selected for this demonstration for several reasons. First, watershed impacts are primarily due to nonpoint sources; there are no major point sources of discharge to the creek. Second, a preliminary nonpoint source management plan was being developed under a Section 319 grant, and this methodology could be used to assist in development of that plan. As a result, this paper presents analyses and results from both the preliminary nonpoint source plan (2) and the targeting methodology application (3). These two projects were originally documented separately, as referenced.

Assessment of Butterfield Creek problems has benefitted from the presence of a group known as the Butterfield Creek Steering Committee. The committee includes representatives from seven local governments in the watershed, and its mission is to address comprehensive stormwater management issues. While the primary focus of the committee has been the reduction of existing flooding problems, it also has identified the protection and improvement of water quality as major objectives. While committee members are concerned about water quality, they are also concerned about the potential expense of retrofitting urban BMPs in already developed areas. Therefore, a goal is to target BMPs to priority areas, where their effectiveness is maximized.

Background

Butterfield Creek drains a 26-square-mile watershed in Cook and Will Counties in northeastern, suburban

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Illinois. Its land use is largely residential and commercial in downstream areas. Much of the upstream watershed is presently undeveloped, although urbanization is anticipated. Existing water quality and stream use data indicate degraded conditions. There are no major permitted point source discharges to the stream, leading to the conclusion that nonpoint source impacts are the likely causative factors for the observed conditions.

Targeting and Prioritization Procedure

The elements of the targeting and prioritization procedure are as follows:

- Characterization of the watershed, including:
  - Subwatershed identification
  - Land-use identification
  - Nonpoint source impacts
- Incorporation of additional relevant factors, based on watershed conditions, into the documented targeting procedure.
- Calculation of pollutant loads and completion of targeting table.
- Prioritization of drainage areas for nonpoint control.

Characterization of Butterfield Creek

Subwatershed Identification

Butterfield Creek is composed of three primary subwatersheds; the mainstem, the east branch, and the west branch. The two branches are parallel systems that are tributary to the mainstem. Approximately 25 percent of the watershed drains to the east branch, and approximately 36 percent of the watershed drains to the west branch. The remaining 39 percent of the watershed drains directly to the mainstem, which is entirely downstream of the two branches.

Land-Use Identification

Land use in the Butterfield Creek watershed was interpreted from 1990 aerial photographs (1 in. equals 400 ft). This information was then digitized and entered into an ARC/INFO geographic information system. Subwatershed boundaries also were entered into the system, and land-use totals were cumulated for both the total watershed and the three distinct subwatersheds (west branch, east branch, and mainstem). This information is presented in Table 1.

About 55 percent of the watershed has been developed into the following urban land-use categories: industrial, commercial/institutional, residential, highway/arterial roadway, railroad, and urban park and golf course. The remainder, including woodland/wetland areas, agricultural land, and vacant land, remains undeveloped. Most of the undeveloped land lies in upstream parts of the watershed, particularly the west branch.

Stream Conditions

Stream conditions were assessed based on review of existing aquatic life, water quality, and sediment quality data as described in the preliminary nonpoint source plan (2). Physical habitat data were collected during development of the preliminary nonpoint source management plan.

Aquatic Life, Water Quality, and Sediment Quality

The existing data indicated degraded fish community conditions throughout the watershed. As is typical with many urban streams, species diversity and number are quite low relative to less urbanized streams in Illinois. Water quality conditions were also generally degraded, particularly in the more urban reaches. Sediment quality data paralleled the water quality data, with more elevated levels recorded in urban reaches.

Physical Habitat

Physical habitat conditions in Butterfield Creek were assessed during field visits to the creek. Data were collected on stream condition reporting forms created for the nonpoint source management planning effort. Conditions such as degree of channelization, stream and riparian vegetation, substrate material, erosion and sedimentation, and observations of benthics and macroinvertebrates and fish species were recorded. The site visits indicated highly variable conditions. The west and east branches tended to be highly channelized as a result of agricultural and urban drainage activities. Mainstem reaches tended to be less altered but appeared to suffer from the effects of flow destabilization due to urban stormwater runoff. Channel erosion and widening was prevalent in many downstream reaches.

Assessment of Nonpoint Source Impacts

Considering all available information from Butterfield Creek and comparing its characteristics to other streams in Illinois, the following conclusions were made regarding nonpoint source impairment in Butterfield Creek.

Stream Uses

Many potential stream uses identified by the Illinois Environmental Protection Agency (IEPA) are inherently constrained by the size and flow of Butterfield Creek. Uses that Butterfield Creek can be expected to support and that were evaluated are fish and aquatic wildlife (including warm water fishery), body contact recreation, and noncontact recreation. IEPA assessments indicate that present stream uses are moderately impaired.

Table 1. Watershed Land Use (square miles)

Land Use Category	Subwatershed: West Branch	Subwatershed: East Branch	Subwatershed: Mainstem	Total Watershed: Square Miles	Total Watershed: Percent of Total
Industrial	0.037	0.079	0.022	0.14	0.54
Commercial/Institutional	0.196	1.027	0.669	1.89	7.38
Low-density residential	1.342	1.369	4.035	6.75	26.33
High-density residential	0.230	0.188	1.655	2.07	8.09
Vacant	0.980	1.236	0.657	2.87	11.22
Open land/urban park	0.171	0.152	1.552	1.87	7.32
Highway/arterial road	0.541	0.265	0.296	1.10	4.30
Agriculture	3.954	1.816	0.233	6.00	23.43
Woodland/wetland	1.828	0.274	0.568	2.67	10.43
Railroad	0.019	0.082	0.143	0.24	0.95
Watershed total	9.30	6.49	9.83	25.62	100.00
Watershed rank value	3.63	2.53	3.84	10.00	

While Butterfield Creek is not presently used to a great degree for water-based recreation, it is a potentially valuable unit of the downstream Thorn Creek and Little Calumet River systems. Also, Butterfield Creek is a valuable indicator of the nonpoint source effects of urbanization on receiving stream quality in northeastern Illinois. Improvement of uses in the larger streams will require the successful restoration of streams such as Butterfield Creek.

Stream Use Impacts

Based on existing data, the most readily identified impacts to uses in Butterfield Creek are related to degraded physical conditions. These conditions include degraded physical habitat, as evidenced by artificially modified or eroded channels, and impaired aesthetics, due in part to debris and trash. Low dissolved oxygen also appears to be a limiting constraint to improved aquatic life uses, particularly in the east branch and several reaches of the mainstem.

Several other water quality factors, including toxicity to aquatic life, turbidity, and siltation, were identified as contributing constraints to improved stream uses. Based on existing data from Butterfield Creek and other urban streams, however, whether these water quality factors by themselves limit the potential stream uses in much of Butterfield Creek is unclear.

Causes of Stream Use Impacts

The primary causes of stream use impacts in Butterfield Creek include physical habitat alterations, flow destabilization, channel erosion, bacterial contamination, nutrient enrichment, and noxious aquatic plants/algae.

Other suspected causes of use impairment include heavy metals, pesticides, oil and grease, unknown toxicity, organic enrichment, and suspended solids. Again, relying on the existing database, determining the degree to which these latter causes adversely affect stream use attainment is difficult.

Contributing Nonpoint Sources

The most prevalent nonpoint source responsible for use impairment in Butterfield Creek is urban runoff, which causes both physical and chemical degradation of the creek. Other significant nonpoint sources include streambank modifications, channelization, and removal of riparian vegetation.

Several other sources have been identified as contributing to stream use impairment, although their relative effects are much less certain. These include onsite wastewater systems, illicit sewer connections, golf course runoff, draining/filling of wetlands, construction site runoff, debris jams/beaver dams, carp/nuisance fish, and nonirrigated crop production.

Finally, potential point-source-related impacts were noted but could not be quantified. These included the treated wet-weather discharge from the former Homewood wastewater treatment plant, wastewater discharges from Ely's Mobile Home Park and Idlewild Country Club, and sanitary sewer overflows.

Application of Urban Targeting Methodology

Overview of Procedure

Objectives of Butterfield Creek Application

This section describes the application of the targeting methodology to Butterfield Creek. The major purpose of this effort is to assess the applicability of the methodology for nonpoint source watershed planning in northeastern Illinois streams.

Comparison of Butterfield Creek Application to Example Watershed

The assessment of nonpoint source impacts has led to some very important conclusions that drive the application of the targeting methodology for Butterfield Creek. Perhaps unlike many other urban watersheds, the nonpoint source assessment of Butterfield Creek did not identify pollutants delivered by urban runoff (e.g., heavy metals, toxic organics) as the primary cause of use impairment. Instead, physical disturbances, including stream channelization and flow destabilization, appear to be among the most significant causes of impairment. (Considering both physical and chemical effects, urban runoff is the most important nonpoint source requiring remediation in the mainstem of the creek.) This conclusion causes the BMP selection procedure to emphasize measures that control runoff rate as well as runoff quality. Because there is not a wide range of potential BMPs addressing this problem, BMP selection becomes more straightforward. As a result, this paper places more emphasis on the targeting aspect of the methodology.

Another difference between Butterfield Creek and the example watershed presented in the methodology report is that stream use attainment in Butterfield Creek does not vary dramatically among subwatersheds. All three subwatersheds of Butterfield Creek are significantly impaired, although the causes of impairment vary substantially among the subwatersheds.

Still another difference between Butterfield Creek and the example watershed is the orientation of the subwatersheds. In the example, there were three parallel stream segments. In Butterfield Creek, there are two parallel stream segments that are tributary to the third. Therefore, BMPs implemented in the two upstream watersheds affect both the local watershed and the downstream watershed. Similarly, adequately addressing problems in the downstream subwatershed without applying some BMPs in upstream areas may be impossible.

Further, the three watersheds differ significantly in the levels of potential use attainability. Both the west and east branches are headwater streams with low dry-weather flows. Mainstem flows are more substantial, and its larger channel dimensions allow greater potential for full stream use.

Computation of Pollutant Loadings

The methodology report describes a procedure for estimating pollutant loadings by land-use category. The procedure involves the assignment of runoff coefficients and pollutant concentrations to watershed land uses.

Runoff Coefficients

The first step is to assign a dimensionless runoff coefficient to each land use. The runoff coefficient is a measure of the watershed response to rainfall events and is intended to be equivalent to the total storm runoff divided by the total rainfall volume for runoff-producing rain events. The runoff coefficient (Rv) is estimated from the percent imperviousness of individual land uses by the following equation (4):

$$Rv = 0.05 + (0.009 * \text{percent impervious}). \quad \text{(Eq.1)}$$

While this methodology is quite simplistic with respect to true watershed hydrologic response, it is an appropriate way to represent the relative runoff responses of different land uses to pollutant-generating rainfall/runoff events. As such, it represents only the short-term surface component of runoff and is not intended to represent the complete storm hydrograph.

Pollutant Concentrations

The methodology report also includes suggested pollutant concentrations for different land uses. These concentrations can be used in conjunction with the runoff coefficients to estimate differences in expected pollutant loads for different land uses. The methodology report makes it clear, however, that these concentrations are not intended to be used in the estimation of actual pollutant loads for the area. Also, the methodology report provides concentrations for just six land-use types. Four additional land uses were used to represent Butterfield Creek, and pollutant concentrations for these were derived from both local sources (5) and the methodology report.

Table 2 summarizes the runoff coefficient and pollutant concentration assumptions for the Butterfield Creek land uses. These estimates are used to reflect relative differences in runoff rates and pollutant loads and are not intended to estimate actual loads.

Pollutant Loadings

Pollutant loads from runoff and concentration are computed as follows:

Table 2. **Runoff Coefficients and Pollutant Concentrations by Land Use**

Land-Use Category	Runoff Coefficient	Pollutant Concentrations (mg/L) TSS	O&G	TP	Copper
Industrial	0.60	120	20	0.20	0.05
Commercial/institutional	0.80	80	20	0.20	0.05
Low density residential	0.20	100	5	0.60	0.03
High density residential	0.40	90	10	0.40	0.04
Vacant	0.10	60	0	0.20	0.01
Open land/urban park	0.10	50	0	0.60	0.01
Highway/arterial road	0.60	80	15	0.20	0.05
Agriculture	0.10	150	0	0.80	0.01
Woodland/wetland	0.05	50	0	0.20	0.01
Railroad	0.20	80	15	0.20	0.05

Mass load (pounds) =
Rv * area (acres) * concentration (mg/L) * 0.227. (Eq. 2)

This computation provides an estimate of the relative pollutant load per inch of runoff-producing rain.

Runoff Rates

As previously indicated in the summary of nonpoint source impacts to the watershed, pollutant loadings in stormwater runoff do not appear to be the limiting cause of stream use attainment. The quantity or rate of runoff from urban land uses, however, does appear to be a limiting constraint to improved stream uses, especially for aquatic life. In particular, the expansion of impervious surfaces increases the rate and volume of runoff for storm events and reduces stream base flow. This altered hydrology destabilizes the receiving stream channel and adversely affects habitat. Another cause of physical habitat impairment is channel modification (e.g., channelization, armoring).

Although runoff rate was not used as a targeting factor during development of the methodology, it can be incorporated readily. The runoff coefficient provides a similar indicator of runoff "load" as the product of runoff coefficient and concentration provides for pollutant load.

Comparison of Relative Loads: Targeting

Watershed Pollutant Loads

Using the methodology described in the previous section, pollutant and runoff loads were estimated by land-use category for each subwatershed and the overall watershed. Tables 3 through 6 summarize pollutant loadings for total suspended solids (TSS), oil and grease (O&G), total phosphorus (TP), and copper, and Table 7 summarizes storm runoff.

Total Suspended Solids. Evaluation of Table 3 indicates that TSS loads vary by subwatershed, but not to a great degree. There is, however, a great deal of variability in loadings between land-use categories. This variability is based on differences in runoff coefficients and pollutant concentrations (summarized in Table 2).

Figure 1 presents TSS loadings in a different fashion. This map visually represents loading intensity. It suggests, for example, that TSS loads could be reduced significantly by targeting just those areas of the watershed that contribute at high rates (e.g., greater than 4,000 lb/mi^2). The nonpoint source assessment of Butterfield Creek identified TSS as a contributing cause of use impairment, particularly for aquatic life and recreational uses. While TSS does not appear to be as important as some other identified causes of use impairment (such as flow destabilization, physical habitat alteration, and channel erosion), it still should be addressed in the final watershed management plan. The targeting information presented in this section will be useful in determining a comprehensive control strategy.

Oil and Grease. O&G loadings as presented in Table 4 vary dramatically by both subwatershed and land use. The reason for this greater variability is the fact that oil and grease is assumed to originate completely from developed urban areas. Therefore, there is a relatively small loading in the mostly nonurbanized west branch subwatershed.

As with TSS, if O&G control was a high priority for stream use remediation, it would be relatively easy to identify areas for BMP targeting by using a map similar to Figure 1 for O&G. As indicated in the nonpoint source

Table 3. Total Suspended Solids Loading (pounds per inch of rain)

	Subwatershed			Total Watershed	
Land-Use Category	West Branch	East Branch	Mainstem	Pounds	Pounds/ Sq. Mile
Industrial	389.0	827.1	233.8	1,450	10,357
Commercial/institutional	1,817.5	9,533.2	6,207.7	17,558	9,290
Low-density residential	3,892.9	3,970.6	11,700.0	19,564	2,898
High-density residential	1,200.3	983.5	8,641.3	10,825	5,229
Vacant	852.5	1,075.7	572.2	2,500	871
Open land/urban park	124.1	110.0	1,125.6	1,360	727
Highway/arterial road	3,765.5	1,846.2	2,061.7	7,673	6,976
Agriculture	8,601.9	3,951.9	505.8	13,060	2,177
Woodland/wetland	663.0	99.4	206.1	968	363
Railroad	44.1	189.3	332.4	566	2,357
Watershed total	2,1351	22,587	31,587	75,524	2,948
Watershed rank value	2.8	3.0	4.2	10.0	

Table 4. Oil and Grease Loading (pounds per inch of rain)

	Subwatershed			Total Watershed	
Land-Use Category	West Branch	East Branch	Mainstem	Pounds	Pounds/ Sq. Mile
Industrial	64.9	138.1	39.0	242	1,739
Commercial/institutional	455.1	2,387.1	1,554.4	4,397	2,319
Low-density residential	195.0	198.8	586.3	980	145
High-density residential	133.6	109.4	961.7	1,205	580
Vacant	0.0	0.0	0.0	0	0
Open land/urban park	0.0	0.0	0.0	0	0
Highway/arterial road	707.2	346.7	387.2	1,441	1,304
Agriculture	0.0	0.0	0.0	0	0
Woodland/wetland	0.0	0.0	0.0	0	0
Railroad	8.3	35.5	62.4	106	435
Watershed total	1,564	3,216	3,591	8,371	327
Watershed rank value	1.9	3.8	4.3	10.0	

assessment, O&G is identified as a potential, but not major, contributor to use impairment.

Total Phosphorus. Total phosphorus loadings as presented in Table 5 vary the least among the land-use categories. This is explained by the fact that relatively high concentrations are assumed for low-density residential and agricultural land uses, and these concentrations counterbalance the relatively low runoff coefficients for these uses.

Copper. The last pollutant to be presented is copper. Copper loadings are presented in Table 6 and Figure 2. Relative differences in copper loadings are similar to those observed for O&G in that the heaviest loadings come exclusively from intensely developed urban land uses. Figure 2 makes clear that effective reduction of total copper loadings could be achieved by targeting a relatively small fraction of the total watershed for BMPs.

Available data, however, suggest that copper is not a major cause of stream use impairment in Butterfield Creek. While violations of the copper water quality standard occur with some frequency, acute toxicity to fish due to copper concentrations in stormwater does not appear to be problematic. Nonetheless, copper may be used as an effective surrogate for other urban runoff toxicants, particularly other heavy metals, which are believed to play a role in limiting aquatic life in the creek.

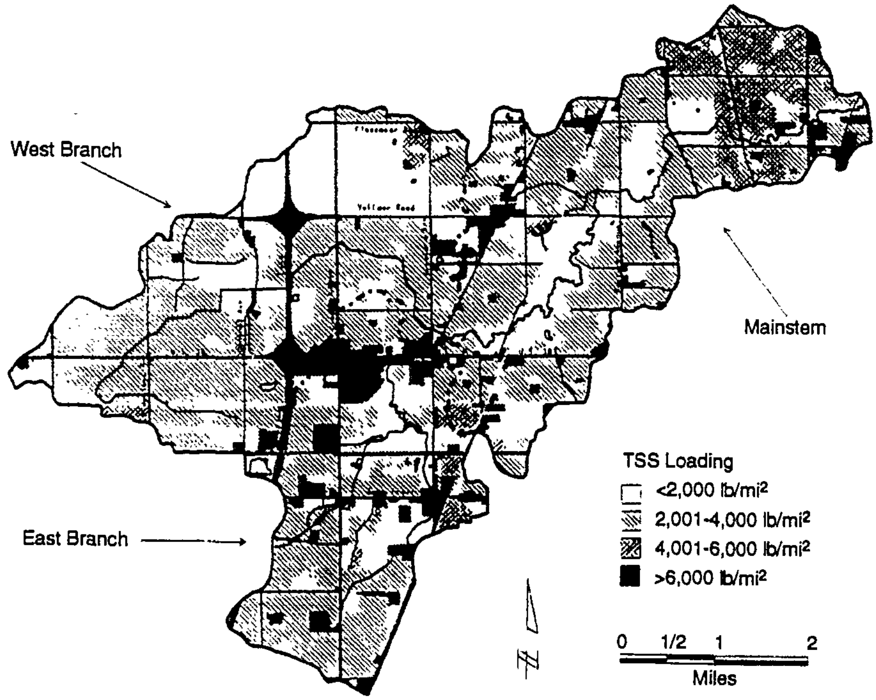

Figure 1. TSS loading per inch of rain, Butterfield Creek.

Table 5. Total Phosphorus Loading (pounds per inch of rain)

	Subwatershed			Total Watershed	
Land-Use Category	**West Branch**	**East Branch**	**Mainstem**	**Pounds**	**Pounds/ Sq. Mile**
Industrial	0.648	1.379	0.390	2.4	17.4
Commercial/institutional	4.544	23.833	15.519	43.9	23.2
Low-density residential	23.358	23.824	70.238	117.4	17.4
High-density residential	5.335	4.371	38.406	48.1	23.2
Vacant	2.842	3.586	1.907	8.3	2.9
Open land/urban park	1.489	1.320	13.507	16.3	8.7
Highway/arterial road	9.414	4.615	5.154	19.2	17.4
Agriculture	45.877	21.077	2.698	69.7	11.6
Woodland/wetland	2.652	0.397	0.824	3.9	1.5
Railroad	0.110	0.473	0.831	1.4	5.8
Watershed total	96.3	84.9	149.5	330.6	12.9
Watershed rank value	2.9	2.6	4.5	10.0	

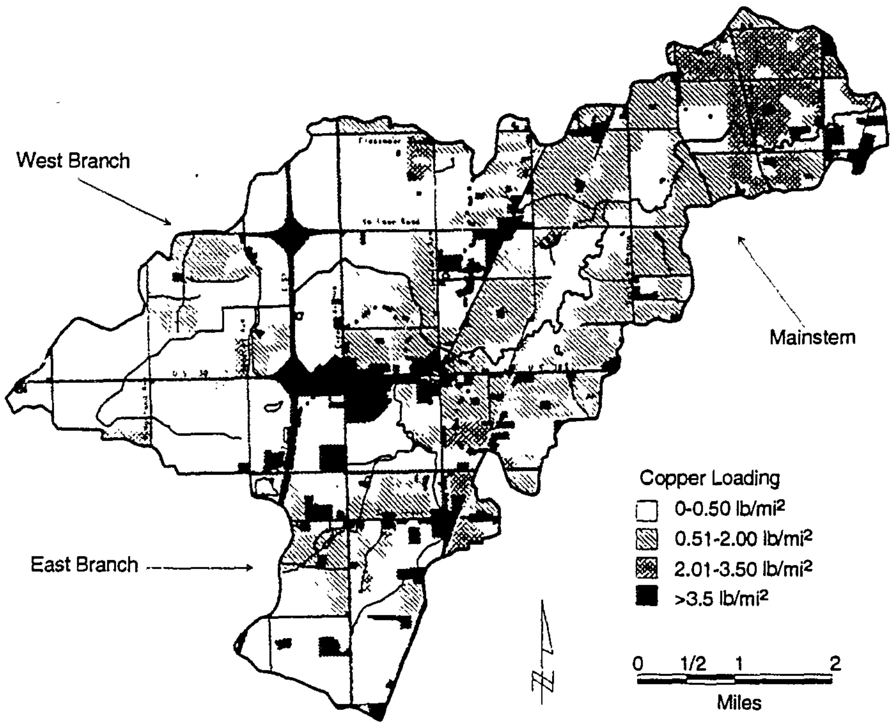

Figure 2. Copper loading per inch of rain, Butterfield Creek.

Table 6. Copper Loading (pounds per inch of rain)

	Subwatershed			Total Watershed	
Land-Use Category	**West Branch**	**East Branch**	**Mainstem**	**Pounds**	**Pounds/ Sq. Mile**
Industrial	0.16	0.35	0.10	0.6	4.3
Commercial/institutional	1.14	5.97	3.89	11.0	5.8
Low-density residential	1.17	1.19	3.52	5.9	0.9
High-density residential	0.53	0.44	3.85	4.8	2.3
Vacant	0.14	0.18	0.10	0.4	0.1
Open land/urban park	0.03	0.02	0.23	0.3	0.1
Highway/arterial road	2.36	1.16	1.29	4.8	4.3
Agriculture	0.57	0.26	0.03	0.9	0.1
Woodland/wetland	0.13	0.02	0.04	0.2	0.1
Railroad	0.03	0.12	0.21	0.4	1.4
Watershed total	6.3	9.7	13.2	29.2	1.1
Watershed rank value	2.1	3.3	4.5	10.0	

Storm Runoff. Although runoff is not a pollutant, it has been shown to be nearly as important as pollutant loading for causing degradation of stream uses. Storm runoff "loadings" in units of acre-inch/inch of rain are presented in Table 7 and Figure 3. Relative differences in storm runoff loadings are similar to those observed for O&G and copper, and high rates of runoff are from intensely developed urban land uses. Table 7 suggests that, as with the urban pollutants, targeting a relatively small area could reduce the overall loading by a substantial proportion. Figure 3 indicates that the same areas contributing high copper loads are contributing high storm runoff rates.

Evaluation of BMP Alternatives for Butterfield Creek

The methodology report describes several BMP types, including detention, retention, vegetative controls, and source controls. Each of these were discussed briefly in the Butterfield Creek targeting report (3), and that discussion will not be repeated here. The important conclusions from that discussion follow.

The feasibility of implementing certain BMPs differs dramatically between remedial applications (i.e., existing development) and preventative applications (i.e., new development or redevelopment). Most of the municipalities in the Butterfield Creek watershed have recently adopted comprehensive stormwater management ordinances that require implementation of effective detention designs for development activities and require site-by-site evaluation of other BMPs, such as infiltration trenches, filter strips, and vegetated buffers. The ordinance discussed here was developed by the Butterfield Creek Steering Committee.

The limiting cause of stream use impairment in Butterfield Creek is hydrologic destabilization and streambank modification/channelization. After addressing these problems, however, full uses still may not be supported without addressing contributing water quality factors. Thus, BMPs for Butterfield Creek must control both runoff rates or volumes and pollutant loadings.

Stormwater detention is a widely accepted practice in the watershed, and recent experience indicates that the stringent designs that accommodate pollutant removal functions are implementable. The generally accepted detention design for new development among watershed communities calls for limiting the runoff rate for the 2-year storm to 0.04 ft^3/sec/acre. This should provide effective pollutant removal as well as control of rates for most storm events. Virtually the only other management practice capable of controlling runoff volumes (and rates) is infiltration (retention devices). This practice, however, has not been widely applied in the watershed or throughout the northeastern Illinois region. The primary constraint to using infiltration practices is the relatively impervious soils of the region.

Most existing detention facilities in the watershed were built without consideration of pollutant removal functions or rate control of more routine events. Investigation of typical facilities, however, suggests that most could be readily retrofitted by installing new outlet controls and performing minor regrading to achieve substantial water quality and rate control benefits. Similarly, there are open areas (e.g., school yards, parks, vacant land) in the watershed where detention could be constructed adjacent to existing uncontrolled developments.

Detention retrofitting has the benefit of controlling both water quality and runoff rate to address stream use impairments as well as flood control benefits, which are often perceived as greater needs. Thus, detention retrofitting has the greatest potential for reducing constraints to stream uses as well as the greatest implementability. Targeting of detention retrofitting is discussed in the following section.

Reduction of Pollutant and Storm Runoff Loads via Detention Retrofitting

To demonstrate how targeting of BMPs can remediate high pollutant loadings in Butterfield Creek, it was assumed that detention basin retrofitting would be applied to land uses contributing high copper loads. These included industrial, commercial/institutional, and high-density residential uses, representing 16 percent of the total watershed area. For purposes of this evaluation, it is assumed that under existing conditions there is no effective detention-based control of copper runoff from these land uses. This is generally true in that much of the historical development in the watershed occurred without detention requirements. Further, most detention facilities built subsequent to the promulgation of ordinance requirements did not include pollutant removal features. Another significant contributor of copper loads, highways/arterial roads, was not considered for this BMP because of the general unavailability of land within right-of-ways to implement detention.

Targeting is also demonstrated for remediating high storm-runoff rates. Because the same land uses that contribute high copper loadings also contribute the highest runoff rates, the same 16 percent of the area will be targeted for runoff rate control. As with copper, it is assumed that under existing conditions there is no effective control of the 2-year and smaller storm events most affected by urbanization.

Effective detention retrofitting designs, based on fully detaining runoff from the 2-year storm (as now required by most Butterfield Creek communities), was assumed to remove 60 percent of the copper load. Table 8 and Figure 4 show the effects of this action. By controlling

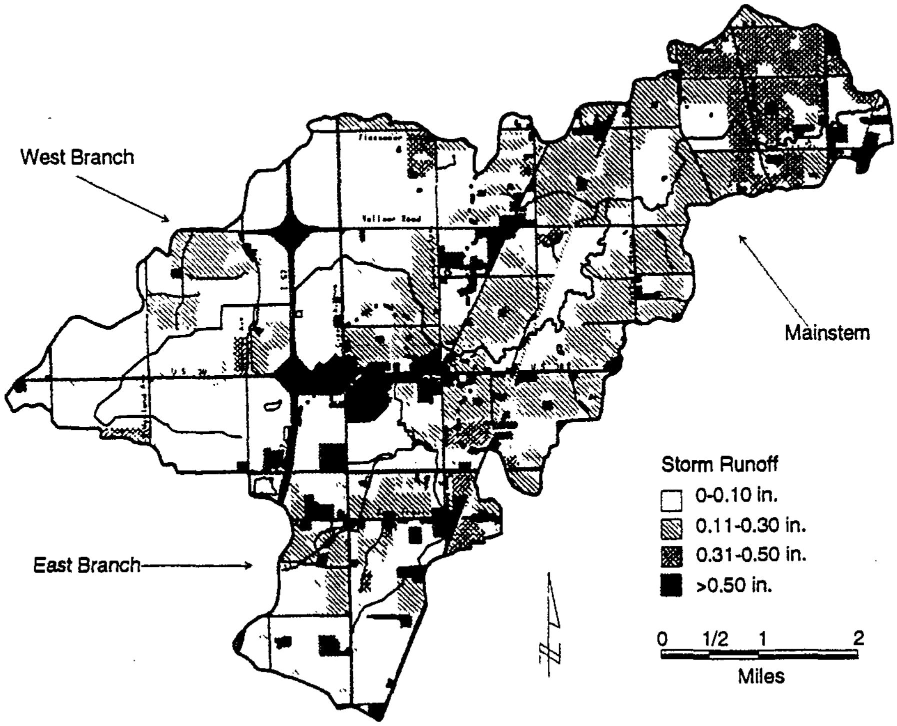

Figure 3. Storm runoff per inch of rain, Butterfield Creek.

Table 7. Storm Runoff (inch-acres per inch of rain)

	Subwatershed			Total Watershed	
Land-Use Category	**West Branch**	**East Branch**	**Mainstem**	**Inch-Acres**	**Inches**
Industrial	14.3	30.4	8.6	53	0.60
Commercial/institutional	100.2	525.8	342.4	968	0.80
Low-density residential	171.8	175.2	516.5	863	0.20
High-density residential	58.8	48.2	423.7	531	0.40
Vacant	62.7	79.1	42.1	184	0.10
Open land/urban park	10.9	9.7	99.3	120	0.10
Highway/arterial road	207.7	101.8	113.7	423	0.60
Agriculture	253.0	116.2	14.9	384	0.10
Woodland/wetland	58.5	8.8	18.2	85	0.05
Railroad	2.4	10.4	18.3	31	0.20
Watershed total	940	1,106	1,598	3,644	0.22
Watershed rank value	2.6	3.0	4.4	10.0	

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just 16 percent of the watershed via detention retrofitting, the total watershed copper load is reduced from 29.2 lb/in. of rain to 19.3 lb/in. of rain, a 34-percent reduction. This example demonstrates quite clearly the value of being able to target BMPs within a watershed.

It is assumed that effective detention retrofitting, which includes control of runoff from the 2-year storm to 0.04 ft^3/sec/acre, can limit the storm runoff rates (not volumes) for high-intensity land uses to the runoff rate from nonurbanized land. Table 9 and Figure 5 illustrate the effects of this control being applied to industrial, commercial/institutional, and high-density residential land uses. Comparing Table 7 to Table 9 indicates that the short-term, storm runoff rate is reduced by 35 percent for the entire watershed, from 0.22 in. per in. of rain to 0.14 in. per in. of rain. The reduction in storm runoff rate is even more dramatic for the mainstem (39 percent). In other words, if detention retrofitting can be implemented for just 16 percent of the creek watershed, short-term storm runoff can be reduced dramatically, thereby reducing downstream bank erosion and habitat destabilization effects. While detention retrofitting will have relatively little effect on total runoff volumes, it will dampen stormwater runoff peaks substantially and also produce significant pollutant removal benefits.

Application of Watershed Prioritization Analysis

The methodology report briefly describes a procedure for prioritizing subwatersheds for BMP targeting. This procedure relies on a number of factors (including water body importance; type, status, and level of use; pollutant loads, and implementability of controls) to rank subwatersheds. The relative importance of these factors is indicated by assigning weights. As discussed previously, the Butterfield Creek watershed orientation is different from the example presented in the methodology report and, as a result, may not be as appropriate for this type of prioritization as the example. Nonetheless, the suggested prioritization methodology is illustrated in the following example.

Assignment of Prioritization Factors

The methodology report recommends the assignment of factors based on relative rankings. For purposes of this evaluation, the ranking scale ranges from 0 to 10.

Water Body Importance/Stream Size

Stream size factors are assigned in proportion to the total drainage area providing flow to the stream. Subwatershed drainage area rank values were previously computed and are presented in Table 1.

Beneficial Use Type

Use-type ranks are based on the nature of potential use of the stream reach. The mainstem is assigned a relatively high rank because of the presence of riparian public open space and because its size and physical characteristics offer the most potential for aquatic life and recreational uses. The west and east branches are assigned relatively lower ranks because of their more limited potential and because of the perception, particularly for sections of the east branch, that the stream's primary function is drainage.

Table 8. Copper Loading[a] With Detention Basin Retrofitting for Industrial, Commercial/Institutional, and High-Density Residential Areas (pounds per inch of rain)

	Subwatershed			Total Watershed	
Land-Use Category	**West Branch**	**East Branch**	**Mainstem**	**Pounds**	**Pounds/Sq. Mile**
Industrial	0.07	0.14	0.04	0.2	1.7
Commercial/institutional	0.45	2.38	1.55	4.4	2.3
Low-density residential	1.17	1.19	3.51	5.9	0.9
High-density residential	0.21	0.18	1.54	1.9	0.9
Vacant	0.14	0.18	0.10	0.4	0.1
Open land/urban park	0.03	0.02	0.23	0.3	0.1
Highway/arterial road	2.35	1.15	1.29	4.8	4.3
Agriculture	0.57	0.26	0.03	0.9	0.1
Woodland/wetland	0.13	0.02	0.04	0.2	0.1
Railroad	0.03	0.12	0.21	0.4	1.4
Watershed total	5.2	5.6	8.5	19.3	0.8
Watershed rank value	2.7	2.9	4.4	10.0	

[a]60 percent loads reduction assumed for targeted areas

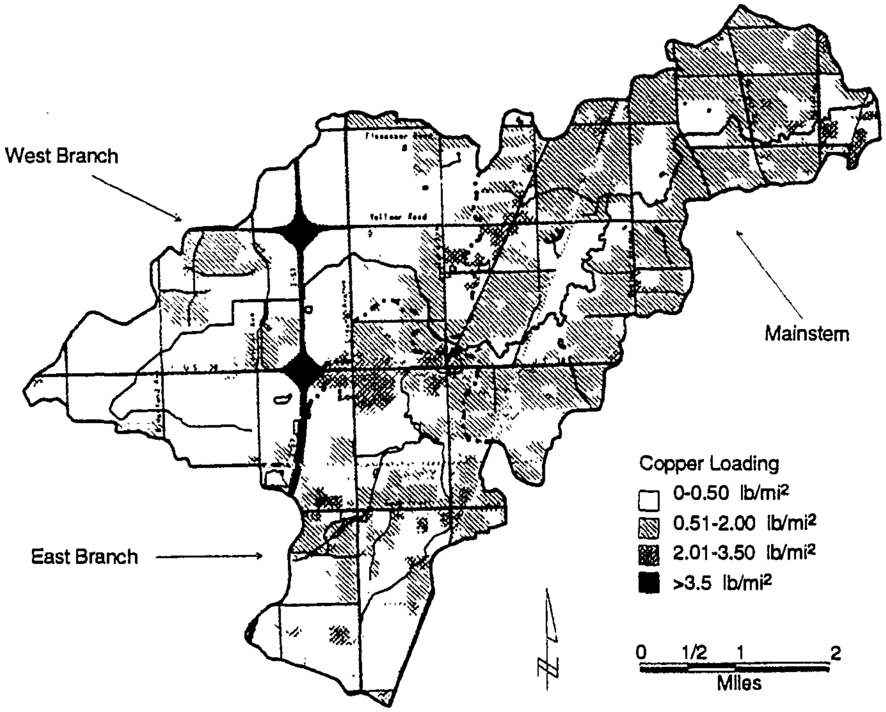

Figure 4. Copper loading per inch of rain, Butterfield Creek (with detention basin retrofitting for industrial, commercial/institutional, and high-density residential areas).

Table 9. Storm Runoff[a] With Detention Basin Retrofitting for Industrial, Commercial/Institutional, and High-Density Residential Areas (inch-acres per inch of rain)

	Subwatershed			Total Watershed	
Land-Use Category	**West Branch**	**East Branch**	**Mainstem**	**Inch-Acres**	**Inches**
Industrial	2.4	5.1	1.4	9	0.10
Commercial/institutional	12.5	65.7	42.8	121	0.10
Low-density residential	171.8	175.2	516.5	863	0.20
High-density residential	14.7	12.1	105.9	133	0.10
Vacant	62.7	79.1	42.1	184	0.10
Open land/urban park	10.9	9.7	99.3	120	0.10
Highway/arterial road	207.7	101.8	113.7	423	0.60
Agriculture	253.0	116.2	14.9	384	0.10
Woodland/wetland	58.5	8.8	18.2	85	0.05
Railroad	2.4	10.4	18.3	31	0.20
Watershed total	797	584	973	2,354	0.14
Watershed rank value	3.4	2.5	4.1	10.0	

[a]Reduction of runoff coefficient to 0.1 for targeted areas

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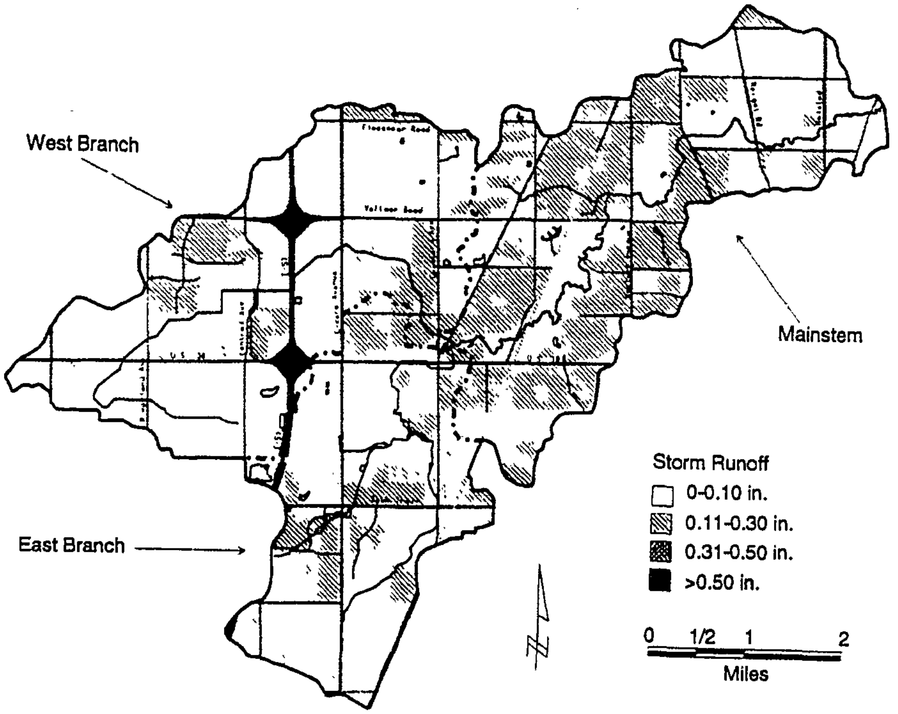

Figure 5. Storm runoff per inch of rain, Butterfield Creek (with detention basin retrofitting for industrial, commercial/institutional, and high-density residential areas).

Beneficial Use Status

The methodology report is somewhat unclear regarding the determination of this factor. It is assumed in this example that use status reflects the degree of restoration and protection needed to achieve desired beneficial uses. Because each of the branches is similar in its relative degree of aquatic life use impairment, similar factors are assigned. The mainstem's ranking is slightly lower, however, because of the greater level of streamside activities presently supported.

Beneficial Use Level

This factor reflects the level of stream use relative to other water bodies in the target watershed. For Butterfield Creek subwatersheds, use level considers accessible riparian and accessible open space (e.g., parks and golf courses) and the presence of residential land use adjacent to the stream corridor. With these factors considered, the mainstem is assigned the highest ranking, followed by the east branch and the west branch.

Pollutant Loads

This factor represents the degree of pollutant loading or some other cause that is impairing water body use. In this example, runoff rate (rather than quality) is used to reflect this factor. Storm runoff rate factors are derived from Table 7.

Implementability of Controls

This factor is assumed to represent the relative degree of implementability of control measures. In this example, the recommended control measure to reduce storm runoff rates is detention basin retrofitting. As was discussed previously, retrofitting of existing highway/arterial roads probably will not be feasible in most areas. Beyond that, distinguishing the relative implementability of retrofitting based on institutional or technical factors is not easy. For this reason, ranks are assigned on the basis of watershed size and the relative degree of high-density urban development. Another factor that could have been considered is the relative proximity of targeted land uses. Large concentrations of targeted land uses could more readily be addressed through more cost-effective regional controls.

Table 10 presents ranks for each of these factors by subwatershed. It includes an assignment of factors for the total watershed as well. The recommended basis for assignment of total watershed factors is not described in the methodology report. In the Butterfield Creek example, totals of the subwatershed ranks are used for both stream size and stormwater rate. For the remaining

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Table 10. Butterfield Creek Prioritization Analysis

Watershed	Stream Size	Beneficial Use: Type	Status	Level	Stormwater Rate	Ability To Implement	Target Score
Weights	25	10	10	5	25	25	100
West branch	3.63	4	7	3	2.6	8	4.81
East branch	2.53	3	8	4	3.0	4	3.68
Mainstem	3.84	6	6	7	4.4	4	4.61
Total watershed	10.00	5	7	5	10.0	5	7.70

Target score = weighted average of rank points = sum (rank score * weight) / sum (weights)

factors, approximate averages of the subwatershed ranks are used.

Assignment of Relative Weights

The methodology report recognizes that some factors may be more important than others and suggests that these differences be accounted for by assigning different weights to each factor. The report also recognizes that considerable subjectivity is involved in the selection of factors and the assignment of ranks and relative weights.

Discussions with representatives from the watershed, primarily the Butterfield Creek Steering Committee, were considered in assigning relative weights for Butterfield Creek. The actual assignment, however, becomes somewhat challenging for several reasons. First, as indicated, evaluation of the different factors is quite subjective, and quantification, even in relative terms, is difficult. Second, while the listed evaluation factors are clearly important to the efficient remediation of use constraints in Butterfield Creek, they are difficult to compare and weight relative to each other. Third, as discussed previously, because two of the stream branches flow into the third, the remediation of problems in the third branch (the mainstem) is clearly not independent of remedial activities in the other branches. The example from the methodology report does not directly reflect this interdependence.

Bearing in mind these qualifications, weights were assigned to the identified factors by following the procedure described in the methodology report. As seen in Table 10, equal weights of 25 are assigned to the four factors. For the beneficial-use category, weights are assigned to the three subcategories so that they total 25.

Results of Watershed Prioritization

On the basis of the assignment of weights and factors as described above, stormwater rate controls should be applied first to the west branch, followed closely by the mainstem, and then the east branch. Just as in the example in the methodology report, however, the "total watershed" receives the highest target score, implying priority control of the entire watershed.

In evaluating the results of this prioritization to Butterfield Creek, the west branch apparently receives the highest subwatershed priority primarily because it scores quite well in the ability-to-implement category. In reality, its high score in this category is due to the relatively little high-density urbanization within its watershed and, therefore, its relative ease of control. The east branch receives the lowest targeting score because it is smallest in watershed size and because it scores poorly relative to potential beneficial uses.

The interpretation of the total watershed score of 7.7, higher than each of the subwatershed scores, is somewhat perplexing. The procedure applied to Butterfield Creek, which establishes total watershed ranks as averages or sums of the subwatershed ranks, always results in the total watershed receiving the highest score. This implies that problem remediation (or prevention) always should be addressed watershedwide, despite the results of subwatershed prioritization. It also may suggest that the assumptions used in arriving at total watershed ranks are not appropriate and, therefore, the total watershed score should not be compared with the subwatershed scores.

Overall, the results of this simple analysis are quite interesting. Intuitively, if limited funds are available for remedial measures, it makes sense to spend them in subwatersheds in which stream use has the most potential for improvement and in which remedial activities are most implementable. The results for Butterfield Creek, in which the mainstem and west branch receive similarly high targeting scores, are generally consistent with this logic. Because conditions in the mainstem also are dependent on nonpoint contributions from the east branch, however, it may not be possible to eliminate critical use constraints and to fully restore mainstem stream uses without applying effective BMPs watershedwide.

Other Prioritization Applications

Application of the prioritization in this watershed was not straightforward due to the configuration of the watershed. Based on the experience gained in this application, however, it is apparent that there are two cases in which the prioritization methodology would be more useful and straightforward. The first case would be in prioritizing restoration efforts between separate watersheds under a single management agency or funding source. The second case would be in prioritizing efforts within a single watershed tributary to a critical resource (e.g., recreational lake, high-quality stream segment, water supply reservoir).

Prioritizing Between Distinct Watersheds

During development of a statewide or regionwide nonpoint source control program, limited funds often must be prioritized between distinct watersheds within the region. This methodology provides a relatively objective method for assigning priorities to watersheds competing for funds. To ensure acceptance of the results of the prioritization and to avoid conflicts between competing watershed officials, involving the officials and interested parties from all of the watersheds in the assignment of ranking and weighting factors is very important. Because they all have participated in that process and agreed on the ranks and weights, it will be difficult for them to dispute the outcome of the prioritization results. Therefore, a rational schedule can be developed for expenditures and efforts in the various watersheds.

Prioritizing Within a Watershed

During development of a watershed nonpoint source management plan, a particular resource within the watershed often motivates development of the plan. The methodology could be used readily to prioritize targeted land uses within that watershed. In this case, however, the beneficial use and probably even the stream size factors would be meaningless because all subwatersheds would be tributary to the same resource whose uses are being protected. The only two factors that would be used would be the pollutant load (or stormwater rate) and the ability to implement.

Summary and Conclusions

This report has discussed some of the strengths and weaknesses of the urban targeting and prioritization methodology as applied to Butterfield Creek in northeastern Illinois. Highlights of this evaluation are discussed below.

Technical Representation

The methodology recommends a relatively simple methodology for generating pollutant loads and assessing BMP effectiveness. For purposes of this type of application, which emphasizes relative loadings among land-use types and subwatersheds, this simplicity is appropriate and appears to produce reasonable results for Butterfield Creek. One shortcoming is that the technical procedure is limited to pollutant loads. Inclusion of runoff rates was readily incorporated into the methodology, however, making it more useful for urban streams such as Butterfield Creek.

Urban Targeting

The urban targeting component of the methodology worked quite well, especially when combined with mapping, which highlighted relative pollutant contributions by land use. Targeting also provided a fairly clear indication of the relative pollutant (and high runoff rate) contributions by subwatershed.

BMP Selection

Effective BMP selection must take into account the causes of stream use impairment as well as the physical characteristics of the watershed and the drainage system. In the application of the recommended BMP selection methodology to Butterfield Creek, it was clear that BMPs that control both pollutant loads and runoff rates would be required. As a result, detention facility retrofitting became, somewhat by default, the selected BMP for evaluation. The quantification procedure recommended in the methodology report worked quite well and was enhanced by the mapping of pollutant loadings.

Watershed Prioritization

The application of watershed prioritization to Butterfield Creek, based on assigning ranks and weights to prioritization factors among subwatersheds, was accomplished with some difficulty. Part of this difficulty was related to the subwatershed orientation in Butterfield Creek, in which two stream segments were tributary to a third. The existing methodology is not structured to address this situation. A related difficulty was the subjectivity involved in assigning relative ranks and weights to unrelated prioritization factors. The methodology would be more useful for prioritizing between distinct watersheds or prioritizing within a watershed all tributary to a single critical resource.

Remedial Versus Preventative Applications

The Butterfield Creek application of the targeting and BMP selection methodology focused on BMPs to remediate existing stream use impairments. This methodology could potentially be applied to assess preventative BMPs as well. In this context, pollutant loads could be assessed for a nonurbanized watershed, for a fully urbanized watershed without BMPs, and for a fully urbanized watershed with BMPs. For a nonurbanized watershed, however,

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some of the stream-use prioritization factors become irrelevant, assuming that stream use is relatively unimpaired before urbanization. In the Butterfield Creek watershed, several preventative BMPs have already been chosen for newly urbanizing areas. These include soil erosion and sediment control measures, effective stormwater drainage and detention controls, and stream and wetland protection requirements. These preventative BMPs have been endorsed by most watershed communities because of their multipurpose benefits (i.e., nonpoint control, flood prevention, channel erosion control, and aesthetic enhancement) and implementability. Partly for reasons of equity, local officials have no strong desire to target or prioritize these BMPs to particular land uses or subwatersheds.

Conclusions

One of the major benefits of this approach is that the user can document the decision-making process in a systemized fashion. The methodology also forces consideration of the interdependence of various technical and institutional factors in the decision-making process. In addition, the methodology enables the presentation of complex decision-making factors in a visual format. As a result, this methodology could be very useful in targeting BMPs in stream watersheds throughout northeastern Illinois. For successful application of the methodology, however, existing stream use impairments, causes, and nonpoint sources must be clearly understood. In most watersheds, this will require the collection and assessment of additional stream use and water quality data.

The primary limitations of the methodology may be its subjectivity and the fact that it attempts to represent complex watershed interrelationships in a relatively simple fashion. These shortcomings can be addressed by properly qualifying assumptions and providing thorough documentation of results, as well as by involving all of the interested parties in the ranking and weighting process. Without the proper awareness of critical assumptions, however, the methodology is capable of producing misleading or counterintuitive results. Another potential shortcoming of the methodology, revealed in its application to Butterfield Creek, is the difficulty in representing interdependent (i.e., upstream-downstream) subwatersheds and stream reaches.

References

1. Woodward-Clyde Consultants. 1989. Urban targeting and BMP selection: An information and guidance manual for state NPS program staff engineers and managers. Oakland, CA.

2. Dreher, D., T. Gray, and H. Hudson. 1992. Demonstration of an urban nonpoint source planning methodology for Butterfield Creek. Northeastern Illinois Planning Commission, Chicago, IL.

3. Dreher, D., and J. Clark. 1992. Application of urban targeting and BMP selection methodology to Butterfield Creek, Cook and Will Counties, Illinois. Northeastern Illinois Planning Commission, Chicago, IL.

4. Schueler, T.R. 1987. Controlling urban runoff: A practical manual for planning and designing urban BMPs. Washington, DC: Metropolitan Washington Council of Governments.

5. Northeastern Illinois Planning Commission. 1979. Areawide water quality management plan. Chicago, IL.

Development of a Comprehensive Urban Nonpoint Pollution Control Program

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Abstract

Comprehensive urban nonpoint pollution control is a new, rapidly developing multidisciplinary field. Significant water quality improvements will be achieved when all state and local governments have the necessary resources, knowledge, skills, and vision to implement effective programs. Urban nonpoint pollution has traditionally been addressed by relying heavily on structural stormwater control devices to treat contaminated runoff. Yet, this "band-aid" approach has proven relatively ineffective for controlling such a ubiquitous and poorly defined problem.

The objective of this paper is to illustrate some of the many problems, issues, and obstacles that federal, state, and local government agencies must address to facilitate further advancements in urban water quality control. A more comprehensive, watershed approach must be developed, specifically focusing on source prevention programs, improved technology, and intra-agency coordination. Measuring the effectiveness of innovative source control programs, such as public education, will become essential for targeting problems, focusing goals, and allocating resources to areas needing improvement.

Guidance for implementing these nonpoint pollution control strategies is needed to assist state and local governments. The nature, magnitude, and scope of urban nonpoint source pollution, one of the most fundamental and universal problems facing local governments, are issues that have yet to be adequately resolved. Without program guidance and leadership, the urban nonpoint pollution problem will persist and the quality of our nation's waters will further deteriorate.

Introduction

To address the complex nature of the national water pollution problem and the comprehensiveness of nonpoint pollution control, all states and municipalities must have access to the understanding, expertise, knowledge, resources, and insight needed to respond to difficult challenges and provide the most appropriate services and solutions. Effective water quality improvement will depend on the ability of municipalities to appropriately implement an array of preventative measures, management strategies, and treatment technologies for dealing with all aspects of water pollution.

Traditional offsite structural treatment is only one of the tools available for addressing this national problem. At the local level a variety of other innovative tools must be tailored to the unique problems and characteristics of a particular site, land use, community, or watershed. Nonpoint source pollution will be fully and effectively controlled only when municipalities understand how to identify problems, evaluate alternatives, and implement solutions.

Discussion

The magnitude and scope of critical issues associated with current urban nonpoint source control programs, such as the National Pollutant Discharge Elimination System (NPDES) program, must be appreciated to ensure success. To effectively implement the NPDES regulations, municipalities must address the following questions:

How Will the NPDES Goals Be Met?

The success of the municipal NPDES program in achieving the water improvement objectives of the Clean Water Act will depend heavily on the ability and commitment of each municipality to develop focused and effective comprehensive pollution control programs. To reduce nonpoint pollution to the maximum extent possible, local governments must be prepared to support and effectively implement the full range of necessary program components and to shift their programs to a more balanced approach between prevention and treatment.

Municipal governments need active leadership that empowers each jurisdiction with the necessary knowledge, tools, skills, and resources to implement effective programs. Ultimately, each municipality's success will be judged based on the ability to effectively implement program constituents related to planning, coordination, integration, education, prevention, management, maintenance, inspection, enforcement, funding, and appropriate use of technology. Many roadblocks, however, will inhibit the ability to accomplish these objectives. Funding and competition with other local programs are obvious barriers, while misunderstanding the nature of the problem, setting incorrect priorities, and focusing programs on nontraditional prevention strategies are less obvious pitfalls.

What Does Each Jurisdiction Need?

The successful integration of effective nonpoint source pollution reduction programs into traditional local stormwater programs is more easily accomplished if implementation problems are identified and thoroughly addressed. These problems can concern:

- Legal, financial, and political liabilities and issues.
- Public awareness, acceptance, and education.
- Development and implementation of adequate inspection programs for construction and maintenance.
- Development and implementation of effective enforcement programs.
- Funding options for various programs.
- Integration, coordination, and enhancement of existing programs.
- Allocation and sharing of private, public, and corporate resources.
- Understanding the techniques, approaches, strategies, and philosophies of comprehensive water quality planning.
- Development of mechanisms for technology transfer and implementation of innovative practices.
- The need for practical guidance on program development.

Local governments will be looking for guidance on how to overcome these obstacles. Thus guidance on effective model programs must take into account the effect policy decisions have at the local level.

Can We Depend on Treatment Technology?

Historically, stormwater programs have addressed water pollution from a treatment standpoint, making them rather symptomatic and ineffective. Typical programs rely heavily on structural treatment devices to control contaminated runoff from new development. As a result, current water pollution control programs address problems through a "band-aid" approach instead of a more comprehensive approach in which both preventative and treatment measures are employed within a watershed.

With the many years of experience that some municipalities now have using treatment devices, it is becoming clear that many current treatment practices are riddled with inherent problems that may be difficult, if not impossible to overcome. Problems such as burdensome maintenance, improper construction, inadequate design, ineffective site management, and the latest obstacles posed by federal and state wetland permitting requirements have left many local governments frustrated. Thus the proper role, long-term impacts, and effectiveness of current treatment practices in urban nonpoint source pollution control need to be carefully evaluated.

Reliance on treatment technology as the primary approach to pollution control can result in failure of a program. Many current treatment practices cause problems that limit, restrict, or prohibit their use. Thus, in a more recent study, Prince George's County, Maryland, found that of 151 urban nonpoint source treatment devices constructed or put into operation within the past 5 years, only 60 percent were functioning as designed. Given such limitations, it would be inappropriate to guide other local jurisdictions to heavily rely on treatment technology in the hope of greatly improving water quality.

Do We Effectively Control New Development?

One problem that has yet to be adequately addressed is an effective and comprehensive approach to environmentally safe development. Current programs primarily focus on treatment controls for new development and generally do not consider or incorporate other important pollution reduction and prevention strategies.

New development must be designed in such a manner that onsite treatment of stormwater runoff can be effective. In addition, prevention must become an integrated part of site development through public education, implementation of site maintenance and management plans, and industrial process changes.

The goal of an effective stormwater management site plan should be the integration of preventive, management, and treatment devices that can effectively mitigate all adverse water quality impacts associated with the development. New development can be easily regulated and pollution abatement requirements selected from a broad range of options can be imposed, including:

- Greater use of open and surface drainage systems.
- Limited and creative grading to encourage onsite retention and to enhance ground-water recharge.
- Treatment of surface water by maximizing biological, chemical, and physical treatment devices.

- Requiring grounds maintenance plans.
- Education programs for developers and the public.
- Use of effective construction and maintenance inspection and enforcement programs.
- Greater preservation of existing natural water quality and habitat features.

What Do We Do About Existing Development?

Controlling nonpoint source pollution from existing development represents the greatest challenge but offers the most potential for attainment of overall pollution reduction goals. Water pollution problems associated with existing development are the most difficult to control and require the most complicated mix of approaches. Typical issues include a lack of regulations requiring retrofitting of facilities, a lack of available space to construct onsite controls, limited incentives, difficulty in identifying problems and solutions, a lack of public awareness, a lack of funding, and limited experience with source control and prevention programs. To address these issues, municipalities should consider the following:

- A community and/or watershed-based approach.
- Baseline data collection needs.
- A comprehensive nonpoint source reconnaissance study.
- Investigative approaches and tools.
- Water quality data collection and use.
- Public outreach programs.
- Regulatory actions.
- Inspection.
- Enforcement.
- Comprehensive maintenance and management plans.
- Retrofit opportunities.
- Innovative control technology.
- Lake, stream, and wetland restoration and enhancement.

How Comprehensive Is Comprehensive?

A comprehensive program not only uses dedicated local government personnel, but also integrates existing programs and personnel at the state and federal level. Coordination, cooperation, communication, and participation among all agencies involved with programs related to water quality improvements are essential for efficient use of available resources.

Many important water quality-related programs have been independently developed over time that achieve a variety of environmental objectives. Identifying all such programs and directing and focusing them on a common goal would be extremely valuable and useful. Although many water quality-related pollution control programs exist, few coordinate oversight in order to pool resources and combine efforts.

Existing water quality protection and community outreach programs can be easily enhanced or expanded to incorporate additional water quality education and enforcement programs. For example, in Prince George's County, the police community relations program is working with the state's Department of Environmental Resources, the U.S. Attorney's Office, and local citizens groups to incorporate water pollution control educational information into the program. In conjunction with a state, federal, and local enforcement training program, this effort focuses on the enforcement of water quality regulations.

The final aspect of a comprehensive program is to consider all possible sources of water pollution, point and nonpoint source alike. Combining the investigation and enforcement efforts of both programs could help eliminate loopholes in the system and facilitate effective use of existing resources. Investigators and enforcement agents at all levels of government must pool their resources and continuously exchange information regarding known sources of water pollution. Leadership will be critical for facilitating such communication and coordination.

How Will We Measure the Effectiveness of NPDES Programs?

Municipal governments, scientists, environmentalists, and the public will continue to ask, How effective are source controls? Various plans have been discussed as a result of the NPDES stormwater permit application requirements to quantify the effectiveness of municipal programs. Among these is the water quality standards approach that is currently used in the NPDES industrial point source discharge program.

The water quality standards approach to measuring the effectiveness of urban nonpoint source control/prevention programs will require extensive water quality base-flow and storm-event monitoring. In the past, however, water quality monitoring programs, either with automated equipment or manual sampling, have proven to be difficult and costly to implement. Problems with drought conditions, weather predictions, equipment errors, and the physical constraints associated with manual sampling present particular challenges. Ultimately, municipalities, which will be responsible for implementing source control programs and measuring their effectiveness, will need to rely on the availability of low-cost, flexible alternatives.

The success of source control programs will rest on the ability of small and medium-size municipalities to implement comprehensive and effective water quality control programs. How these programs are structured and the number of programs implemented will ultimately determine the effectiveness of urban nonpoint source pollution control efforts. The focus of efforts should not be on the development of water quality standards but on the development and implementation of a wide range of prevention, management, and treatment programs.

Summary

Significant reductions in urban nonpoint pollution will be achieved only when effective treatment, prevention, management tools, strategies, and programs have been fully developed and implemented. Given the clearer picture of the nature and scope of the problem, how the pieces will fit together is better understood. Nonetheless, effective efforts will require time, patience, and cooperation. All governments, agencies, and organizations dealing with these issues must work together to develop the technology necessary for a nationally comprehensive urban nonpoint source control program. Momentum for change must be sustained by continued strong leadership, and expertise in this ever-growing and complicated field must be appropriately channeled to develop state-of-the-art technology, and not just to restate it.

Site Planning From a Watershed Perspective

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Abstract

The site planning review process involves consideration of the impacts on water resources that can result from the proposed activity, including changes in water quality and quantity. These changes can affect areas immediately adjacent to the site, as well as distant areas of the watershed. Therefore, site-specific and watershed issues must be considered when developing solutions for proper management.

An important first step in the process involves locating the project site within the watershed and becoming familiar with the watershed characteristics. Secondly, analysis of the impact of site development on the resource areas within the watershed should be conducted so that management objectives can be identified. This aids in the identification of best management practices that can meet management objectives for the site and the watershed.

Introduction

Site planning tends to occur on a limited scale, usually when developing individual sites, such as subdivisions, commercial developments, industrial parks, residential areas, and schools, as well as infrastructure such as roadways and bridges. Together, these sites compose an urban area.

As sites within the urbanizing area develop, water resources such as streams, lakes, wetlands, and ground water degrade. Because of the incremental nature of development and the cumulative effect that development can have on resources, the site planning process must involve consideration of the watershed within which the development is occurring. The watershed approach, which allows for a comprehensive evaluation of the development process, contains several elements that together form a review process: 1) delineation of the watershed and subbasins, 2) inventory of soils, 3) inventory of natural systems, 4) identification of impacts from development, 5) development of management goals and objectives, and 6) development of recommendations for mitigation.

Delineation of the Watershed

A watershed is an area of land that drains to a water resource such as a wetland, river, or lake. Depending on the size and topography, watersheds can contain numerous tributaries, such as streams and ditches, and ponding areas such as detention structures, natural ponds, and wetlands.

Rainwater and snowmelt that do not evaporate or infiltrate into the soil run off into a nearby tributary or ponding area, then flow to the main wetland, river, or lake within that watershed. Through this linkage, the upper portions of a watershed can affect downstream areas. Thus, the quality of a wetland, stream, or lake often reflects the land use and other activities being conducted in upstream areas. Because the relationship of cause and effect can extend for large distances throughout the entire watershed, it is important to address environmental management issues from a watershed perspective.

Use of topographic maps is a common method of locating and delineating the boundaries of watersheds. To locate a site on a topographic map, the site plan should be closely examined. A topographic map represents the physical features of the land such as hills, valleys, basins, ridges, and channels. The mapping technique used is based on elevation data (usually mean sea level) and contour intervals (commonly of 10 ft). Distinctive features such as road intersections and curves, towns, agricultural field boundaries, streams, and lakes make acceptable landmarks. These landmarks can be used to locate the approximate site on a topographic map. The next step is to delineate the watershed that

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contains the site. Below is an outline of steps necessary to delineate a watershed:

1. Use a topographic map(s) to locate the river, lake, stream, wetland, or other water bodies of interest (see Figure 1).
2. Trace the watercourse from its source to its mouth, including the tributaries. This step determines the general beginning and ending boundaries (see Figure 2).
3. Examine the lines on the topographic map that are near the watercourse; these are referred to as contour lines (see Figure 3). Contour lines connect all points of equal elevation above or below a known reference elevation. The thick contour lines have a number associated with them, indicating the elevation. The thin contour lines are usually mapped at 10-ft intervals, and the thick lines are usually mapped at 50-ft intervals. Contour lines spaced far apart indicate that the landscape is more level and gently sloping. Contour lines spaced very close together indicate dramatic changes (rise or fall) in elevation over a short distance (see Figure 4). To determine the final elevation of a location, simply add or subtract the appropriate contour interval for every thin line or the appropriate interval for every thick line.
4. Check the slope of the landscape by locating two adjacent contour lines and determine their respective elevations. The slope is calculated as the change in elevation divided by the distance. A depressed area (valley, ravine, swale) is represented by a series of contour lines "pointing" towards the highest elevation (see Figure 5). A higher area (ridge, hill) is represented by a series of contour lines "pointing" towards the lowest elevation (see Figure 6).

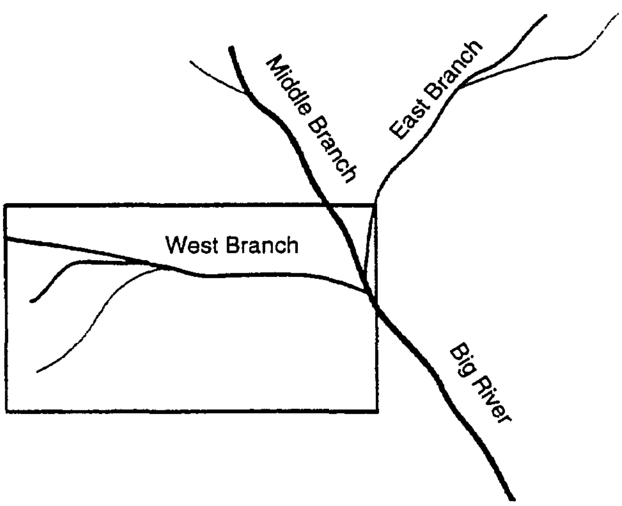

Figure 1. Big River watershed.

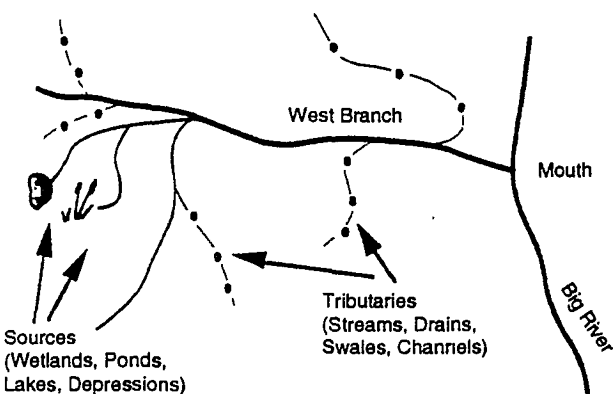

Figure 2. West Branch subwatershed.

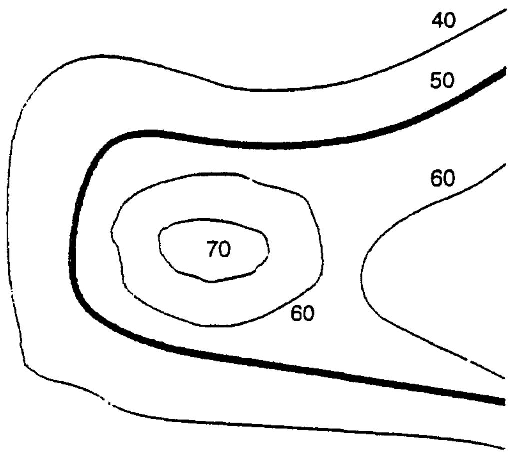

Figure 3. Contour lines.

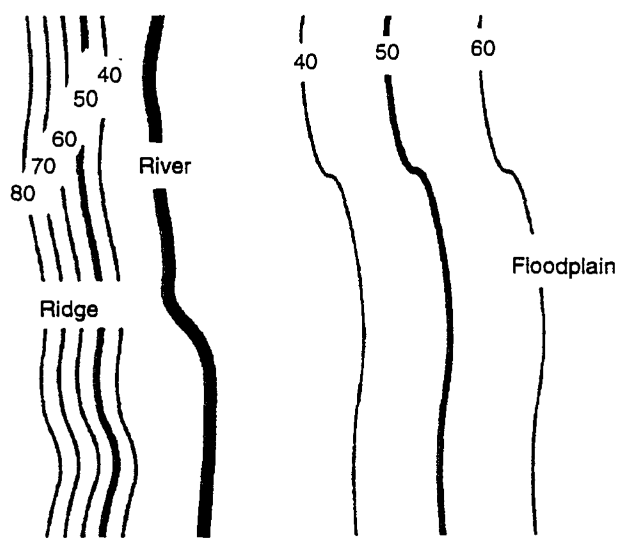

Figure 4. Floodplains and ridges.

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5. Determine the direction of drainage in the area of the water body by drawing arrows perpendicular to a series of contour lines that decreases in elevation. Stormwater runoff seeks the path of least resistance as it travels downslope. The "path" is the shortest distance between contours, hence a perpendicular route (see Figure 7).

6. Mark the break points surrounding the water body. The "break points" are the highest elevations where half of the runoff would drain towards one body of water and the other half would drain towards another body of water (see Figure 8).

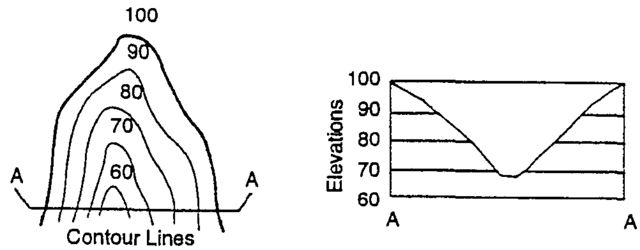

Figure 5. Valley.

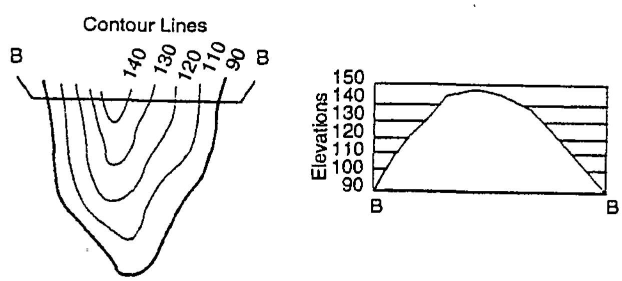

Figure 6. Ridge.

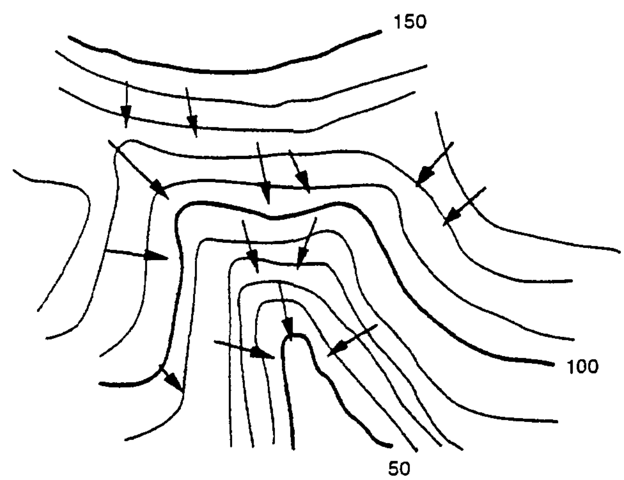

Figure 7. Direction of drainage.

7. Connect the break points with a line following the highest elevations in the area. The completed line represents the boundary of the watershed (see Figure 9).

Inventory of Soils

Locating the site on the soils map requires a U.S. Department of Agriculture (USDA) Soil Conservation Service (SCS) soil survey of the county. Select the appropriate soil sheet for the site by examining the *Index to Map Sheets*. Each numbered section corresponds to a soil sheet. After obtaining the necessary soil sheet, locate the site by using distinguishing landmarks, such as road intersections, field outlines, creeks, and rivers. Note the map unit symbols that are in that area. Map unit symbols in a soil survey may consist of numbers or letters, or a combination of numbers and letters. Soil surveys differ from state to state and county to county. Some soils are symbolized by letters and others by numbers. Figure 10 depicts a typical soils map found in an SCS soil survey.

A variety of information that can be used to evaluate sites is contained within the soil survey and maps. The different types of information contained in the soil survey include land capability classification, suitability tables, slopes, erosiveness, wetness, permeability, and drainage patterns.

Land Capability Classification

The land capability classification shows the suitability of the soils for various types of activities, from farming to engineering. The capability classification, denoted by roman numerals, suggests ways to manage and use the soils and highlights any potential hazards. Included in the capability classification are subclasses of erosion, wetness, shallowness, and climate limitations, indicated by small letters after the roman numerals. These subclasses signal a soil's tendency, for example, towards erosiveness or wetness.

Suitability Tables

Suitability tables are found in the section located after the soil descriptions and management capability groupings. They designate the soil's suitability for various categories of uses, including wildlife plantings, septic fields, building foundations, and road subgrades. This table can highlight some potential hazards for sites planned on questionable soils. For example, soils that are appropriate for a road subgrade may not always do as well for septic fields.

Slopes

Steepness of slopes can be easily determined by looking for the capital letter posted behind the first series of numbers or letters. The "A" slopes are usually very

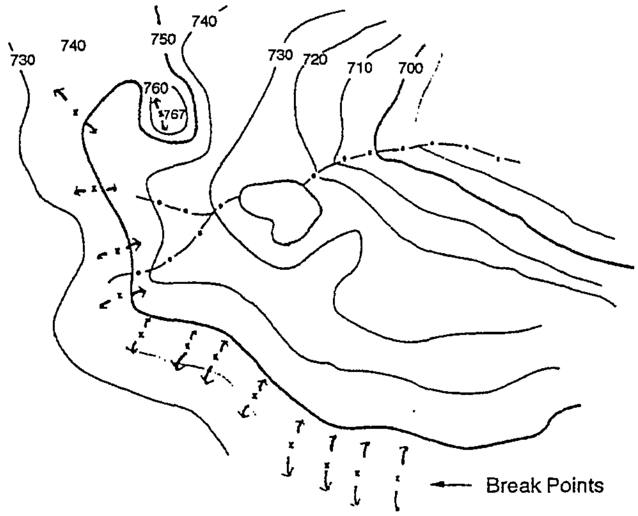

Figure 8. Identify break points.

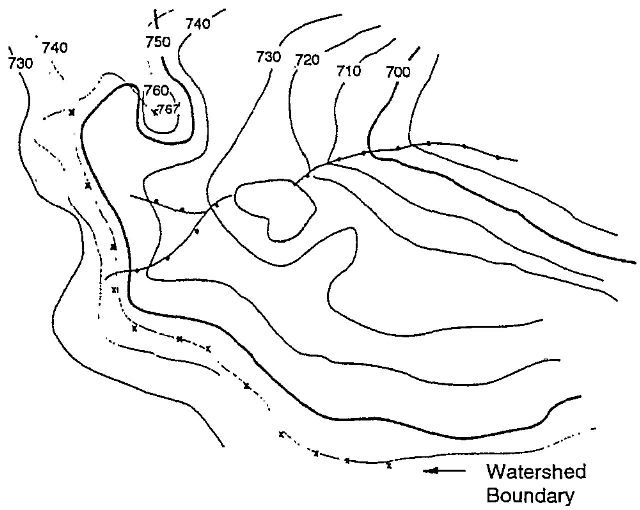

Figure 9. Watershed boundary.

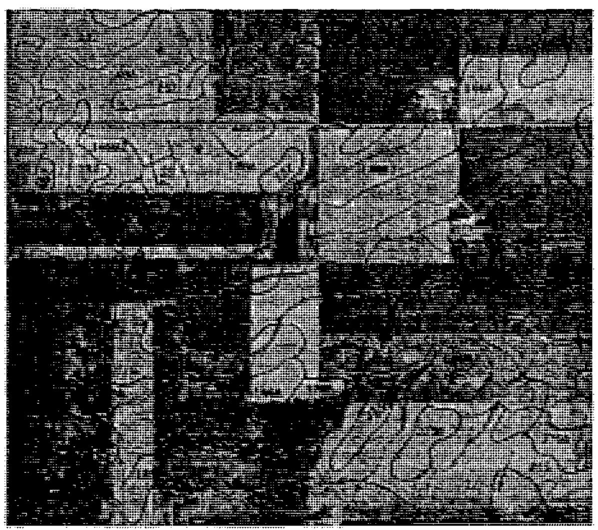

Figure 10. Soils map.

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gentle, with B, C, and D slopes progressively steeper. Knowing the slopes on the site helps determine the amount of grading required and the amount of earth to be moved. Slope steepness also indicates the potential for problems with erosion and stabilization of the site.

Erosiveness

The soil survey sections entitled "Detailed Soil Map Units" and "Classification of the Soils" provide more specific information regarding the soils and their formations and uses. It is important to scan these sections for any potential erosion problems. Knowing a soil is erosive in nature is useful when analyzing how construction, mass grading, and clearing could affect the site. This can help predict how much soil loss could occur and pinpoint the best erosion and sediment controls to be used on the site. An erosion problem already present on the site may be indicated by the use of a number after the symbol depicting the soil type and slope on the map (e.g., 104B2).

Wetness

To determine if the soil present on the site is hydric or "wet," the soil description section and land capability classification indicate whether or not that soil has a water table at or near the surface. Most of the wet soils occur in valley bottoms or depressional areas. On the soil map itself, the wetness may be designated with a "W" preceding or following the soil symbol. Knowing if a soil has a tendency towards wetness can signal potential hazards. A site originally planned for septic systems may have to turn to sewer and water, or a site could contain wetlands that require protection.

Permeability

Soil permeability is important to a variety of people when looking at a potential construction site. The permeability of the soil can determine if the site is appropriate for a detention pond, a septic field, or an infiltration trench. In addition, knowing if the soil has a slow or fast permeability can alert the planner to the potential for ponding or ground-water vulnerability.

Drainage Patterns

Soil surveys typically have a smaller scale than a topographic map; therefore, more detail pertaining to the landscape can be shown. Drainage patterns are important to identify. Drainage patterns highlight how the land slopes and drains and in what direction. This is important when considering a site for development, as it is advisable to keep the natural drainage pattern intact whenever possible. Utilizing natural drainage can eliminate the need for regrading and rerouting of runoff from the site.

Other Information

Other symbols used on a soil survey may denote a wetland or marsh, or the presence of heavy clays, depressional areas, intermittent streams, springs, and erosion spots. These features are not always found on a topographic map. This information is particularly important when doing cursory site evaluations.

The most important point to remember when using the information in a soil survey is to recognize that it has inherent limitations. Due to the scale in the field versus that of an aerial photograph, the soil survey can only point towards a situation that may need further investigation. Any questions raised by the soil survey should be followed by an onsite soil determination by a qualified soil scientist.

Inventory of Natural Systems

Most areas have National Wetland Inventory (NWI) maps produced by the U.S Fish and Wildlife Service. On the NWI maps, the wetlands are defined as "lands transitional between aquatic and terrestrial systems where the water table is usually at or near the surface, or the land is covered by shallow water." In addition, the definition requires that one or more of the following three attributes be present: "1) at least periodically the land supports predominantly hydrophytes, 2) the substrate is predominantly undrained hydric soil, or 3) the substrate is nonsoil and is saturated with or covered by shallow water at some time during the growing season of each year." Therefore, these maps contain information on sites that have lakes, rivers, and streams, as well as such areas as marshes, bogs, and swamps.

Some counties have advanced wetland mapping that delineates critical areas in need of protection from construction disturbances using the NWI maps as one of their criteria. Recently, SCS has inventoried wetlands in agricultural fields and adjacent areas. In addition, SCS has also identified highly erodible cropland fields. These areas, if developed, will have special needs for soil erosion and sediment control measures.

Other natural systems that need to be included in the watershed review process are ground-water resources, such as aquifers, and recharge areas to public and private wells. Many states have mapped their ground-water resource areas, and local municipalities should have maps showing the location of and contribution zones to public wells.

It is important to examine several additional maps to gain a proper perspective on other developments in the watershed. Comprehensive zoning and plan maps reveal current land use and plans for the future of the area. These maps are invaluable when determining what stormwater best management practices (BMPs) should be applied to the site. If development currently exists upstream or more development is planned, caution may need to be taken when situating homes or businesses near a stream. Conversely, if the proposed development will be upstream of existing developments, detention measures may be needed to prevent downstream flooding. Whatever the situation, knowing where developments are and where they will be helps determine what means and methods of prevention and protection need to be taken.

Identification of Impacts From Development

Once the locational information for the project has been gathered and the contributing watershed identified, it is necessary to consider the impacts the development will have on the watershed. In general, the major impacts will be alterations in water quality, water hydrology, and terrestrial and/or aquatic habitat. Some simple methods allow initial judgments to be made as to the extent of the impact and the level of mitigation required to protect the surrounding ecosystem (1).

Changes in Water Quality

As people inhabit and use the lands around them, they deposit various pollutants on the land. When rainfall and runoff occur, these pollutants are washed into receiving waters. As urban development occurs within the watershed and the land use changes, pollutants, loading rates, and the concentration of pollutants discharged to the receiving waters also change. Many studies have been conducted during the past 20 years to characterize the types and amounts of pollutants associated with various land uses, including urban land uses. A review of the results indicates that different types of land use generate "typical" pollutants, at amounts within a range of values (2). (These values have been consolidated into a single value based on statistical analysis of all data.)

Pollutant Concentration

Some pollutants are more likely to have short-term (acute) effects on environmental systems because of the pollutant concentration. Typically, the pollutants considered to have an acute impact on water quality are oxygen-demanding substances and bacteria. Using an equation that considers normal probability, median pollutant concentrations, and variability, estimates can be made of the probability that pollutant concentrations will exceed acceptable water quality standards. The equations used for estimating concentrations and probability of exceedances are found in Equations 1 and 2 (2).

To estimate expected concentrations, use the equation

$$C_x = C_m (\exp [Z (1n \{1+COV\}^2)^{1/2}]) \qquad \text{(Eq. 1)}$$

where (for log-transformed data)

C_x = expected concentration of pollutant x
Z = standard normal probability (for specified probability of occurrence)
C_m = median pollutant concentration
COV = coefficient of variation

To estimate probability, use the equation

$$Z = (\ln[C_x/C_m])/[\ln(1+COV^2)^{1/2}] \qquad \text{(Eq. 2)}$$

Pollutant Loads

Some pollutants are likely to have long-term (chronic) effects on environmental systems because of pollutant loading rates. Typically, the pollutants considered to have a chronic impact on water quality are nutrients, sediments, toxic metals, organics, and some oxygen-demanding substances. One approach relies on the development of unit area loading rates for various pollutants for different land uses. The unit area loading values are generally a numerical value based on the area of land use (1).

Many methods have been developed to estimate the pollutant load that would be expected from a proposed development. The anticipated value can be compared with the existing pollutant loads to determine the increase in pollutant loading. One of the easiest methods to use is the Simple Method (3). This method uses readily available information but is limited to sites less that 1 square mile in area. Loading information gathered can be used to judge whether some type of runoff treatment will be needed before discharging to the receiving waters. The equation for estimating pollutant loads is found in Equation 3.

When concentration is in mg/L,

$$L = (P)\ (P_j)\ (R_v)\ (C)\ (A)\ (0.227) \qquad \text{(Eq. 3)}$$

where

L = annual mass of pollutant export (lb/yr)
P = annual precipitation (in.)
P_j = correction factor for smaller storms that do not produce runoff (dimensionless)
R_v = runoff coefficient (dimensionless)
C = average concentration of pollutant
A = site area (acres)

When concentration is in µg/L,

$$L = (P)\ (P_j)\ (R_v)\ (C)\ (A)\ (0.000227) \qquad \text{(Eq. 4)}$$

Changes in Water Hydrology

As development occurs within the watershed, the degree of imperviousness within the watershed often increases. Impervious surfaces do not allow rainfall to infiltrate as would occur in an undeveloped setting; as a result, more rainfall becomes runoff. As the amount of imperviousness increases, so does the amount of runoff from the site. Taken individually and cumulatively, the increase in runoff will change the hydrology of the watershed. Depending on the location of the site within the watershed and on development conditions in other areas of the watershed, changes in watershed hydrology can negatively affect downstream properties, causing flooding and property destruction, and also lead to downstream bank destabilization, erosion, and scouring. In some areas of the country, land subsidence becomes an issue if the water table is lowered because of the lack of ground-water recharge. This problem can be addressed through ordinances that stipulate all pre- and postdevelopment runoff rates for the entire watershed be considered when a single site is being developed.

A commonly used method for determining the pre- and postdevelopment runoff rates for a site and watershed is SCS Technical Release 55, "Urban Hydrology for Small Watersheds." TR55 can serve as an initial screening procedure for estimating runoff values. An advantage of the procedure is its ease of use through charts and availability on computer disk (4).

Alterations in Terrestrial and Aquatic Habitat

As more undisturbed lands near shore areas are converted into urban and suburban land uses, areas once inhabited by terrestrial and aquatic animal and plant species are minimized or destroyed. As native habitats have continued to decrease over the years, more attention has been given to the need to protect and preserve them. In many areas, endangered species laws serve to protect habitat areas for those plants and animals appearing on state and federal endangered species list. Although this is helpful, it does little to protect more prolific and less sensitive plant and animal species that are burdened by urban development. Consideration of and accommodations for plant and animal species should and can be incorporated into the individual site planning process as well as the watershed management strategy.

Development of Management Goals and Objectives

An effective method to review site development is to first consider what the overall watershed management objectives are. One place to start looking for this type of information is within the existing state water quality standards. Water quality standards give numerical values and narrative descriptions for various pollutants, at levels that are protective to human and biological health, and assign designated uses for the resource. A management approach can consist of a review of the existing and potential designated uses for the resources within the watershed, and can attain or preserve these uses. In addition, local agencies may have developed management objectives through such mechanisms as watershed protection districts.

A simple hierarchy of management objectives has been presented by Schueler et al. (5), which consists of the following:

- Reducing increases in pollutant loading and concentration.
- Reducing the severity of impacts of pollutant loading and urbanization.
- Addressing specific pollutants.
- Protecting sensitive areas.
- Controlling floods.
- Restoring the area.

Whipple (6) also uses a hierarchical method of designated uses as management objectives:

- Habitat of threatened or endangered species and outstanding natural resource waters.
- Water supply from both surface and ground.
- Other areas to be protected.
- Those not needing protection.

Figure 11 presents a resource area hierarchy consisting of:

- Baseline urban nonpoint source pollutant control
- Baseline urban resource protection
- Control of specific pollutants
- Protection of sensitive resource areas
- Flood control

Management Objectives

"Baseline" Urban Nonpoint Source Pollutant Control

"Baseline" Urban Resource Protection

Control of Specific Pollutants

Protection of Sensitive Resource Areas

Flood Control

Figure 11. Resource area hierarchy.

Development of Recommendations for Mitigation

After consideration has been given to the degree to which changes in water quality, hydrology, and habitat alterations potentially affect the watershed and the site and after management goals and objectives have been identified, it is necessary to develop management strategies that mitigate impacts to the level desired. This is accomplished through the use of mitigation techniques, commonly referred to as BMPs. These practices can take the form of engineered practices, called structural BMPs, or nonengineered practices, called nonstructural BMPs. BMPs can be implemented on a site-specific basis and on a regional or watershed basis. The overall management objectives and the severity of impacts from development may dictate the degree of mitigation required (7).

In selecting BMPs for a site, it is important to consider 1) how the BMPs will function as a system; 2) how the practice will meet watershed- and site-specific management objectives, such as pollutant load and concentration reduction, control of storm volumes, and provision of habitat; and 3) what some of the limitations and uses of the practices are.

Best Management Practice Systems

Structural and nonstructural BMPs differ in their design, limitations, and optimal applicability (i.e., addressing pollutant loads, habitat, or hydrology). While some BMPs are implemented to provide a primary objective, secondary mitigation and benefits also are commonly provided. For example, a wet detention pond optimally functions to improve water quality through pollutant load reduction but can also function to balance water hydrology and provide habitat. BMPs can be grouped into discrete functional units that address different aspects of stormwater management. These units are pollution prevention, habitat protection, runoff attenuation, runoff conveyance, runoff pretreatment, and runoff treatment. The units, taken together, form the BMP system. The BMPs selected to meet watershed- and site-specific objectives generally will be from all of these functional units. Figure 12 depicts a BMP systems approach, described below:

- *Pollution prevention:* An effective approach to managing pollutants in urban settings is to prevent or reduce the potential for pollutant loading. Many of the pollution prevention practices are referred to as nonstructural BMPs. These practices can include such activities as public education, zoning ordinances, site planning procedures, restricted use policies, and overlay districts.
- *Habitat protection:* An effective tool for the restoration and management of habitat areas is the implementation of measures to ensure long-term protection. Habitat protection is usually accomplished through nonstructural BMPs, such as river corridor programs, wetland protection programs, critical habitat protection programs, and zoning tools such as open space requirements and creative land-use planning techniques (cluster development).
- *Runoff attenuation:* One of the most effective ways to manage stormwater flows is to prevent and reduce them. Much of this can be accomplished through a reduction in site impervious cover. Reduction in impervious cover allows for increased infiltration. Other practices that attenuate runoff are drywells, depression storage, and appropriately placed infiltration trenches. Implementing these practices reduces the other impacts of development by reducing runoff volume, flood occurrence, pollutant loads and concentrations, and stream degradation.
- *Runoff conveyance:* Runoff conveyance systems serve to transport the storm flows from the point of origin to the runoff pretreatment and treatment system. Runoff conveyance systems can allow for limited treatment levels, as in the case of grassed swales with check dams and exfiltration devices. Other conveyance systems for stormwater include structural elements, such as pipes with flow splitters.
- *Runoff pretreatment:* Runoff pretreatment is the process whereby runoff is diverted through pretreatment practices. These practices usually prolong and improve the efficiency of the treatment device. Pretreatment practices include vegetated filter strips, riparian systems, settling basins, and water quality inlets.
- *Runoff treatment:* Runoff treatment practices are devices designed to treat stormwater runoff and remove pollutants through a number of processes, including adsorption, transformation, and settling before entry to

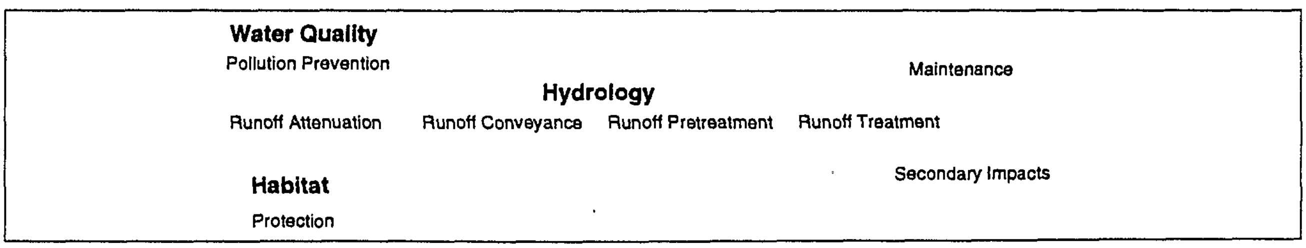

Figure 12. BMP systems approach.

the resource area. Treatment devices are considered the final component of the BMP system. Some familiar treatment devices include detention, retention, and infiltration.

Several additional issues need to be considered when developing recommendations for practices. Among these are acceptance of practices by landowners and the aesthetic quality of the practices. Although these issues seem minor, disgruntled landowners can inhibit implementation of effective long-term management programs.

A frequently overlooked but critical consideration for stormwater management is the development of long-term maintenance and financing programs. BMPs, once installed, require upkeep and periodic repairs. Long-term urban runoff management programs require a commitment to maintain technical and program support staff.

Determine Reduction or Protection Measures Necessary To Achieve Objectives and Meet Watershed and Site-Specific Needs

To develop a management strategy, it is important to integrate watershed needs with site-specific needs. The simplest approach is to first consider the broader watershed needs and then "work in" site-specific needs around them. Examples of broad watershed management needs are protecting public water supplies, river corridors and riparian areas, wetlands and wildlife habitat; preserving/expanding open space; or meeting a watershedwide pollutant reduction goal. To address these needs, management practices such as no construction/no disturbance buffer zones, creative site layout practices, impervious cover limitations, tree disturbance restrictions, total site disturbance limitations, and riparian enhancement zones may be utilized. These management practices tend to define or refine areas for the actual site development and site-specific practices.

On the site level, with broader watershed management practices incorporated, more specific needs can be addressed. Examples of site-specific management needs are preventing or managing soils loss, lowering the postdevelopment discharge rate and volume, enhancing riparian areas, and reducing pollutant loads from the site. To address these needs, management practices such as developing and implementing a preventive soil erosion control plan, and installing such items as temporary sediment basins, siltation fencing, dry wells, infiltration trenches, wet ponds, and native plant species planting may be utilized.

It is important to remember that a combination of BMPs is often necessary to achieve desired objectives. No one single practice will provide all necessary mitigation or benefits. Table 1 provides an example of how watershed objectives can direct selection of various practices.

Best Management Practice Limitations

To provide information on the limitations and uses of BMPs, several charts have been developed. The most recently completed of these is found in Schueler et al. (5). Summary information can also be found in Schueler (3) and U.S. EPA (8). Information contained in the charts includes advantages, disadvantages, cost efficiency, limitations for ground-water depth, and soils. Schueler and colleagues consolidated information on reported BMP efficiency in a similar chart form (5). All of this information can help the decision-maker determine the most effective mix of practices to meet stated objectives. Figures 13 and 14 provide an example of the BMP limitation charts available.

Benefits of Watershed Planning

The most obvious benefit realized from a watershed planning approach is the installation of BMPs to mitigate water management issues before serious problems result. Advance planning saves valuable resources at the state and local level, which could be used in other areas.

Economies of scale can also be realized as a result of the watershed approach. When installing regional practices, larger areas within the watershed can be treated on a per unit area cost basis. This will be beneficial to the development community and the local jurisdictions.

Restoration is always more expensive than prevention. Most restoration costs are associated with damage off site and downstream by runoff and sedimentation. As emphasized earlier, the amount and velocity of runoff flowing off site can cause severe erosion of streambanks and watercourses. Watershed planning can eliminate restoration costs by examining the surrounding area proposed for development. With preliminary runoff control measures, much downstream and offsite damage can be prevented and controlled.

Another hazard of poor planning involves dredging of sediment-laden streams, channels, and lakes. Dredging is a very expensive solution to a problem that could have been prevented for a fraction of the cost. Again, proper examination of an area on a watershed basis can target erosive soils and extensive urbanization with BMPs to keep offsite erosion and sedimentation from occurring.

Mitigation involves creating sensitive habitat areas, usually wetlands, after they have been replaced by filling or construction. Mitigation can often be avoided if some advanced watershed planning is undertaken. By delineating sensitive areas early, alterations in construction plans can be worked around the sites. In planning large areas, sensitive areas can be designated and protected through land acquisitions and greenbelt planning.

Finally, by doing advanced watershed planning the potential for court actions in the case of flooding, erosion

Table 1. Tools To Achieve Watershed Objective

Watershed Objective	BMP System Component	Tools
Baseline nonpoint source pollutant control	Pollution prevention	Erosion control
		Buffer requirements
		Pesticide/Fertilizer reduction
	Runoff conveyance	Grassed swales with check dams
	Runoff pretreatment	Vegetated buffer strips
Baseline urban resource protection	Pollution prevention	Steep slope restriction
		Site fingerprinting
		Minimum site disturbance
		Cell closure/opening
		Construction phasing
		Erosion control
		Buffer requirements
	Runoff attenuation	Infiltration trenches
		Drywells
		Reduced directly connected impervious areas
	Runoff pretreatment	Stream buffers
		Wetlands buffers
	Runoff treatment	Infiltration basins
Specific pollutants	Pollution prevention	Septic system density
		Restricted use areas
		Nitrogen overlay district
	Runoff conveyance	Grassed swales with check dams
	Runoff pretreatment	Vegetated buffer strips
		Riparian buffers
		Water quality inlets
	Runoff treatment	Wet extended detention ponds
Sensitive areas	Pollution prevention	Hazardous waste recycling
		Stenciling storm drains
		Industrial cross connections
		Underground storage tank regulations
		Protection districts
		Restricted uses
		Decreased DCIA
		Nitrogen overlay zones
		Septic density requirements
		Extensive erosion/sediment control
		Wellhead protection program
	Habitat protection	River corridor program
		Open space requirements
		Cluster development
		Wetlands protection program
		Critical habitat program
		Riparian zone requirements
		Resource area buffer requirements
Flood control	Runoff attenuation	Infiltration trench
		Drywells
	Runoff conveyance	Riprap swales
		Detention ponds
		Retention ponds

BMP	Slope	High Water Table	Close to Bedrock	Proximity to Foundations	Space Consumption	Maximum Depth	Restricted Land Uses	High Sediment Input	Thermal Impacts
Extended Detention Pond	●	●	◑	●	○	●	●	◑	●
Wet Pond	●	●	◑	●	○	○	●	◑	○
Infiltration Trench	○	○	○	○	●	○	●	○	●
Infiltration Basin	◑	○	○	◑	◑	○	●	○	●
Porous Pavement	○	○	○	○	○	○	○	○	●
Water Quality Inlet	●	●	○	○	●	○	○	○	●
Grassed Swale	○	○	◑	◑	●	●	○	○	●
Filter Strip	◑	◑	◑	◑	●	●	◑	○	●

○ May Preclude the Use of a BMP

◑ Can Be Overcome With Careful Site Design

● Generally Not a Restriction

Figure 13. Other common restrictions on BMPs (3).

damages, sedimentation removal, dredging, and sensitive habitat areas may be lessened. By looking at the watershed area in total and addressing probable hazards both upstream and downstream, the chances of causing damage downstream will be minimized.

References

1. Marsalek, J. 1991. Pollutant loads in urban stormwater: Review of methods for planning level estimates. Water Res. Bull. (April).
2. U.S. EPA. 1983. Results of the Nationwide Urban Runoff Program, Vol. I. Final report. NTIS PB84185552.
3. Schueler, T.R. 1987. Controlling urban runoff: A practical manual for planning and designing urban BMPs. Washington, DC: Metropolitan Washington Council of Governments.
4. U.S. Department of Agriculture, Soil Conservation Service. 1986. Urban hydrology for small watersheds. Technical Release 55.
5. Schueler, T.R., P.A. Kumble, and M.A. Heraty. 1992. A current assessment of urban best management practices: Techniques for reducing nonpoint source pollution in the coastal zone. Washington, DC: Metropolitan Washington Council of Governments.
6. Whipple, W., Jr. 1991. Best management practices for storm water and infiltration control. Am. Water Res. Bull. (December).
7. Phillips, N. 1992. Decisionmaker's stormwater handbook: A primer. Washington, DC: Terrene Institute.
8. U.S. EPA. 1993. Guidance specifying management measures for sources of nonpoint pollution in coastal waters. EPA/840/B-92/002. Washington, DC.

Additional Reading

1. Bannerman, R.T., R. Dodds, D. Owens, and P. Hughes. 1992. Sources of pollutants in Wisconsin stormwater. Wisconsin Department of Natural Resources grant report.
2. Dennis, J., J. Noel, D. Miller, and C. Eliot. 1989. Phosphorus control in lake watersheds: A technical guide to evaluating new development. Maine Department of Environmental Protection.
3. Schueler, T.R. 1991. Mitigating the adverse impacts of urbanization on streams. In: Watershed restoration sourcebook. Washington, DC: Metropolitan Washington Council of Governments.
4. Schueler, T.R., J. Galli, L. Herson, P. Kumble, and D. Shepp. 1991. Developing effective BMP systems for urban watersheds. In: Watershed restoration sourcebook. Washington, DC: Metropolitan Washington Council of Governments.
5. Shelly, P. 1988. Technical memorandum to SAIC. November 3.
6. U.S. Department of Agriculture, Soil Conservation Service. 1986. Soil survey of Ford County, Illinois.
7. U.S. EPA. 1990. Urban targeting and BMP selection. Washington, DC: Terrene Institute.
8. U.S. EPA. 1985. Water quality assessment: A screening procedure for toxic pollutants. EPA/600/6-85/002A.

BMP/Design	Suspended Sediment	Total Phosphorus	Total Nitrogen	Oxygen Demand	Trace Metals	Bacteria	Overall Removal Capability
Extended Detention Pond							
Design 1	◕	◔	◔	◔	◑	⊗	Moderate
Design 2	●	◑	◔	◑	◕	⊗	Moderate
Design 3	●	◕	◑	◑	◕	⊗	High
Wet Pond							
Design 4	◕	◑	◔	◔	◔	⊗	Moderate
Design 5	◕	◑	◔	◔	◕	⊗	Moderate
Design 6	●	◕	◑	◑	◕	⊗	High
Infiltration Trench							
Design 7	◕	◑	◑	◕	◕	◕	Moderate
Design 8	●	◑	◑	◕	●	◕	High
Design 9	●	◕	◕	●	●	●	High
Infiltration Basin							
Design 7	◕	◑	◑	◕	◑	◕	Moderate
Design 8	●	◑	◑	◕	●	◕	High
Design 9	●	◕	◕	●	●	●	High
Porous Pavement							
Design 7	◑	◕	◑	◕	◑	◕	Moderate
Design 8	●	◕	◕	◕	●	●	High
Design 9	●	◕	◕	●	●	●	High
Water Quality Inlet							
Design 10	○	⊗	⊗	⊗	⊗	⊗	Low
Filter Strip							
Design 11	◔	○	○	○	◔	⊗	Low
Design 12	●	◑	◑	◕	●	⊗	Moderate
Grassed Swale							
Design 13	○	○	○	○	○	⊗	Low
Design 14	◔	◔	◔	◔	○	⊗	Low

Key:

- ○ 0 to 20% Removal
- ◔ 20 to 40% Removal
- ◑ 40 to 60% Removal
- ◕ 60 to 80% Removal
- ● 80 to 100% Removal
- ⊗ Insufficient Knowledge

Design 1: First-flush runoff volume detained for 6 to 12 hr.
Design 2: Runoff volume produced by 1.0 in., detained for 24 hr.
Design 3: As in Design 2 but with shallow marsh in bottom stage.
Design 4: Permanent pool equal to 0.5 in. of storage per impervious acre.
Design 5: Permanent pool equal to 2.5 (Vr), where Vr = mean storm runoff.
Design 6: Permanent pool equal to 4 0 (Vr); approx. 2 weeks of retention.
Design 7: Facility exfiltrates first-flush; 0.5 in. of runoff/impervious acre.
Design 8: Facility exfiltrates 1-in. runoff volume per impervious acre.
Design 9: Facility exfiltrates all runoff up to the 2-year design storm.
Design 10: 400 ft^3 of wet storage per impervious acre.
Design 11: 20-ft-wide turf strip.
Design 12: 100-ft-wide forested strip with level spreader.
Design 13: High-slope swales with no check dams.
Design 14: Low-gradient swales with check dams.

Figure 14. Comparative pollutant removal of urban BMP designs (3).

The Soil Conservation Districts' Role in Site Plan Review

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Kent Conservation District, Dover, Delaware
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Abstract

Officially organized nearly 50 years ago, both the Kent and Sussex Conservation Districts have been at the forefront of soil and water conservation. The more specific role of the conservation districts in sediment control and stormwater management is tied to two legislative initiatives. In 1978, the Delaware State Legislature passed an Erosion and Sediment Control Law (Chapter 40, Title 7, Delaware Code). In 1991, this law was amended to include stormwater management.

Because certain types of construction can increase sediment yields by 2,000 times, sediment control is a necessary first step on any construction site. The conservation districts' role in reviewing site plans is based on the importance of sediment control for limiting the degradation of surface water.

The conservation districts review site plans for stormwater management quantity control to ensure that the risk of downstream flooding is reduced and stream channel erosion is controlled. This is achieved by sustaining predevelopment runoff rates for the 2-, 10-, and 100-year storm events at the postdevelopment state and maintaining similar hydrograph timing for peak flows before and after development.

When reviewing site plans, the conservation districts also consider the quality of stormwater runoff. The order of preference for practices to improve water quality, according to Delaware law, is as follows: ponds with a permanent pool, extended detention ponds without a permanent pool, and infiltration systems. The acceptability of other practices that can remove up to 80 percent of the suspended solids in runoff is determined on a case-by-case basis. The Kent and Sussex Conservation Districts have promoted sand filtration systems and biofiltration swales for water quality treatment where applicable.

Background

Delaware, the first state to ratify the Constitution, in 1787, has a rich history dating back to pre-colonial times. Delaware is 1,978 square miles; only Rhode Island has less land mass. Located entirely on the DelMarVa (Delaware, Maryland, and Virginia) Peninsula, Delaware is a 2- to 3-hour drive from Baltimore, Maryland; Washington, DC; Philadelphia, Pennsylvania; and Norfolk, Virginia.

Location between the Chesapeake and Delaware Bays and the Atlantic Ocean provides for a moderate climate. Delaware receives 45 in. of rainfall annually, and Kent and Sussex Counties experience an average of 187 frost-free days a year. New Castle County, the northernmost of the three Delaware counties, is partially located in the Piedmont region, while the rest of the state is in the Atlantic coastal plain. Delaware's gently rolling topography starts at sea level and peaks at 368 ft in the northern part of the state.

With a statewide population of just over 666,000, Delaware has unique demographics. Currently, two-thirds of the population is located on less than one-third of the land in the state. Northern New Castle County, in which the city of Wilmington lies, is within easy commuting distance of Philadelphia and northeastern Maryland.

The city of Dover, located in Kent County in the central portion of the state, is not only the state capital but in 1992 was officially designated a metropolitan area. Kent County, which has considerable land in agricultural production, is also the home of Dover Air Force Base, a central military airlift command facility. Both of these factors have combined to produce considerable growth around the capital city.

Sussex County, the southernmost of the three counties, has two areas of interest that have brought considerable development to a primarily rural area. One is a 25-mile stretch of Atlantic Ocean shoreline. The other area is commonly referred to as the "Inland Bays" region, which has 80 miles of shoreline located directly behind the coastal barrier dune system. Although the resident population of Sussex County is just over 113,000, during the peak of the tourist season (July 4th weekend) the population balloons to an estimated 300,000 people.

In 1969, Governor Russell Peterson assigned a task force to study the steady decline of shellfish and finfish populations as well as related environmental issues of concern for the Inland Bays region. Reports and studies over the subsequent two decades pointed to the necessity of encouraging land-use planning and establishing various water quality initiatives regarding agricultural land and land that could be developed.

Steady growth in the state's metropolitan areas was not surprising. The increasing development in the two more rural counties of Kent and Sussex, however, brought the conservation districts to the forefront of soil and water conservation efforts at land development projects.

The Role of the Conservation Districts

In their first 50 years, the conservation districts were primarily involved in agricultural issues affecting local landowners. Historically, each district has been run by a board of seven elected supervisors, most of whom are local farmers, and has functioned as a clearinghouse for current information about the construction and maintenance of drainageways, wildlife ponds, and water control structures; updates on the availability of technical and financial assistance for farmers and other residents; and education activities related to resource management and protection.

In 1978, Delaware passed an Erosion and Sediment Control Law covering most types of residential, commercial, industrial, and institutional construction. In 1980, the conservation districts were enlisted to implement the law by the Delaware Department of Natural Resources and Environmental Control (DNREC). DNREC turned to the conservation districts because of their intimate knowledge of the counties in terms of constituents, soils, topography, and local and county governmental structure. Moreover, the conservation districts had a proven ability to run cost-effective programs with a minimum of "red tape."

From 1980 to 1987, development authorities were primarily concerned with erosion and sediment control in regard to all types of new construction. Stormwater management was handled by various state and municipal agencies on an "as needed" basis to control flooding. Then, in 1989, DNREC began the long process of establishing a statewide stormwater management law to address both runoff quantity control and water quality concerns. Using an approach that involved not only the regulators but also the regulated community, DNREC encountered a minimal amount of public opposition and gained the full support of the state legislature.

Thus, on July 1, 1991, the Erosion and Sediment Control Law was amended to include stormwater management. The conservation districts are now the lead agencies implementing this law. The program is considered by many to be a model of efficiency, not only from a cost perspective but also in terms of the rapid turnaround time for plan reviews, which is extremely important for interested parties in this age of fax machines, electronic mail, and cellular phones.

Scope of Site Plan Review

Review of site plans for construction projects has evolved from mere suggestions provided by a district employee concerning what might work best at a particular location to an engineered topographic plan showing the project's location, the site's details, and specifications for all practices to be used. To illustrate the plan review process, we occasionally refer in this paper to a project for "Running Brook Estates and Business Park" (Figure 1).

Plan review goes beyond looking at blueprints to see that specifications meet minimum standards set forth in state laws and regulations. Material that district inspectors frequently use to assess a project include:

- The state erosion and sediment control handbook.
- The district sediment and stormwater manual.
- County soil surveys.
- U.S. Geological Survey topographic maps.
- Federal Emergency Management Agency floodzone maps.
- State/Federal wetland inventories.
- The Delaware Department of Transportation (DelDot) specification book.
- Equipment manufacturer specifications and literature.

The most important tool for ensuring a thorough design as well as a consistent and efficient review is the management plan checklist. Figure 2 presents the checklist used by the Kent Conservation District.

Sediment Control

A plan for sediment control and stormwater management usually evolves from the site or grading plan but includes the location, dimensions, and details for the required erosion and sediment controls.

In some cases, designers or developers choose to use the stormwater facility as a sediment trap or basin. This is easily accomplished by modifying the facility's outlet control structure to include the necessary filtration devices (Figure 3). Although use of an infiltration basin

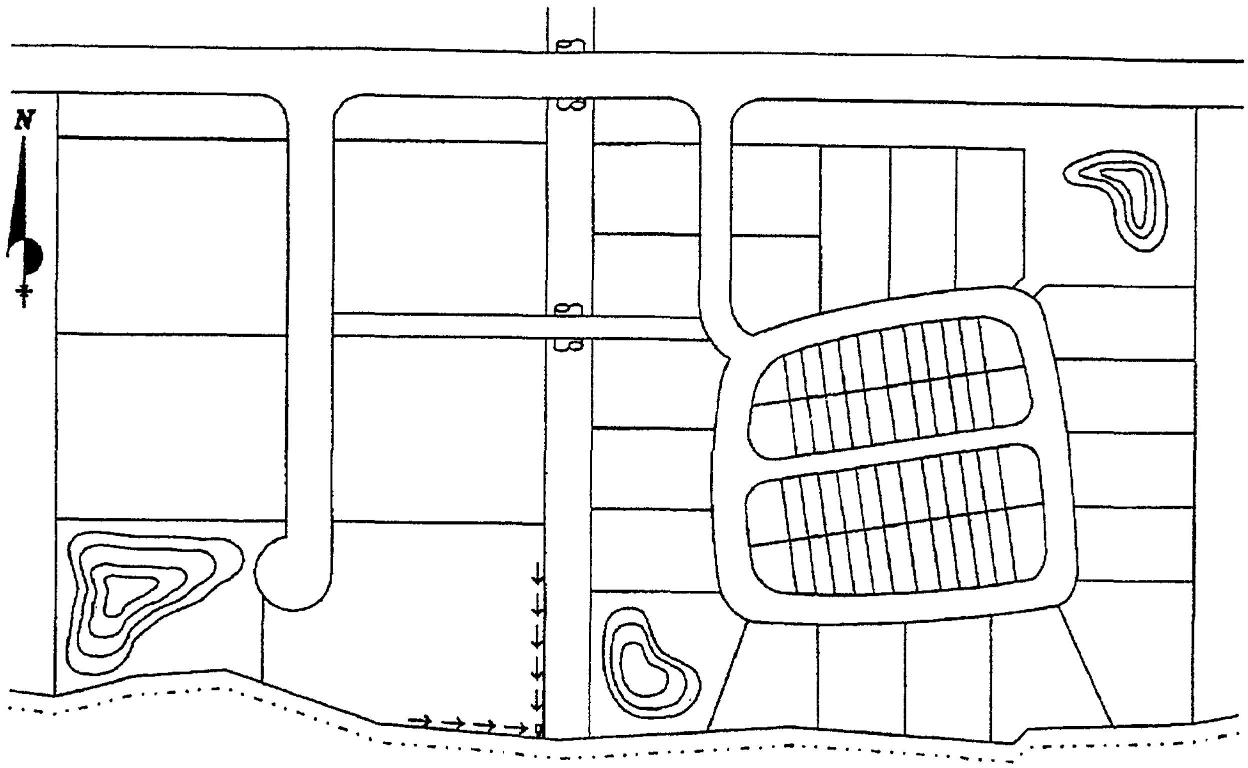

Figure 1. Site map for Running Brook Estates and Business Park.

as a sediment trap is generally discouraged, on occasion it may be necessary. For such cases, several approaches are recommended. One is to direct any sediment-laden runoff to a trap (Figure 4, northeast corner). Another is to leave the basin 12 to 24 in. above finished grade until the site is stabilized; excess material is then removed and the basin graded according to the plan's specifications.

The management plan must describe the construction sequence and establish the points at which various control installations must be added, removed, completed, or activated. For certain features, such as embankment ponds, the contractor may be required to notify the district inspector when construction is about to commence. This gives the inspector the opportunity to reemphasize the importance of such aspects of the installations as a cutoff trench and the emergency spillway's dimensions and to visually inspect riser structures, antiseep collars, and the foundation preparation.

Additional sediment control features commonly presented in the plan include the following (see also Figure 4):

- *Rock-check dams:* Used for velocity and erosion control in ditches and swales.
- *Perimeter dikes/swales, earth dikes, temporary swales:* Used to convey runoff to a trap or as a clean-water diversion.
- *A stabilized construction entrance:* Stone structure used to minimize sediment tracking onto roadways.
- *Vegetative requirements list (permanent and temporary):* Used to specify amounts and types of seed, mulch, and soil amendments needed.
- *A silt fence:* Commonly used downstream of disturbed soils as a perimeter filtration device.

Often the review process reveals unique or unexpected site features requiring that the district inspector make additional site visits, hold meetings with designers, and seek technical guidance from the Soil Conservation Service or the DNREC Division of Soil and Water Conservation. For example, because of the unique soils on the DelMarVa Peninsula, erosion problems necessitated that a list of soil erodibility (K) values (Figure 5), as determined by the Universal Soil Loss Equation, be compiled for the predominant soil types shown on the sediment and stormwater plan for Running Brook Estates and Business Park (Figure 6). Such lists not only expedite the review process but also help designers better prepare for the review comment period.

Stormwater Management for Quantity Control

The adverse impacts of stormwater runoff have been well documented. Damage caused by flooded streams and rivers has cost millions of dollars in property losses and has degraded the quality of the nation's waters. Reducing the risk of downstream flooding and stream-channel erosion after land development is the primary

KENT CONSERVATION DISTRICT
SEDIMENT AND STORMWATER MANAGEMENT PLAN

SUBMISSION REQUIREMENTS

1_____Review is predicated upon receipt of one set of plans and applicable review and inspection fee.

2_____Upon notification of approval, one additional set of plans must be submitted to be stamped and kept available on the construction site at all times.

REQUIRED STATEMENTS

1_____Provide the name, mailing address, and phone number of the owner of the property, the land developer, the engineer or consultant and the applicant. Provide names of adjacent property owners on the plan.

2_____Include the following notes:

- A_____The Kent Conservation District must be notified in writing five (5) days prior to commencing with construction. Failure to do so constitutes a violation of the approved Sediment and Stormwater Management Plan.
- B_____Review and or approval of the Sediment and Stormwater Management Plan shall not relieve the contractor from his or her responsibilities for compliance with the requirements of the Sediment and Stormwater Regulations, nor shall it relieve the contractor from errors or omissions in the approved plan.
- C_____If the approved plan needs to be modified, additional sediment and stormwater control measures may be required as deemed necessary by the Kent Conservation District.
- D_____The Kent Conservation District reserves the right to enter private property for purposes of periodic site inspection.
- E_____Following soil disturbance or redisturbance, permanent or temporary stabilization shall be completed within 14 calender days as to the surface of all perimeter sediment controls, topsoil stockpiles, and all other disturbed or graded areas on the project site.

3_____Include signed Owner's Certification of the following statements (<u>these must be signed in ink on each plan submitted</u>):

- A_____I, the undersigned, certify that all land clearing, construction and development shall be done pursuant to the approved plan.
- B_____I, the undersigned, certify that responsible personnel certified by DNREC will be in charge of on-site clearing and land disturbing activities.

GENERAL REQUIREMENTS

1_____Provide a legend on the Sediment and Stormwater Management Plan.

2_____Provide a "limit of disturbance" line and the disturbed area in acres.

3_____Provide a vicinity map with a scale of 1" = 1 mile.

4_____Provide a north arrow on the plan.

5_____Maximum plan scale of 1" = 100'

6_____Plans must be submitted on 24"x36" sheets.

7_____When two or more sheets are used to illustrate the plan view, an index sheet is required, illustrating the entire project on one 24"x36" sheet.

8_____Provide existing and proposed contours based on mean sea level datum provided at one foot intervals. Total contributing drainage area must be shown regardless of being located on or off-site.

9_____For small projects, provide existing and proposed spot elevations on a 50 foot grid system, based on mean sea level datum, with high and low points.

10_____State and Federal wetlands must be accurately delineated.

11_____Delineate the National Flood Insurance Program 100 Year Flood Zone.

12_____Provide soils mapping on plan with a general description of each soil.

13_____Streams must be delineated.

Figure 2. Sample sediment and stormwater management plan checklist.

EROSION AND SEDIMENT CONTROL

1_____All erosion and sediment control practices shall comply with the Delaware Erosion and Sediment Control Handbook 1989.

2_____Projects must be phased so that no more than 20 acres is cleared at any one time. Once grading is initiated in one 20 acre section, a second 20 acre section may have stumps, roots, brush, and organic material removed. Grading of the second 20 acre section may not proceed until temporary or permanent stabilization of the first 20 acre section is accomplished.

3_____Stone check dams are required in all swales, ditches and channels. Provide details, cross sections and specifications, including check dam station locations. Check dam depth must be such that a maximum stone depth is achieved while ensuring that flow will continue over the center of the dam. A minimum 6" depth from the weir to the top of the structure is required.

4_____All stone, with the exception of check dams, must be underlined by a filter fabric. Filter fabric specifications must be provided for various applications.

5_____Outlet protection is required at all points of discharge from pipes, channels, and spillways. Provide details, cross-sections and specifications, including d50 stone size, stone depth, outlet dimensions and type of filter fabric.

6_____Provide inlet and outlet invert elevations for all drainage structures and facilities.

7_____Provide profiles for all outfall pipes and channels.

8_____Erosion control matting is required on slopes of 3:1 or greater.

9_____Provide corner and lowest floor elevations for all buildings.

10____Specify what stabilization measures will be used if dust control becomes a problem.

11____Sediment traps and basins shall be utilized and sized to accomodate 3600 cubic feet of storage per acre of contributing drainage area until project stabilization is complete. These structures must be located at the base of the drainage area. The following information is required: top of slope, bottom, and outlet elevations, dimensions, proposed and required volumes, type of trap or basin, and contributing drainage area. Include details, cross sections and specifications; a minimum 2:1 length to width ratio is required.

12____Diversions must be used to direct runoff into traps. When sediment-laden stormwater is directed to traps or basins by closed pipe systems, temporary diversions must be used to direct stormwater to traps and basins until closed pipe systems are operational.

13____Provide a detailed sequence of construction, at a minimum, include the following activities: clearing and grubbing those areas necessary for the installation of perimeter controls, construction of perimeter controls, remaining clearing and grubbing, road grading, grading for remainder of site, utility installation and whether storm drains will be used or blocked until after completion of construction, final grading, landscaping or stabilization, and removal of sediment control practices.

14____Soil stockpile areas must be delineated, locate stockpiles on areas with little or no slope. Stockpiles must be surrounded with silt fence or a stabilized earthen berm.

Figure 2. Sample sediment and stormwater management plan checklist (continued).

STORMWATER MANAGEMENT

1_____ Show drainage calculations considering off-site contributing drainage. Provide pre and post-development velocities, peak rates of discharge, and inflow and outflow hydrographs of stormwater runoff at all existing and proposed points of discharge from the site for the 2 year and 10 year frequency storms. Show site conditions around points of all surface water discharge including vegetation and method of flow conveyance from the land disturbing activity and design details for structural controls.

2_____ All hydrologic computations shall be accomplished using the most recent version of USDA Soil Conservation Service TR-20 or TR-55, with the Delmarva Unit Hydrograph. The storm duration for computational purposes shall be the 24 hour rainfall event. The pre-development peak discharge rate shall be computed assuming that all land uses in the site to be developed are in good hydrologic condition.

3_____ Sub-watershed areas must be delineated on the plan for both the pre and post-development conditions. Provide the area in acres of each sub watershed.

4_____ Provide directional stormwater flow arrows for all existing and proposed channels, pipes, etc.

5_____ QUANTITY: Post-development peak rates of discharge for the 2 and 10 year frequency storm events shall not exceed the pre-development peak rates of discharge for the 2 and 10 year frequency storm events.

6_____ QUALITY: Water quality structures having a permanent pool shall be designed to release the first 1/2 inch of runoff from the site over a 24 hour period. Practices not having a permanent pool shall be designed to release the first inch of runoff from the site over a 24 hour period.

INFILTRATION

1_____ Infiltration practices shall be used only when the following criteria can be met or exceeded:

- A_____ Systems shall be designed to accept, at least, the first inch of runoff from all streets, roadways and parking lots. (Including all contributing drainage areas.)
- B_____ Areas draining to these practices must be stabilized and vegetative filters established prior to runoff entering the system.
- C_____ A suspended solids filter accompanies the practice, when vegetation is used there shall be at least a 20 foot length of vegetative filter.
- D_____ The bottom of the infiltration practice is at least 3 feet above the seasonal high water table.
- E_____ The system shall be designed to drain completely in 48 hours.
- F_____ Infiltration practices are limited to soils having an infiltration rate of at least 1.02 inches per hour. On site soil borings and textural classifications must be done to verify site conditions and seasonal high water table. This information must be submitted with the plan.
- G_____ Infiltration practices greater than 3 feet deep shall be located at least 20 feet from basement walls.
- H_____ Infiltration practices designed to handle runoff from impervious parking areas shall be a minimum of 150 feet from any public or private water supply well.
- I_____ Infiltration practices shall have overflow systems with measures to provide a non-erosive velocity of flow along its length and at the outfall.
- J_____ The slope of the bottom of the infiltration practice shall not exceed 5 percent.
- K_____ Infiltration practices shall not be installed on or atop a slope whose natural angle of incline exceeds 20 percent.
- L_____ Infiltration practices shall not be installed in fill material.
- M_____ Unless allowed on a specific project, infiltration practices will only be permitted for the primary purpose of water quality enhancement.

Figure 2. Sample sediment and stormwater management plan checklist (continued).

PONDS

1_____All ponds constructed for stormwater management shall be designed and constructed in accordance with USDA Soil Conservation Service Small Pond Code 378, dated September 1990, as approved for use in Delaware.

2_____All ponds shall have a forebay or other design feature to act as a sediment trap, a 10 foot reverse slope bench must be provided 1 foot above the normal pool elevation for safety purposes, a 10 foot level bench 1 foot below the normal pool elevation, and all embankment ponds having a permanent pool shall have a drain installed.

DETAILS

1_____Provide details and specifications for all erosion and sediment control and stormwater management practices used.

2_____Provide details of temporary and permanent stabilization measures.

3_____Provide details, cross-sections and specifications (including stabilization) for diversions, ditches, ponds, swales, infiltration structures, etc.

4_____Specify details of any unusual practices used.

MAINTENANCE

1_____Specify whose responsibility it will be to maintain and repair all erosion and sediment control and stormwater management practices during utility installation.

2_____Maintenance set aside areas for disposal of sediments removed from stormwater management facilities must be provided. Set aside areas shall accomodate at least 2 percent of the stormwater management facility volume to the elevation of the 2 year storm volume elevation, maximum depth of set aside volume shall be 1 foot, and the slope of the set aside area shall not exceed 5 percent.

3_____A clear statement of defined maintenance responsibility shall be established during the plan review and approval process.

Figure 2. Sample sediment and stormwater management plan checklist (continued).

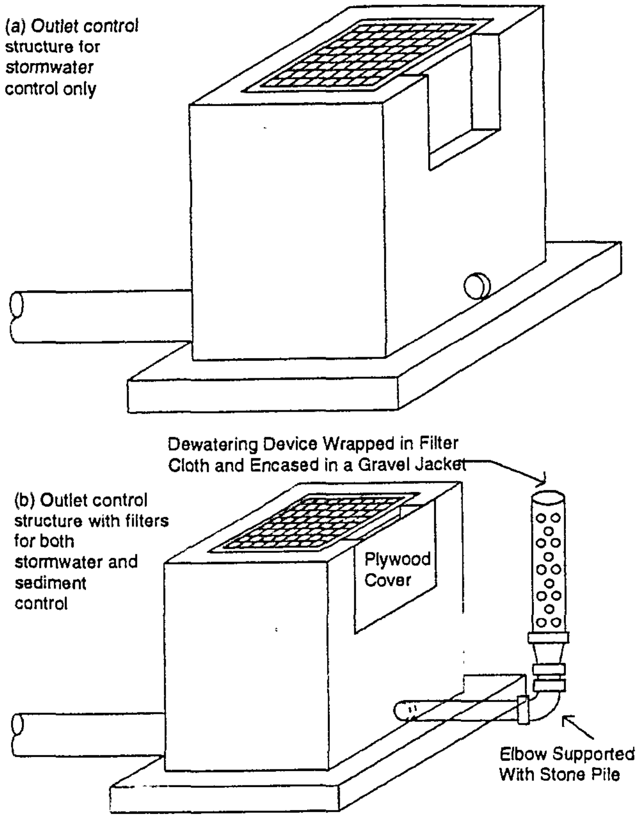

Figure 3. Outlet control structures for sediment and stormwater control.

reason for establishing a program that encourages stormwater management quantity control. Indeed, it has also been shown that flood peaks after development can increase by more than 500-fold.

The conservation districts' role in stormwater management quantity control is to ensure that discharge rates for the 2- and 10-year, 24-hour duration storm events do not increase following development. The districts also review management plan data on hydrograph timing and runoff volumes to ensure that areas downstream of development sites are not adversely affected. The districts prefer multiple-storm control because it is generally accepted as the most appropriate management approach for a wide range of storm discharges.

To compute stormwater discharges, procedures described in the Soil Conservation Service's Technical Release (TR) 20 and TR55 are used. Along with being generally user friendly, TR20 and TR55 procedures facilitate the production of required hydrographs and the computing of runoff storage requirements. Sussex and Kent Counties—and the DelMarVa Peninsula generally—fall under the TR20 and TR55 Type II rainfall distribution.

Early in the model's development, concerns were expressed that this rainfall distribution did not accurately represent the DelMarVa Peninsula, with its generally gently rolling topography, sandy soils, and limited outfalls. As a result, studies were performed and a new

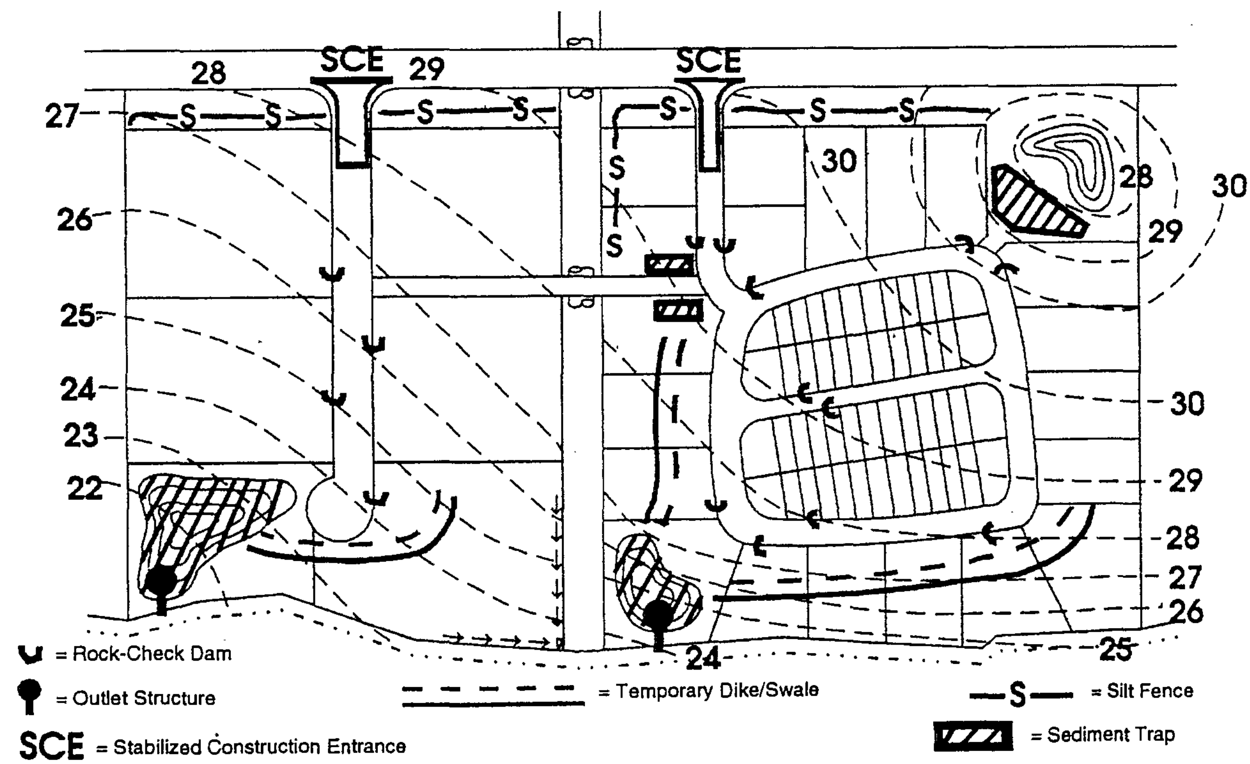

Figure 4. Sediment control features at Running Brook Estates and Business Park.

Sussex Conservation District
P.O. Box 8 - Georgetown, Delaware 19947 - Phone (302) 856-2105 or 7219

LIST OF HIGHLY ERODIBLE SOILS*

*S.C.S. FIELD OFFICE TECNNICAL GUIDE ("K" VALUE OF 0.20 OR GREATER)

SOIL NAME	SOIL SYMBOL	"K" VALUE	
ELKTON SANDY LOAM	El	0.43	
ELKTON LOAM	Em	0.43	
EVESBORO SAND (0-15%)	EoB-D	0.43	
FALLSINGTON SANDY LOAM	Fa	0.28	
FALLSINGTON LOAM	Fs	0.28	
KALMIA SANDY LOAM	Ka	0.28	
KENANSVILLE LOAMY SAND (0-5%)	KbA/B	0.24	
KEYPORT FINE SANDY LOAM (0-5%)	KfA/B2#	0.43	#ERODED
MATAWAN LOAMY SAND	Mm	0.28	
MATAWAN SANDY LOAM	Mn	0.32	
POCOMOKE SANDY LOAM	Pm	0.28	
PORTSMOUTH LOAM	Pt	0.28	
RUMFORD LOAMY SAND (0-10%)	RuA-C	0.20	
SASSAFRAS SANDY LOAM	SaA/B/C2#/D	0.28	#ERODED
SASSAFRAS LOAM (0-5%)	SfA/B	0.28	
WOODSTOWN SANDY LOAM	Wo	0.28	
WOODSTOWN LOAM	Ws	0.28	

Figure 5. Erodibility values for predominant soils on the DelMarVa Peninsula.

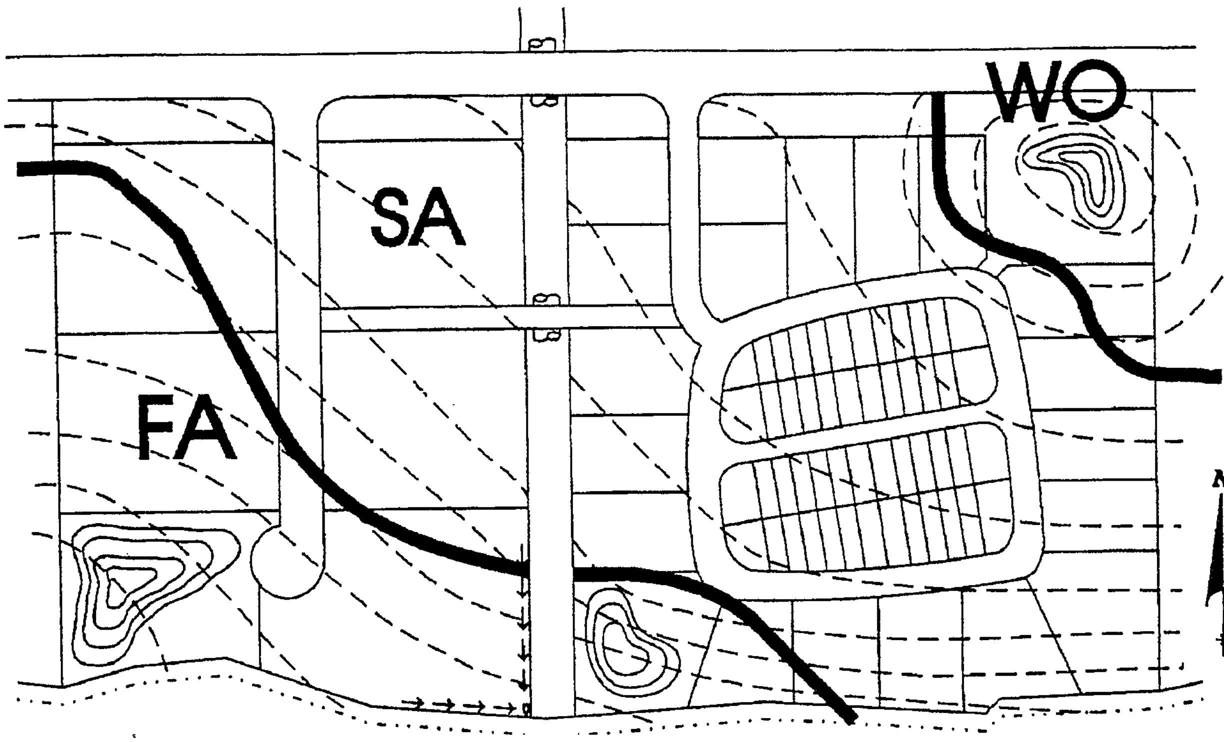

Figure 6. Predominant soils at Running Brook Estates and Business Park.

dimensionless, synthetic unit hydrograph was developed to be used with the Type II rainfall distribution. This hydrograph, named the DelMarVa Hydrograph, is used in Kent and Sussex Counties. The DelMarVa Hydrograph can develop peak flow rates up to 60 percent of those using just the given dimensionless synthetic hydrograph with the Type II rainfall distribution.

Stormwater is primarily managed for quantity control with ponds. In the Running Brook Estates and Business Park example, three stormwater management ponds are used (see Figure 7). The two ponds at the south side of the site were sized in accordance with standard criteria (i.e., using the 2- and 10-year, 24-hour duration storm events for discharge rates). The third pond is sized for a watershed with no positive outfall, a unique situation that often exists on the DelMarVa Peninsula. In such situations, when all possibilities to achieve an outfall have been exhausted, the facility is sized for the 10-year storm event runoff volume. A modified 100-year flood zone is then determined to establish finished floor elevations for any properties that could be affected by storms larger than the 10-year event. Infiltration can be factored in to reduce the size of such structures.

When development is proposed in urban areas and site space is limited, the district inspector has the flexibility to reduce the stormwater management quantity requirements to those related to quality, as discussed in the next section.

Stormwater Management for Quality Control

The preferred method for water quality treatment is use of a retention, or "wet," pond. Such a pond has a permanent pool capable of holding up to 1/2 in. of runoff over the drainage area. The elevation of the pool is determined by the low flow orifice of the outlet structure (Figure 3), from which the first 1/2 in. of runoff flows. Thus, above this elevation, 24-hour extended detention is provided for the 1/2 in. of runoff. Another feature required in the construction of a wet pond is the level bench. The bench is a 10-ft wide ledge around the perimeter of the pond, approximately 1 ft below the design elevation of the permanent pool, on which vegetation may be planted or allowed to grow naturally. The establishment of a thick mat of vegetation offers water quality improvements through sedimentation, filtration, and nutrient uptake. In addition, once this marshy area is established, it may help deter public access to the permanent pool area. Conservation districts often encourage addition of a wet pond as a water quality measure when soil and ground-water conditions are appropriate.

Figure 7 shows a wet pond in the southwest corner of Running Brook Estates and Business Park that was installed to capture and provide water quality treatment for a majority of the site's runoff. The pond's irregular shoreline and its proximity to wetlands (south of the site) make the pond aesthetically appealing and provide an

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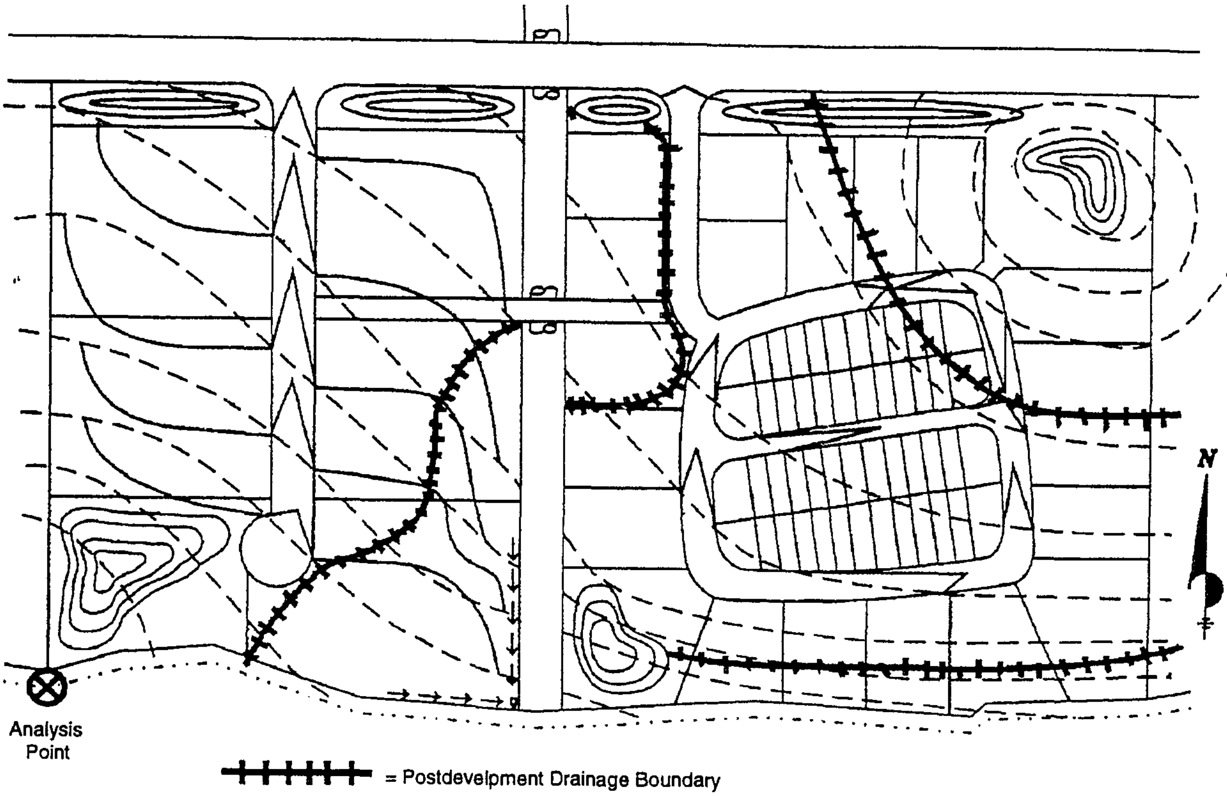

Figure 7. Stormwater management ponds at Running Brook Estates and Business Park.

extension of the natural area. Picnic tables were placed in the area for tenants' use.

More common for new construction projects is the detention, or "dry," pond, which detains runoff during a storm but then drains completely to a dry state. To meet regulations, a dry pond must be designed with a low flow orifice that provides extended detention of the first inch of runoff for a 24-hour period. While this appears to be an increase from the 1/2 in. required for wet ponds, actually the reverse is true. The first flush is generally accepted to be the first inch of runoff, but because wet ponds have been shown to provide better sedimentation and nutrient uptake, a volume credit is given for the use of a wet pond. This reduces the extended detention requirements by 50 percent.

Figure 7 shows a pond at the southern edge of Running Brook Estates and Business Park that provides extended detention for runoff from a large portion of the residential development. Discharge is to the wetland areas south of the site. Based on studies by the Mercer County Conservation District in New Jersey, the bottom and sides of this pond need to be planted with a wildflower mix. This type of vegetation will reduce the necessity of mowing to once a year, in the fall, greatly reducing maintenance expenses and increasing visual appeal. While state law requires a 3:1 side slope ratio for ponds in residential areas, the conservation districts encourage owners and consultants to design milder slopes.

If the use of ponds is not feasible on a site, an infiltration system should be considered. Infiltration trenches, in which perforated pipe is placed on a stone bed surrounded by filter fabric, are often preferred for urban sites, where higher land values make such systems particularly cost efficient. Infiltration trenches are generally considered less cost-effective for larger sites.

Another type of infiltration system is the basin. The infiltration basin depicted in the northeast corner of Running Brook Estates and Business Park in Figure 7 is used for the no-positive-outfall situation described above. The infiltration method of runoff management is encouraged for water quality enhancement but is discouraged for water quantity control due to the high potential for failure.

State law also allows the use of any practice that can achieve 80-percent removal of suspended solids in stormwater runoff. One such practice, the use of sand filters, has been effective in Delaware. Sand filtration can also be effective for capturing hydrocarbons, which can escape from ponds. Such systems function much like a septic system, with a sediment chamber leading to a filtration chamber (Figure 8); however, the majority of runoff is stored ahead of the structure in two grassed swales. Because this design is new, a strict maintenance schedule has been developed that must be followed until

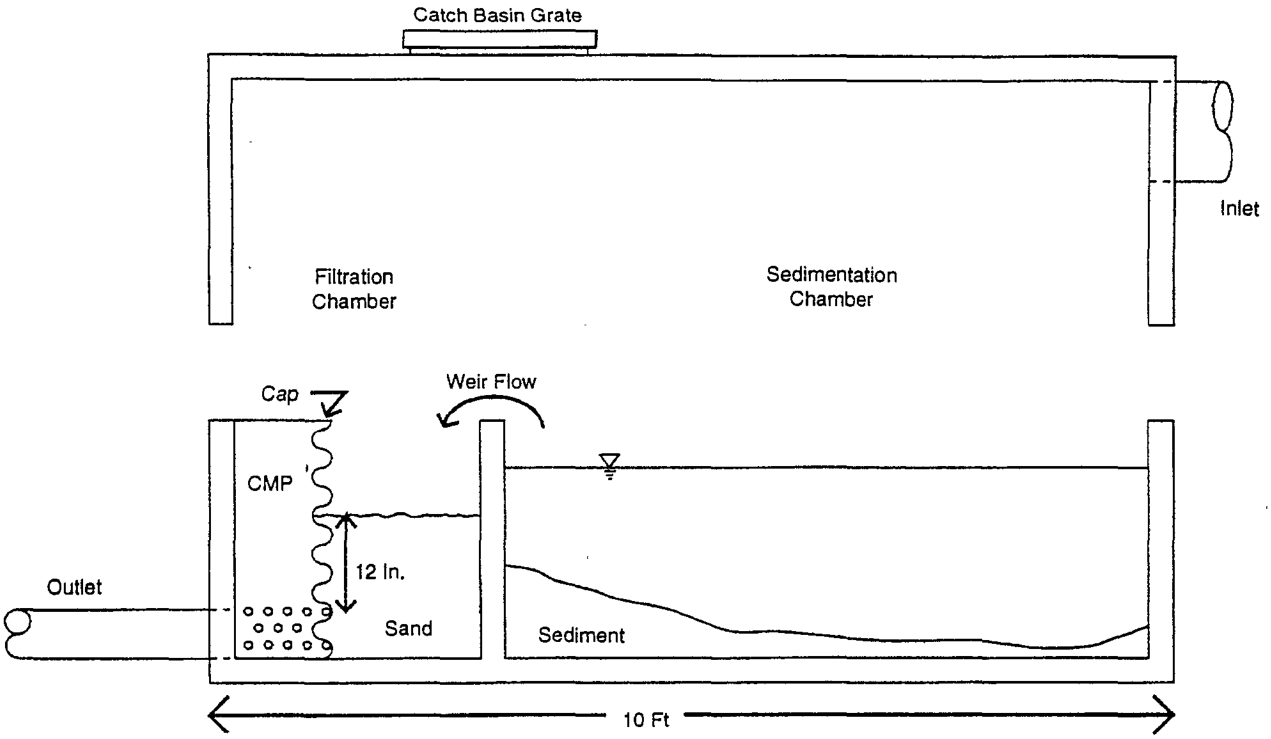

Figure 8. Septic tank modified for sand filtration.

performance can be verified. The system must be inspected every 3 months and any large debris removed. Once a year, the sedimentation chamber must be evaluated and the polluted top layer of sand removed and replaced. Every 5 years, the entire volume of sand must be replaced.

Another acceptable method of infiltration is the use of vegetated swales, an approach referred to as biofiltration. Given their linear configuration, vegetated swale systems may be especially appropriate for space-limited urban sights where a water quality pond might otherwise be used.

Runoff from the northwest corner of Running Brook Estates and Business Park is treated in two biofiltration swales before it enters the tax ditch that separates the residential subdivision from the business park. The swales are located on either side of the forestry lane leading to the tax-ditch crossing. The forestry lane, which was installed because fire laws require two access points for developments of this size, is demarcated with a combination of fescue and a wildflower mix, which the conservation district mandates for the quality and aesthetic aspects of swales.

Because these swales at Running Brook Estates and Business Park only receive water quality treatment, a TR20 analysis was performed on the entire site to assess flows at the analysis point shown in Figure 7. Other factors were also considered in finalizing review of the site plan (see Figures 9, 10, and 11).

Site Inspection

Plan review is not the only element of sediment control and stormwater management delegated to the conservation districts. To keep day-to-day operation of the program within one agency, the conservation districts also conduct site visits periodically during construction and then on an annual basis to perform maintenance inspections of all completed facilities. A long-term maintenance plan for each facility, identifying the responsible parties, must be established during the plan review stage.

Conclusion

The most important role the conservation districts have in site plan review is providing technical assistance to landowners, designers, and contractors with respect to sediment control and stormwater management. The districts' staff pride themselves on their working relationships and knowledge of the evolving situations in the state's counties.

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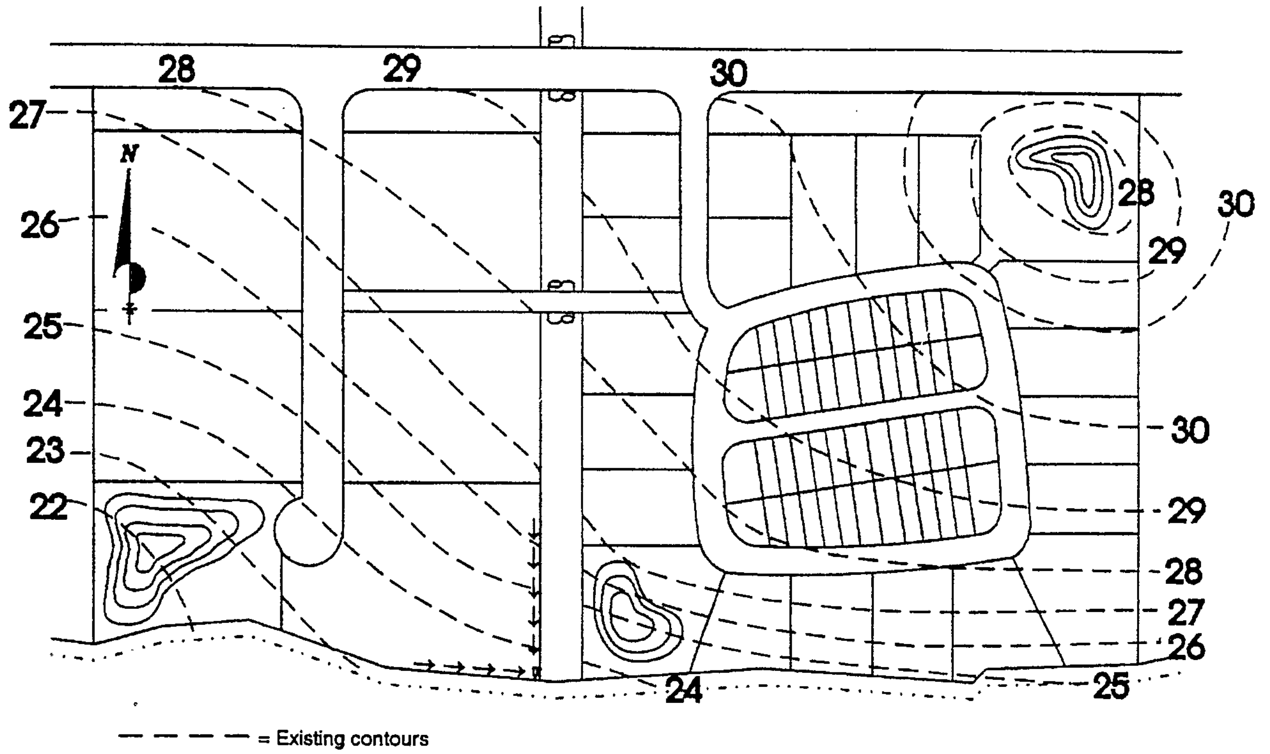

Figure 9. Existing contours at Running Brook Estates and Business Park.

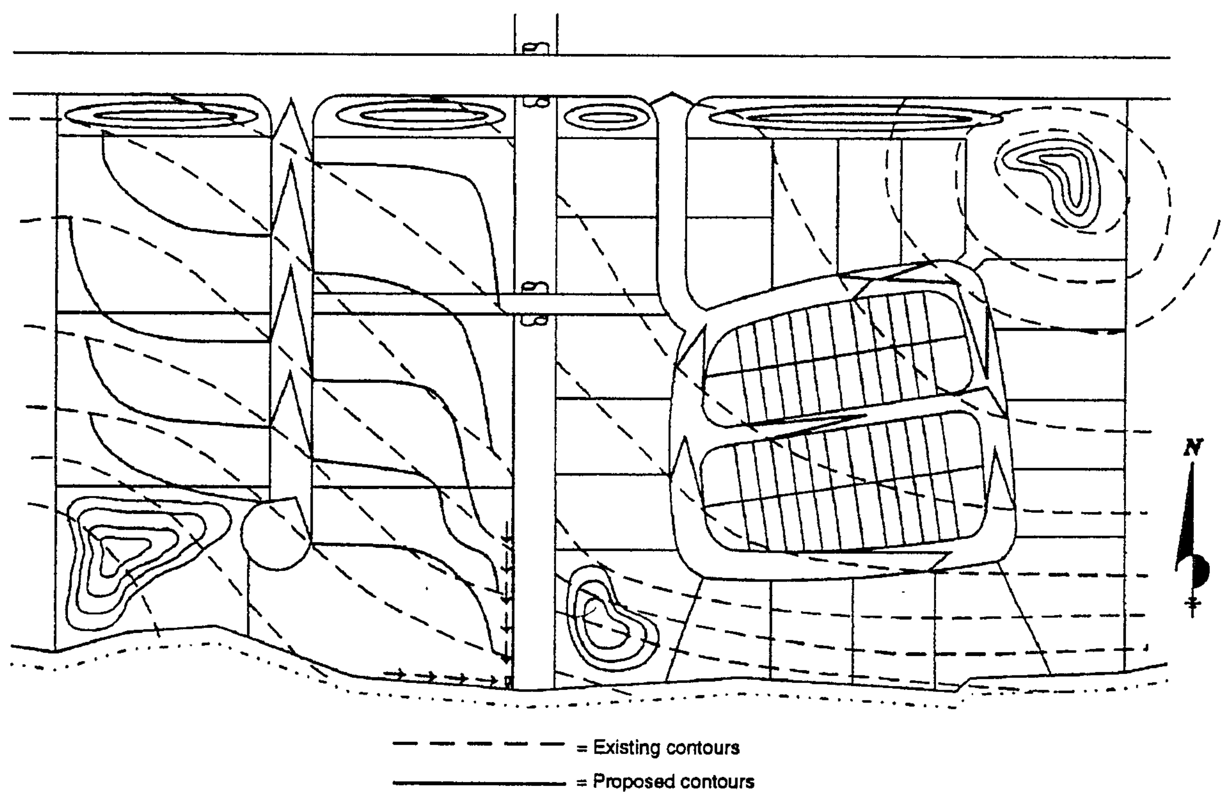

Figure 10. Existing and proposed contours at Running Brook Estates and Business Park.

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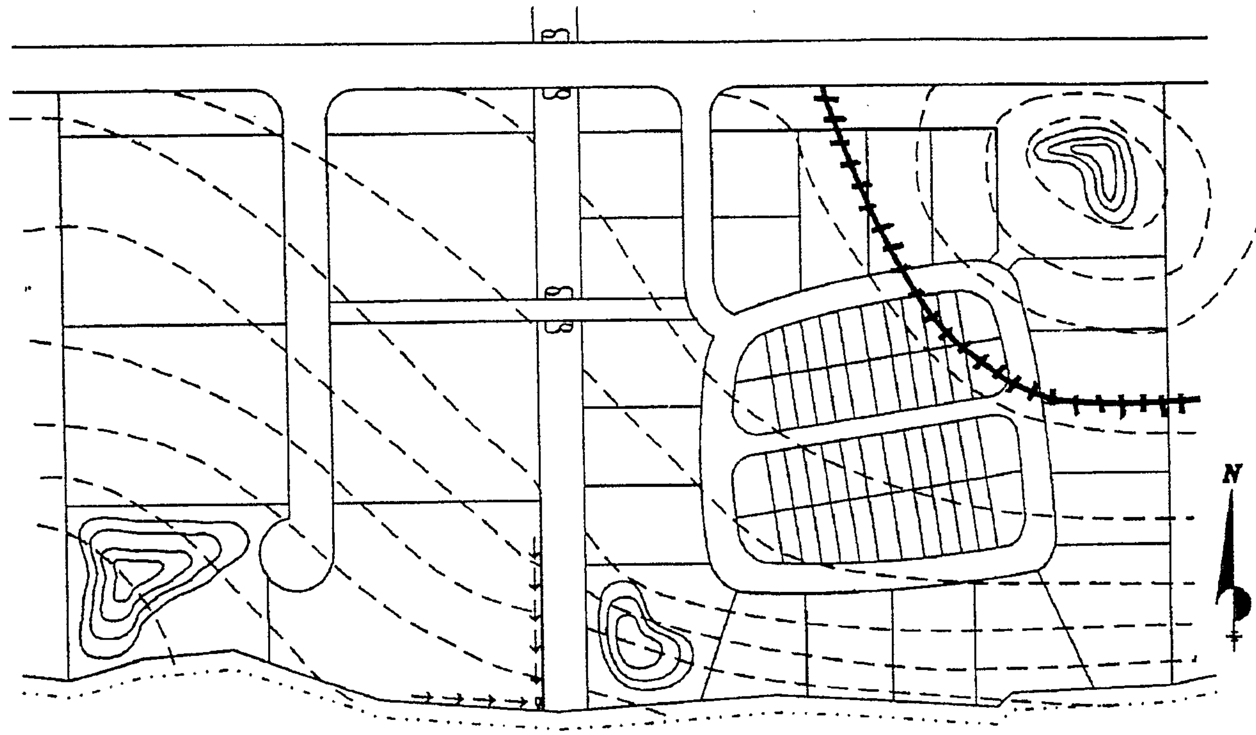

= Predevelopment Drainage Boundary

Figure 11. Predevelopment drainage boundary at Running Brook Estates and Business Park.

The Role of Landscapes in Stormwater Management

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Abstract

This paper presents evidence that many existing streams did not have conspicuous channels and were not identified during presettlement times (prior to 1830s in the midwestern United States). Many currently identified first-, second-, and third-order streams were identified as vegetated swales, wetlands, wet prairies, and swamps in the original land survey records of the U.S. General Land Office.

The data presented show that significant increases in discharge for low, median, and high flows have occurred since settlement. Stream channels have formed inadvertently or were created to drain land for development and agricultural land uses. Currently, discharges may be 200 to 400 times greater than historical levels, based on data from 1886 to the present for the Des Plaines River in Illinois, a 620-square-mile watershed. Historic data document how this river had no measurable discharge or very low flow conditions for over 60 percent of each year during the period from 1886 to 1904.

This study suggests that land-use changes in the previous upland/prairie watershed have resulted in a change from a diffuse and slow overland flow to increased runoff, concentrated flows, and significantly reduced lag time. Preliminary modeling suggests the following results: reduced infiltration, reduced evaporation and evapotranspiration, greatly increased runoff and hydraulic volatility, and increased sediment yields and instream water quality problems caused by destabilization of streambanks.

The opportunity to emulate historical stormwater behavior by integrating upland landscape features in urban developments and agricultural lands offers stormwater management options that are easier to maintain, less expensive over time, attractive, and possibly more efficient compared with many conventional stormwater management solutions and the use of biofiltration wetlands.

Introduction

Diverse and productive prairies, wetlands, savannas, and other ecological systems occupied hundreds of millions of acres in presettlement North America. These ecological systems have been replaced by a vast acreage of tilled and developed lands. Land-use changes have modified the capability of the upland systems and small depressional wetlands in the uplands to retain water and assimilate nutrients and other materials that now flow from the land into aquatic systems, streams, and wetlands. The historical plant communities that were dominated by deep-rooted, long-lived, and productive species have been primarily replaced by annual species (corn, soybeans, wheat) or shallow rooted non-native species (bluegrass lawns, brome grass fields). The native vegetation was efficient at using water and nutrients, and consequently maintained very high levels of carbon fixation and primary productivity. Modern communities, in turn, are productive but primarily aboveground, in contrast to the prairie ecosystem where perhaps 70 percent of the biomass was actually created belowground in highly developed root systems. These changes in the landscape and vegetation coupled with intentional stormwater management have changed the lag time for water to remain in uplands and consequently the rate and volume of water leaving the landscape.

The Des Plaines River

Changes that have occurred on the uplands and how these changes have affected the hydrology of wetlands and aquatic systems can be illustrated using historical and more recent data to illustrate trends in discharge of major river systems. The Des Plaines River was chosen as a study watershed because of available historical data and trackable changes in watershed land uses.

The Des Plaines River originates southeast of Burlington in southeastern Wisconsin, flows for over 90 river miles through agricultural, urban, and suburban landscape through northeastern Illinois and the Chicago region, then flows west and south, meeting with another river and becoming the Illinois River. The historical data presented are from a case before the Illinois Supreme Court and a circuit court (U.S. Department of War vs. Economy Power and Light, 1904) that dealt with the navigability of the Des Plaines River. The data were derived from a gauge station installed and operated at present-day Riverside, Illinois, from 1886 to 1904. The U.S. Geological Survey has maintained this same station since 1943. Historical data from 1886 to 1904 include a single-stage measurement per day and weekly discharge measurements (rating curves). For our studies, duration flow curves were created for the years 1886 to 1904 and 1943 to 1990. The data were compared using median values of discharge (50 percent) and also using low and high levels of discharge as indicated by the 75 percent and 10 percent values derived from the annual duration flow curves 1886 to 1904 and 1943 to 1990. The watershed area gauged at Riverside is approximately 620 square miles (400,000 acres).

In the late 1800s, about 40 percent of the watershed had been tilled and/or was developed. In contrast, approximately 70 to 80 percent of the watershed is now developed or under annually tilled agriculture land uses. Annual duration flow curve values based on linear regression analysis suggested very significant increases in discharge since 1886; perhaps 250 to 400 times (Figure 1). In 1886, the median discharge was 4 ft^3/sec. In contrast, in recent years the median discharge has been 700 to 800 ft^3/sec. Trends in low, medium, and high flow values for the Des Plaines River have undergone very significant increases.

Preliminary watershed hydrologic modeling suggests that the watershed and discharge data for 1886 to 1904 had already been modified by development and agricultural land uses; the Des Plaines River watershed was settled in the late 1830s, and thus 50 years of land use and development had passed before the 1886 data were collected. Other data resulting from the litigation suggested very clearly that the discharge of water from the Des Plaines River was significantly less between 1886 to 1904 compared with present day discharge. Because the litigation contested navigability, evidence was presented using daily stage, discharge, and water depth data on the opportunity for commercial navigation on the river. The data suggested that between 1886 and 1904, for an average 92 days per year, the river had no measurable discharge. An additional 117 days per year, the river had 60 ft^3/sec or less discharge, which was equal to a depth of less than 3 in. at Riverside. Based on these statistics, over 60 percent of the year the 400,000 acre watershed yielded no water or such low flows that navigation was not possible or reliable. Another 10 to 25 percent of the year the river was covered with ice.

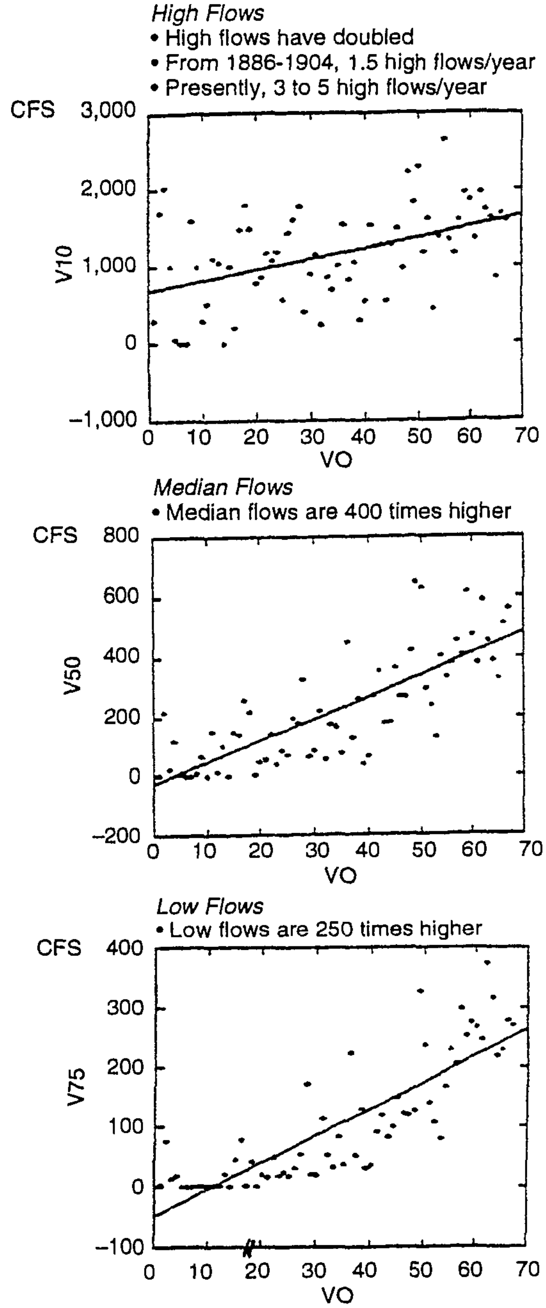

Figure 1. Linear regression analysis and raw data plots of Des Plaines River discharge at Riverside, Illinois, 1886 to 1988. Low, median, and high flow data were derived from duration-flow curves for 75, 50, and 10 percentile annual flow levels (1).

Additional supporting evidence of the significance of changes in the watershed and river is available. The original land survey records for parts of the Des Plaines River where section lines were surveyed identified that reaches of the river had no discernable channels. Where channels now occur, in the 1830s surveyors found wet prairies, swamps, and swales but usually no conspicuous or measurable channel widths. Channels and "pools" were identified in some locations and with greater frequency downstream in the watershed. The original land surveyors were under contract by the U.S. Government Land Office to document the vegetation types covering the land and to identify, where possible, the widths and depths of streams when they were encountered during the process of laying out the section lines.

Conclusions and Applications of the Findings

These data suggest very clearly that highly significant changes in the hydrology, hydraulics, and water yield from the Des Plaines River watershed have occurred since settlement. Other major river and watershed systems have yielded similar results, suggesting the transferability of the concepts and general conclusions reached from the studies of the Des Plaines River. These findings and their applications are discussed below.

Natural Ecological System Functions and Processes Should Be Emulated

Water Yield

The historical landscapes "managed" stormwater very differently than it is managed by present-day strategies. Historical data clearly indicate that a relatively small percentage of the precipitation in a watershed actually resulted in measurable runoff and water leaving the watershed. In fact, preliminary analysis suggests very strongly that an average 60 to 70 percent of the precipitation in the watershed did not leave the watershed from the Des Plaines River; this water was lost through evaporation and evapotranspiration. Analysis predicts that approximately 20 to 30 percent infiltrated and may have contributed indirectly to base flow in the streams and directly to base flow in wetlands in the watershed. During a full year, the balance of the water directly contributed to flow in the "river," where an identifiable river channel now occurs.

Present-day water management strategies involve collection, concentration, and managed release of water. These activities are generally performed in developed parcels in the lower topographic positions. Historically, a greater percentage of water was lost through evaporation and evapotranspiration from upland systems. In these situations, microdepressional storage and dispersed rather than concentrated storage occurred. Weaver (1) documented the ability of the foliage of native perennial grassland vegetation to intercept over an inch of rain with no runoff generated.

Sediment and Pollutant Management

Because many pollutants in stormwater require water to dislodge and translocate the suspended solids to which they are adsorbed, there is a great opportunity to emulate historical functions by using upland systems to perform biofiltration functions, increase lag time, and reduce total volume and rate of runoff.

Increased discharge and velocity of water moving through channels has been documented to greatly affect instream water quality. Perhaps as much as 70 percent of instream sediment loads come from channel and bank destabilization associated with the higher velocity waters and with solufluction and mass wasting of banks after flood waters recede (2). Stabilizing (or at least reducing) hydraulic pulsing in streams can best be accomplished by desynchronization and reduction of tributary stormwater volumes and runoff rates from uplands. This can be accomplished by integrating substantial upland perennial vegetated buffers throughout developments and agricultural land uses. Buffers are designed not only to convey water and minimize erosion (i.e., grassy waterways) but also to attenuate hydraulic pulsing, settle solids and adsorbed nutrients, and reduce and diffuse the velocity, energy, and quantity of water entering rivers, wetlands, and other lowland habitats. Using upland microdepressional storage, perhaps in the form of ephemeral wetland systems and swales in the uplands, also would emulate the historical landscape conditions and functions.

Applications

Several example projects of "conservation developments" are now being completed, which integrate up to 50 to 60 percent of the urban development as open space planted to perennial native prairie, wet swales, and other upland communities (as site amenities). Hybernia is a 132-acre residential development in Highland Park, Illinois, designed and constructed by Red Seal Development Corporation, Northbrook, Illinois. Empirical data from Hybernia suggest that the use of upland vegetation systems in combination with ponded areas has resulted in the rate and volume of discharge being essentially unchanged before and after development. Another project, Prairie Crossing, is a 677-acre residential project designed to offer comprehensive onsite stormwater management in uplands and created lake systems. Extensive upland prairie and wet swale systems biofilter runoff and enhance the quality and reduce the quantity of water reaching wetlands and lakes in the development.

In these types of projects, upland vegetation takes several years to fully offer stormwater management benefits. In planted prairies, surface soil structure develops a three-dimensional aspect in 3 to 5 years. The development of this structure seems to have an important role both in offering microdepressional storage and increasing the lag time for retaining water in upland systems.

Restoration and native species plantings also have provided benefits where ecological system degradation has led to increased water and sediment yields. Where ecological degradation is occurring indirectly because human activities on the landscape have reduced or eliminated major processes (such as natural wildfires), restoration can provide vegetation and stormwater management benefits. Wildfires have been all but eliminated since human settlement has occurred, especially in areas that contain forests, savanna, or oak woods. In the absence of fires in many oak woods and savannas, a dense shading develops caused by increased tree canopy and dense shrub development. Where this has occurred, a reduced ground cover and soil stabilizing vegetation grows under the low-light conditions. Consequently, highly erodible topsoils containing the seeds, roots, and tubers of the soil stabilizing vegetation and higher volumes and rates of water can run off from these degraded savanna sites. The process of savanna deterioration has been documented; restoration has used prescribed burning and other strategies (3-5). Reestablishment of ground cover vegetation is key to reducing runoff, improving water quality, and reestablishing an infiltration component in degraded, timbered systems.

Should Wetlands Be Used for Sediment Management, or Should This Occur on the Uplands?

Because wetlands often provide what little wildlife habitat remains in developed landscapes, and because they are attractive to wildlife, their use for stormwater management must be carefully considered. Currently, a national movement is afoot to use created (and often natural) wetlands for stormwater management and biofiltration. Many studies of existing high-quality wetlands, however, provide little or no evidence that they historically served important biological filtration and sediment management functions. Sediment deposition was generally episodic (e.g., after wildfires), was of short duration, and yielded small sediment loads compared with loads from present-day agricultural and developed lands.

Use of wetlands for biofiltration can actually aggravate existing problems for many wetland wildlife species. For example, in the Chicago region it is not unusual to find 100 to 200 parts per million lead (and other contaminants) in tadpoles (especially in frog species with a 2-year tadpole stage, such as leopard frogs, bullfrogs, and green frogs) found in wetlands receiving highway stormwater. It is imperative to understand the potential long-term toxic effects on biological systems associated with stormwater management in wetlands and contaminant mobility.

Proposals have been made to allow the materials concentrated in biofiltration wetlands to simply be buried by each additional sediment load or to be intentionally buried by adding additional soil. Contaminant mobility through biological pathways still occurs, however, from beneath considerable sediment burial. In fact, in the Great Lakes, contamination from PCBs that are often several feet below the surface of the sediments have contributed to major increased mortality rates and major morphological problems in predacious birds such as cormorants, terns, and gulls (6, 7). The literature on wetland biofiltration inadequately addresses contaminant mobility routes through biological systems and the potential threat to the viability of biological systems. Because wetlands are so attractive to biological organisms (and, in fact, the biological organisms are often key to the successful functions of the biofiltration wetlands), it is necessary to rethink and carefully design biofiltration wetland systems in the future.

Far too often, people view the lowland environments (i.e., rivers, wetlands) as the locations for treating or physically removing problems created in the upland environments. The studies briefly described in the previous section, however, suggest that stormwater, sediment loads, and the varied contaminants may be best managed on upland systems. Although the land cost for using upland rather than lowland environments for stormwater management may be higher, the efficiency and reduction in potential contaminant problems may be greater. A landscape with many upland microdepressional storage opportunities and a large buffering capacity might offer more efficient processing than would a single biofiltration wetland at the downstream end. Each buffer or depressional wetland would need to treat a smaller volume of water and contaminants. Also, upland or dispersed stormwater treatment facilities would have significantly reduced long-term maintenance costs and represent a more sustainable approach to management of stormwater. Centralized biofiltration wetlands, on the other hand, have high maintenance requirements and potential problems that include decreases in removal efficiency for some materials in the short and long term.

There Are No Controlled Year-Round (and Long-Term) Studies of Removal Efficiencies Comparing Uplands and Wetlands

The stormwater treatment literature indicates that use of wetlands and measurements of removal efficiencies have been based primarily on removal during storm events passing through the biofiltration wetlands. Year-round contaminant mass-balance data are largely unavailable. Nongrowing season studies have documented the export of materials to be significant; consequently, removal efficiencies for some materials (e.g., metals, phosphorus) are not likely to be significantly reduced from what has been documented for storm event sampling. Wetland efficiencies need to be experimentally controlled and compared with upland removal efficiencies, which also have not been studied in detail (with the exception of removals for several key elements such as phosphorus). The ability of upland (soil colloids) systems to provide reliable and long-term binding and retention for many contaminants has been demonstrated (8).

Acknowledgments

Funding for a series of ongoing studies summarized in this paper were provided by the Wisconsin Chapter of the Nature Conservancy and by Cook and DuPage County (Illinois) Forest Preserve Districts.

Assistance in these ongoing studies was provided by Dr. Luna B. Leopold, Dr. James P. Ludwig, Dr. Alan W. Haney, Mr. Robert A. Riggins, and Mr. Brett Larson and others at Applied Ecological Services, Inc. Mr. and Mrs. George Ranney and Mr. David Hoffman of Prairie Holding Corporation and Red Seal Development Corporation, respectively, allowed their conservation development projects to be presented as examples here.

References

1. Weaver, J.E. 1968. *Prairie plants and their environment, a 50-year study in the Midwest.* Lincoln, NB: University of Nebraska Press.

2. Dunne, T., and L.B. Leopold. 1978. Water in environmental planning. San Francisco, CA: W.H. Freeman and Company.

3. Haney, A., and S. Apfelbaum. 1990. Structure and dynamics of Midwest oak savannas. In: Sweeney, J.M., ed. Management of dynamic ecosystems. West Lafayette, IN: The Wildlife Society, North Central Section. pp. 19-30.

4. Haney, A., and S. Apfelbaum. 1993. Characterization of midwestern oak savannas. In: U.S. EPA. *Proceedings of the Workshop on Oak Savannas, February.* Chicago, IL. In press.

5. Apfelbaum, S.I., and A. Haney. 1991. Management of degraded oak savanna remnants in the upper Midwest: Preliminary results from 3 years of study. In: Ebinger, J., ed. Proceedings of the Oak Woods Management Workshop, Peoria, IL. pp. 81-89.

6. Schneider, S., and R. Campbell. 1991. Cause-effect linkages II. Abstract presented at the Michigan Audubon Society Symposium, Traverse City, MI, September 27-28.

7. Gilbertson, M., and R.S. Schneider. 1991. J. Toxicol. Environ. Health 33(4).

8. Leeper, G.W. 1978. Managing the heavy metals on the land. New York, NY: Marcel Dekker.

The U.S. Environmental Protection Agency's Advanced Identification Process

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Abstract

Advanced Identification (ADID) is a planning process designed to identify and help protect high-quality wetland resources. The ADID process is a joint effort between the U.S. Environmental Protection Agency (EPA) and the U.S. Army Corps of Engineers, in which wetland functions and values are evaluated to determine which wetlands within an ADID study area are high quality and should be protected from future fill activities or, in some cases, which wetlands are of ecologically low value and could be considered as potential future fill sites. ADID provides the local community with information on the value of wetland areas that may be affected by their activities as well as a preliminary indication of factors that are likely to be considered during permit review of a Section 404 permit application.

Final ADID products usually consist of a technical report that includes the data gathered during the ADID study, a description of how the wetland evaluation was done, and a set of maps that identify the sites determined to be either unsuitable or suitable for filling activities. EPA works closely with other federal, state, and local agencies as well as the public throughout the ADID process. Each ADID process is designed a little differently to meet the specific wetland planning needs of the local area.

Introduction

In an effort to provide protection to remaining wetlands, the U.S. Environmental Protection Agency (EPA), in cooperation with the U.S. Army Corps of Engineers (COE) and other federal, state, and local agencies, may identify wetlands and other waters of the United States as generally unsuitable or suitable for the discharge of dredged or fill material before receiving a Section 404 permit application. This Advanced Identification (ADID) process is authorized by the regulations pertaining to Section 404 of the Clean Water Act. During the ADID process, EPA, COE, and other federal, state, and local agencies collect information on the values of wetlands and other waters of the United States to determine which wetlands in the ADID study area are of high functional value and should be protected from future fill activities and, in some cases, which wetlands are of low functional value and could be considered as potential fill sites.

What Is an ADID?

ADID is an advanced planning process designed to provide an additional level of protection to wetlands and other waters of the United States. The ADID process is one of the few tools currently available to EPA and other regulatory agencies that can help address resource-specific issues from a broader perspective. Typically, Section 404 permitting actions are considered on a case-by-case basis. ADID provides the opportunity to evaluate permit requests against wetland resource concerns from a watershed or regional perspective. Therefore, ADID can be used to address large geographic issues such as regional wetland loss, to provide the information needed to better evaluate cumulative loss impacts, and to provide more detailed ecological information than is typically available to regulatory decision-makers.

A planning tool, ADID is advisory not regulatory in nature. ADID provides landowners and developers with advance information, allowing them to plan with more predictability regarding the Section 404 permitting program. ADID can provide environmental groups, resource agencies, or other groups with information that can be used to guide protection or restoration efforts. ADID also can give information on local wetland loss trends. Most importantly, ADID can provide local communities with information on specific values of local wetlands that can be used to help develop local ordinances or other planning efforts designed to protect wetlands with values important to the community.

ADID projects vary in size and scope. Study areas range in size from 100 acres to 4,000 square miles and have been initiated throughout the country. Nationally, 35 ADID projects have been completed, and 36 are ongoing. The ADID process can be very resource intensive, depending on the scope of the project. From start to finish, the time to complete the ADID process can range from 6 months to several years.

Final ADID products vary from project to project. Typically, a completed ADID includes a map that identifies areas that are either unsuitable or suitable for fill, a database that contains the information used to make the ADID determination, and a technical summary document that explains how the wetland evaluations were done and what criteria were used to make the unsuitable/suitable determinations. Before ADID is completed, a joint public notice is issued by EPA and COE and a public meeting is held to solicit public comment on the products. Public comments are considered before the final ADID determinations are made. The final maps, supporting data, and technical summary document are all available to the public upon request.

In Region 5's experience, ADID is most effective where there is strong local support for such a project. ADID projects that involve local agencies can be tailored to address local needs or problems, such as flood control, water quality problems, or habitat loss. Participation of local agencies in the ADID process not only provides valuable local perspective and expertise but also the opportunity for ADID determinations to be included in local comprehensive planning efforts and wetland protection ordinances.

Lake County ADID

EPA Region 5, in cooperation with COE and several other federal, state, and local agencies, completed an ADID project in Lake County, Illinois, in January 1993. The following is a brief overview of how the ADID process worked in Lake County.

Lake County is 460 square miles and is located in northeastern Illinois. This county has been under intensive development pressure for the last 5 to 10 years. Lake County also contains a significant proportion of the wetlands and lakes within Illinois. The majority of wetlands within Lake County are isolated or above the headwaters; therefore, many small wetland fills (less than 10 acres) were authorized under Nationwide Permit 26. EPA and COE were concerned that, cumulatively, these fills could have a significant negative effect on aquatic resources in Lake County.

Lake County was interested in supporting an ADID study because local citizens were raising many wetland development issues. The county hoped that the ADID process would provide an additional level of protection for the high-quality wetlands, as well as an opportunity for the county to work with federal agencies to resolve local wetland issues. In addition, the county was beginning to work on a stormwater and wetland protection ordinance. The county viewed the ADID process as an opportunity to work with federal and state agencies to develop an evaluation methodology for local wetlands that could be used to guide implementation of the proposed ordinance.

The Lake County ADID process was started in the fall of 1989. The first meeting included representatives from federal, state, and local agencies and public interest groups. The goals of the ADID process were explained, and the wetland functions and values to be evaluated were selected based on local needs. A technical advisory committee was formed consisting of representatives from EPA, COE, the U.S. Fish and Wildlife Service, the Soil Conservation Service, the Illinois Department of Conservation, the Lake County Forest Preserve District, the Lake County Department of Management Services, the Lake County Department of Planning, the Lake County Soil and Water Conservation District, the Lake County Stormwater Management Commission, and the Northeastern Illinois Planning Commission. The committee's task was to develop the methodologies to evaluate the selected wetland functions and values. Due to resource constraints, the committee decided to focus on identifying high-quality wetland sites only. Sites identified as being of high functional value would be considered unsuitable for filling activities.

Lake County, Illinois, contains many lakes and wetlands and is undergoing rapid urban development. Issues such as degradation of water quality, flooding problems, and habitat loss are of local concern. Based on these concerns, the committee selected the following five wetland functions to evaluate for the ADID study:

- Biological community value
- Stormwater storage value
- Shoreline/bank stabilization value
- Sediment/toxicant retention value
- Nutrient removal/transformation value

In considering evaluation methodologies, the committee immediately determined that the selected approach must be capable of dealing with a very large number of wetlands. The final evaluation methodologies developed for use in the Lake County ADID process were combinations of portions of the Wetland Evaluation Technique (WET) developed for COE (1) and the Minnesota Wetland Evaluation Methodology (2) developed by the St. Paul District of COE. Portions of these methodologies were adapted to meet the needs of the Lake County ADID process. The evaluation methodologies and the criteria used to determine which wetlands and streams were of high functional value are described in detail in the Lake County ADID final report (3).

The wetlands identified as being of high functional value were considered generally unsuitable for filling activities. A wetland was determined to be of high functional value, or unsuitable, if the site included high-quality biotic communities or if the site provided three of the four stormwater storage or water quality functions. This ADID study also identified high-quality stream corridors that are designated as being unsuitable.

The preliminary Lake County ADID designations were published in a joint public notice issued by COE and EPA. Also available for public review and comment were the evaluation methodologies used, scale maps (1 in. = 1,000 ft) showing the location of all sites of high functional value, and data sheets corresponding to each site identified as being of high functional value. A public meeting also was held to gather further public comment. After considering all the public comments, five sites were added to the list of areas of high functional value.

Approximately 24,000 acres of wetlands, lakes, and streams were identified as high functional value sites. These sites include both public and privately owned property and represent about 39 percent of the wetlands and lakes remaining in the county. The Record of Decision, final public notice, report, and finalized maps were published in January 1993.

Results and Effectiveness

It is difficult to accurately assess how effective the Lake County ADID study was in providing an additional level of protection for wetlands. The ADID maps have been used by both developers and public entities such as the Illinois Department of Transportation during site planning. In addition, COE relies heavily on the information provided by the ADID study to guide permit decisions for ADID sites. The county, however, has not yet implemented its wetland protection ordinance. Once the county's wetland protection ordinance is in place, not only will the county provide protection for ADID sites but the ordinance will also require that a buffer area be maintained around all ADID sites.

While ADID or similar advanced planning processes are resource intensive, these types of studies can be well worth the effort if the projects are well designed and the resulting information is incorporated into local comprehensive planning efforts that will guide local land-use decisions. In addition to focusing on Section 404 issues, ADID can be tailored to provide information needed for a variety of other wetland related issues. For example, ADID can be designed to provide information that assists in the selection of wetland restoration sites. Advanced wetland planning studies also can be components of larger planning efforts (e.g., watershed protection strategies) or parts of geographic initiatives (e.g., remedial action plans and lakewide management plans).

Summary

ADID is one of the few tools available to EPA and other regulatory agencies that can substantially address resource-specific issues from a broader ecological perspective. ADID can be used in an innovative manner to address large, geographically based issues. Within an urban setting, ADID can provide information to communities regarding the functions and values of local wetlands and can guide local protection and restoration efforts while focusing on local problems or concerns.

References

1. Adamus, P.R., E.J. Clairain, R.D. Smith, and R.E. Young. 1987. Wetland evaluation technique (WET). Vicksburg, MS: Department of the Army, Waterways Experiment Station, Corps of Engineers.
2. U.S. Army Corps of Engineers, St. Paul District. 1988. The Minnesota wetland evaluation methodology for the north central United States.
3. Dreher, D.W., S. Elston, and C. Schaal. 1992. Advanced Identification (ADID) study, Lake County, Illinois. Final report (November).

Wisconsin Smart Program: Starkweather Creek

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Abstract

Starkweather Creek drains a 23-square-mile urban watershed in the city of Madison, Wisconsin. Urban runoff had resulted in elevated levels of biochemical oxygen demand, mercury, lead, zinc, cadmium, and oil and grease in the sediments and a severely degraded fish and macroinvertebrate habitat. Historically, the creek had received significant amounts of stormwater and industrial waste discharges. Industrial activities in the watershed had included metal fabrication, battery manufacturing, meat packing, and food processing. Starkweather is the second largest tributary and the largest source of mercury to Lake Monona, a principal recreation lake for the Madison area. Downstream transport of sediments and associated pollutants from the Starkweather watershed effects the quality of this important lake, which is under a fish advisory to anglers to restrict consumption of larger walleyes due to elevated mercury levels.

To address contamination in the creek and Lake Monona and to implement the recommendation of the local priority watershed plan, Wisconsin's Sediment Management and Remediation Techniques program selected Starkweather as a sediment remediation demonstration project. A joint U.S. Environmental Protection Agency, Wisconsin Department of Natural Resources, county, and city project was developed to 1) reduce nonpoint loading, 2) control the impacts of in-place contaminants, and 3) restore the recreational value and aquatic habitat of the creek. This $1 million program included the dredging of 17,000 yd^3 of contaminated sediments, construction of stormwater detention ponds, development of streambank erosion controls, and aquatic habitat restoration.

Introduction

Starkweather Creek, located on the northeast side of Madison, Wisconsin, is the city's largest urban watershed, draining 23 square miles (Figure 1). The creek discharges to Lake Monona, a principal recreation lake located in the city of Madison. The creek and its watershed have been extensively altered as a result of urbanization. Extensive ditching, channelization, wetland draining and filling, and impervious structure development have shaped the hydrology and water quality of the creek.

Starkweather Creek has been affected by both point and nonpoint pollution over time. The creek drains a heavily industrialized portion of the city where metal fabrication, battery manufacturing, meat packing, and food processing occurred. Urban nonpoint runoff is believed to have contributed significant levels of pollutants in recent years.

Recent monitoring indicated that the creek had elevated levels of sediment oxygen demand, biochemical oxygen demand (BOD), mercury, lead, zinc, cadmium, and oil and grease in the sediments and a severely degraded fish and macroinvertebrate habitat. Concern for the levels of contaminants in the sediments of the creek extended beyond the stream channel and its habitat and also encompassed the downstream impacts of the sediments on Lake Monona.

Lake Monona has a mercury advisory on large walleye due to excessive levels of the metal in the tissues of this fish. Starkweather Creek, identified as the largest source of mercury to the lake, was targeted for remediation to restore the aquatic habitat of the creek and to protect Lake Monona.

Wisconsin Sediment Management and Remediation Techniques Program

In response to the growing awareness of natural resources managers of the continuing impacts of in-place pollutants associated with sediment deposits in the state's waterways, the Wisconsin Department of Natural Resources (DNR) established an interdisciplinary team to develop necessary assessment and remediation tools to restore affected waters of the state. The Wisconsin Sediment Management and Remediation Techniques (SMART) Program has brought together

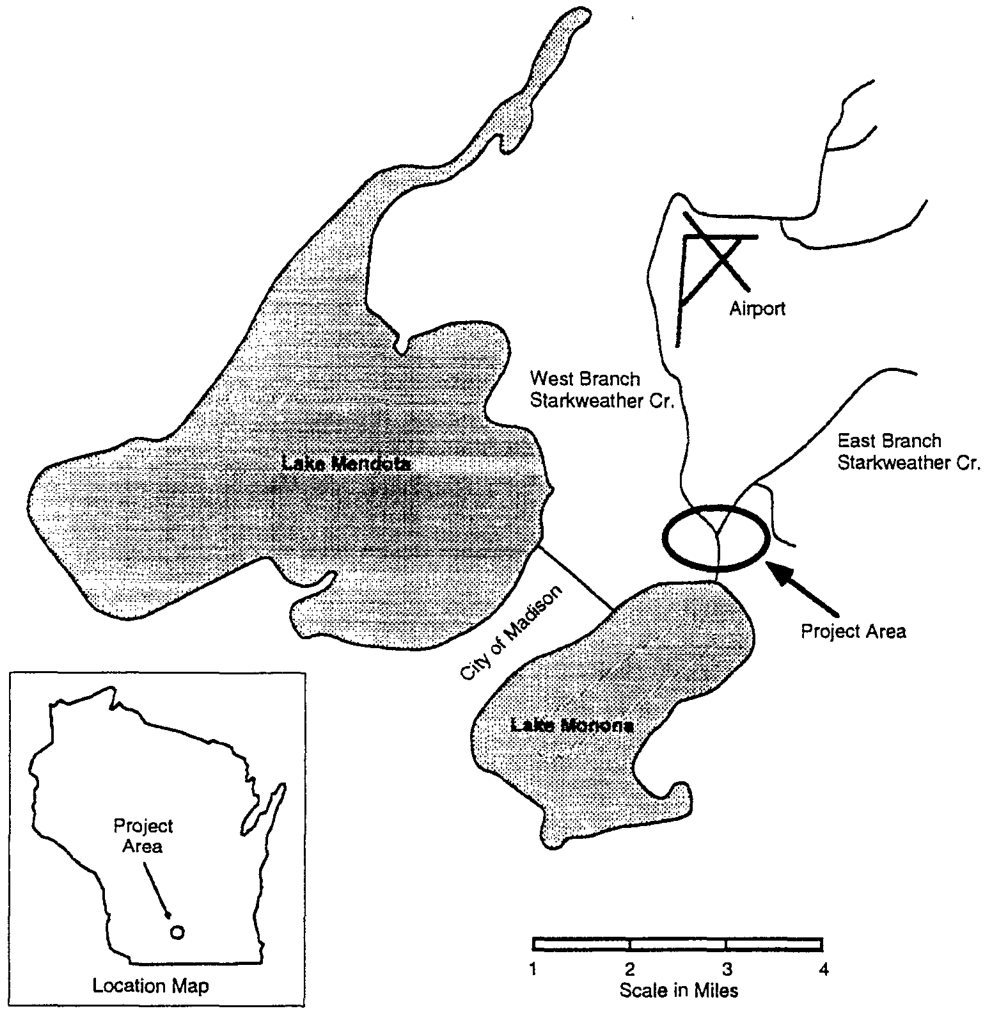

Figure 1. Location map of Starkweather Creek and the restoration project area.

expertise in environmental toxicology, aquatic habitat assessment, hydrographic surveying, sediment mapping, sediment engineering, and remedial technology. The SMART Program has two basic responsibilities: 1) define the extent of sediment contamination and impacts on the waters of the state and 2) guide the remediation of contaminated sediments.

The SMART Program coordinates the state's contaminated sediment activities with various universities and federal programs, such as the U.S. Environmental Protection Agency's Superfund and Great Lakes National Program Office Assessment and Remediation of Contaminated Sediment (ARCS) programs.

Monitoring Data

Starkweather Creek, the first sediment cleanup demonstration of the Wisconsin SMART Program, provided an opportunity to use advance monitoring of the many components of an aquatic system affected by contamination in sediments. Several assessment techniques were used to define the degree of sediment contamination, stream water quality, and aquatic habitat (Table 1). Later sections of this paper address monitoring performed during dredging to assess on- and offsite impacts of the cleanup. Postremediation monitoring will continue for 2 years to document the changes and response of the creek.

Remediation Planning

Starkweather Creek was selected as the first sediment remediation demonstration for the SMART Program based on recommendations from the state's DNR management districts, on the relative small scale of the site, and on ranking of the site with the SMART selection criteria. This criteria included:

- Impaired uses of the water body
- Adequate data for feasibility analysis
- Upstream pollution source controls
- Local support

- Adequate access
- Integration with other state and local programs

The specific project goals and objectives were developed by a project implementation team assembled from representatives of relevant state and local agencies and bureaus who guided the development of the project work plan, schedule, and budget. Individual members were responsible for ensuring that their program's relevant regulations were followed and the work plan was consistent with program policies and goals.

Table 1. A Summary of Starkweather Creek Preremediation Monitoring Data

	Range	Average	Total Weight
Sediment Chemistry			
Mercury	<0.1–3.5	1.1 ppm	40 lb
Lead	33–320	130 ppm	2.4 tons
Chromium	9–31	19 ppm	0.35 tons
Oil and grease	1,500–3,600	2,800 ppm	51 tons
PCBs	<0.14 ppm	<0.14 ppm	
Bulk density	65–106	80 lb/ft^3	18,400 tons
Water Column			
Mercury (total)	1.69–1.70 ng/L		
Mercury (methyl)	0.033–0.050 ng/L		
Lead	<3–10 µg/L		
Chromium	<3–18 µg/L		
Phosphorus–P	0.03–0.37 mg/L		
DO	3.3–14.6 mg/L (37.5–120% saturation)		
COD	10–38 mg/L		
Ammonia–N	0.04–1.8 mg/L		
Fish Tissue			
Freshwater drum (three samples, 10–19 in.)	0.16–0.48 ppm mercury		
Carp (three samples, 18–26 in.)	0.09–0.11 ppm mercury		
Caged Fish Bioaccumulation			
Minnows, 2–wk exposure	0.012–0.018 ppm mercury		
Minnows, 4–wk exposure	0.012–0.016 ppm mercury		
Toxicity Characteristic Leaching Procedure (TCLP)			
Sediment leaching test (three samples)	<1 mg/L lead		
Sediment Mapping			
Surveyed cross sections at 100–ft intervals			
17,000 yd^3 of soft sediment measured			

Following the development of the initial work plan, public informational meetings were held to solicit comments and suggestions. Presentations were also given to neighborhood associations and local environmental groups. Fact sheets outlining the proposed scope of work were distributed at these meetings. These meetings provided the implementation team with feedback on the scope and schedule of the work plan and a sense of the public's priorities regarding the restoration. Most of the public responses were requests for further clarification of the monitoring data, the permitting process, environmental safeguards during remediation, and potential exposure of local residents to contaminants in the sediments. One of the most frequent concerns for local residents was the removal of trees along the creek. The comments provided by the public and interested organizations were, where practical, incorporated into the work plan. For example, the replanting and vegetative restoration aspects of the project were developed in greater detail and the scope of the replanting was increased to address the concerns expressed at the public meetings.

Press releases and direct mailing to interested citizens and residents were used to keep the public involved and informed on the progress of the project.

Work Plan

The Starkweather Implementation Team developed the remediation work plan to achieve the goals of reducing pollutant loading to Lake Monona, restoring the aquatic habitat and fishery, and improving recreational use and access to the creek. The work plan included the following tasks to achieve these goals:

- Dredge 17,000 yd^3 of contaminated sediments.
- Improve the habit for fish and aquatic life through riprapping.
- Regrade and stabilize the eroding creek banks.
- Establish shoreline buffer zones.
- Use vegetative management to improve terrestrial habitat.
- Create public access paths and fishing platforms.
- Enhance public awareness and stewardship.

Dredging was selected as the means to remove the contaminated sediments, eliminate downstream loading of these contaminants, and restore the depth and diversity of the aquatic habitat. Survey cross sections of the creek were established at 100-ft intervals through the project site and were measured for water depth and sediment thickness. These data were used to model the volume and mass of contaminated sediments to be removed from the channel. In addition to removing contaminants from the creek, the enlarged cross-sectional area of the channel would maintain a greater depth of water capable of holding more dissolved oxygen and would provide more cover and structure for aquatic life.

The dredging of the creek channel increased the average depth from 1.5 to 4 ft. The average maximum depth of the channel thalweg was increased from 2 to 7 ft. Figure 2 is a typical cross section of the creek showing the pre- and postproject channel geometry and changes in water depth and streambanks.

Hydraulic studies of the creek channel and Lake Monona were performed to assess the local and regional impacts of dredging Starkweather Creek. This work was performed to assess issues related to changes in water surface elevations, channel stability, base level lowering, and potential upstream bed erosion. Starkweather Creek throughout the project area is in the backwater of Lake Monona. The water surface elevation of the creek is the same as the downstream lake. Therefore, the deepening of the creek by dredging would not decrease the water surface elevation or promote upstream bed or bank erosion.

Riprapping was selected for shoreline protection to protect the bank soils from waves and currents and to provide structure for fish and aquatic life. Sheet pile was used in selected areas where the steepness of the shoreline required vertical protection and regrading was not feasible (e.g., near buildings, roadways, and bridges). Vertical shore protection (sheet pile) was avoided in most areas because it presents a less than natural appearance and forms a barrier to aquatic life migration from water to land.

The banks of Starkweather Creek exhibited significant undercutting and failure and were a significant source of sediment to the creek. The failure of the creek banks undermined shoreline trees and vegetation and produced a perpetuating process of landward erosion of

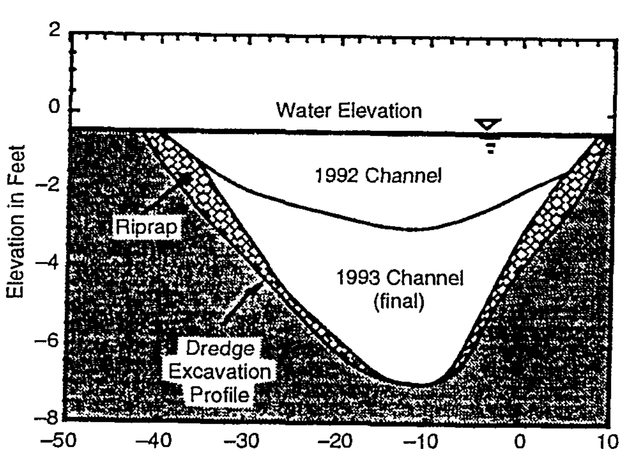

Figure 2. Starkweather Creek example cross section showing the channel profile before and after dredging.

increasingly steep banks. Eventually, the creek would have reached a hydraulic equilibrium by reshaping the channel geometry to a much wider and shallower channel. This process would have eliminated the fishery and small boating uses, however, and would have undermined local structures such as roadways, bridges, and buildings.

The banks of the creek were stabilized by regrading the abovewater slopes from vertical to 3:1 (horizontal:vertical), covering with protective riprap, and finally topping with a 6-in. seed bed planted to native grasses, shrubs, and trees. The near shore areas of the creek banks were planted to provide a vegetative buffer zone to filter pollutants carried by overland flows to the creek.

The terrestrial habitat along Starkweather Creek, although degraded, did provide important food and cover to insects, birds, and animals. Principal goals of the remediation project were to carefully manage all construction activities to minimize disturbances to the existing vegetation, to restore quality terrestrial areas disturbed by the creek restoration construction activities, and to improve the habitat where possible. A vegetation management and restoration plan was developed by the city's landscape architects to identify existing important tree and shrub specimens along the creek that were to be protected during construction work. The management and restoration plan was integrated with the construction plans, and close cooperation between the landscape architects, contractors, the DNR, and city engineering staff was used to resolve conflicting needs for access and mobility of the heavy equipment and the need to preserve desirable species. Trees and shrubs were initially either classified for saving or removal before construction. To reduce disturbance to the site and the costs of revegetation, the landscape architects and construction supervisors performed a final walking tour of the site to identify additional trees and shrubs, initially classified for removal, that could be saved if practical. This process provided the supervising field engineer with the discretion to either modify the construction plans and activities in the field to try to preserve existing vegetation or to permit the construction contractors to remove the specimens to facilitate access and work activities.

The project area was scheduled for replanting in the early spring of 1993. In addition to native and park grasses, 1,400 trees and shrubs were to be planted, including white ash, basswood, oak species, and maples. Planting would be located and spaced to provide optimal habitat areas along the shore of varying species, heights, and distribution.

Public access was provided to allow pedestrians to walk the site without disturbing the wildlife areas or trampling the banks of the creek. Landscape architects designed walkways to connect the project site with existing city parks and natural areas. Access to the creek was provided by low-lying shore areas and fishing/canoe access platforms constructed into higher creek banks near the water line.

Public awareness and stewardship was encouraged from the start to involve local groups throughout the project from early project design through final restoration. Regular press releases, media interviews, talks to neighborhood groups, direct mailings on project activities, aquatic education tours, fishing-for-kids clinic, and a volunteer planting event were used to keep people involved in and informed about the restoration.

Permits and Regulatory Review

The environmental restoration of Starkweather Creek included construction activities that were under the administrative and regulatory jurisdiction of several programs and agencies. Guidance from members of the implementation team representing the state's Water Regulation and Zoning, Solid Waste, and Environmental Assessment Bureaus were incorporated in the development of the project work plan and construction plans. City personnel guided the planning for compliance with local ordinances and coordination with local utilities. Permits were necessary for dredging and shoreline excavation and filling. In addition, regulatory review and approval was requested for the management of sediments dredged from the creek. Related regulations requiring compliance were historical and archeological site assessment, floodplain zoning regulations, and state environmental assessment guidelines. The city of Madison was the applicant for the construction work. Because many portions of the creek shoreline in the work area are privately owned, the permit required that either all riparian landowners individually apply for permits or that they assign the city to act as their agent for the permit application. A form letter was sent to the riparian landowners requesting their approval for the city to apply for the permit in their behalf. All riparian landowners in the project area approved, and copies of the signoff letters were then submitted to the U.S. Army Corps of Engineers and DNR.

Construction

Following completion of the construction plans, sealed bids were requested from qualified, interested contractors. The lowest of five bids was accepted. Speedway Sand and Gravel, Inc., of Madison, Wisconsin, was awarded the contract with a bid 17 percent lower than the highest bid.

Retention Site

The sediment retention and dewatering facility, 6 miles southeast of the project area, was built in January 1992. The site covered 2.8 acres and was built on county-owned land at the local municipal landfill. The sediment retention facility was designed to dewater the sediments and contain the sediment and carriage water. The facility is square in plan view with 7-ft berms built of local clay soils. The bottom was unlined but consisted of several feet of clay. Local monitoring wells provide data on potential leachate from the facility. A concrete drop inlet spillway was built into the facility to allow excess water to be pumped to a sanitary sewer if necessary.

The retention site was built to contain 17,000 yd of sediment with a 25-percent bulking factor and to provide a minimum of 1.5 ft of freeboard to contain direct precipitation and provide a margin of safety.

Dewatered sediments from the facility are available for use as cover on the landfill.

Site Preparation

A double silt curtain of geotextile fabric was placed across the creek at the downstream end of the project in mid-November 1992. The silt curtains were intended to trap debris in the streamflow generated by construction activities. In addition, the porous fabric was intended to trap sediments resuspended by the dredging. The curtains were held in place at the top by a half-inch steel cable tied to trees on the bank and weighted at the bottom by a heavy logging chain.

Utility representatives identified and marked all pipelines, cables, and utility facilities along the creek in the project area.

Site clearing and grading for heavy equipment access followed the installation of the silt curtains. Access roads and trees to be left undisturbed were clearly identified to minimize site disturbances and the cost of restoring vegetation.

Dredging

Dredging began on the upstream end of the west branch of Starkweather Creek on November 19, 1992. Dredging was performed with a backhoe. Construction activities were staged through the project area such that approximately 100 yd of streambed was dredged, the banks were shaped to a stable slope, and then the site was riprapped. The goal of this sequence was to minimize the size of the project area opened by construction. In addition, because the project is in a residential neighborhood, keeping the principal work confined to a limited area at one time minimized noise and dust in the area.

Dredging, bank shaping, and stabilization proceeded in a downstream direction on the west branch to the confluence with the east branch. When the west branch was finished, work moved to the upstream end of the east branch. Approximately 12 dump trucks were used to haul the dredged sediments to the retention facility. Trucks were loaded on average every 5 minutes. To prevent leakage from the trucks, the tailgates were fitted with neoprene seals, and chain binders were used to provide a backup to the tailgate lock. No sediment spills occurred during hauling. Dredging was completed on January 27, 1993. Bank shaping and stabilization work finished 2 weeks later.

Nearly 14,000 tons of riprap and 3,400 tons of crushed stone were used on the project. Bank shaping involved 3,200 yd^3 of soil.

Dredge Monitoring

Monitoring during dredging and other construction work was performed to track the impact of these activities on the creek and Lake Monona. Visual observations were made daily of the degree of turbidity changes caused by construction. Best management practices related to the work on site were used to minimize the instream and offsite impacts. Water sampling for chemical analyses was performed on a weekly basis at upstream reference sites, downstream of the dredging, and above and below the silt curtains. Creek water samples were analyzed for metals (arsenic, cadmium, calcium, copper, chromium, iron, lead, magnesium, nickel, zinc), nutrients (ammonia, nitrate and nitrite, total Kjeldahl nitrogen, total phosphorus), and general water quality parameters (suspended solids, chemical oxygen demand, BOD, conductivity, pH, alkalinity, hardness, temperature, dissolved oxygen).

Monitoring results indicate that there was no significant difference between the water quality parameters at the upstream reference sites and at the downstream end of the project on the dates of sampling. Figure 3 is a plot of selected water quality parameters measured on December 3, 1992, during the dredging activities. On this date, dredging was performed approximately 300 yd downstream of the upstream reference sampling site on the west branch. Sampling was also performed at the first bridge downstream of the dredging site. Other data shown in Figure 3 were obtained on the same date at a reference site on the east branch above the project and at two locations on the downstream end at the silt curtains. In can be seen in this figure that data from the dredging site show significantly higher values than at other sampling sites. The concentrations from the downstream end of the project (at the silt curtains), however, are equivalent to the undisturbed reference sites for most parameters, indicating that the resuspension of sediment and pollutants from the dredging had minimum offsite impacts. Lead and zinc values did exhibit an increase at the downstream site samples (Figure 3) compared with the upstream reference sites; however, the values at the downstream sites were within the

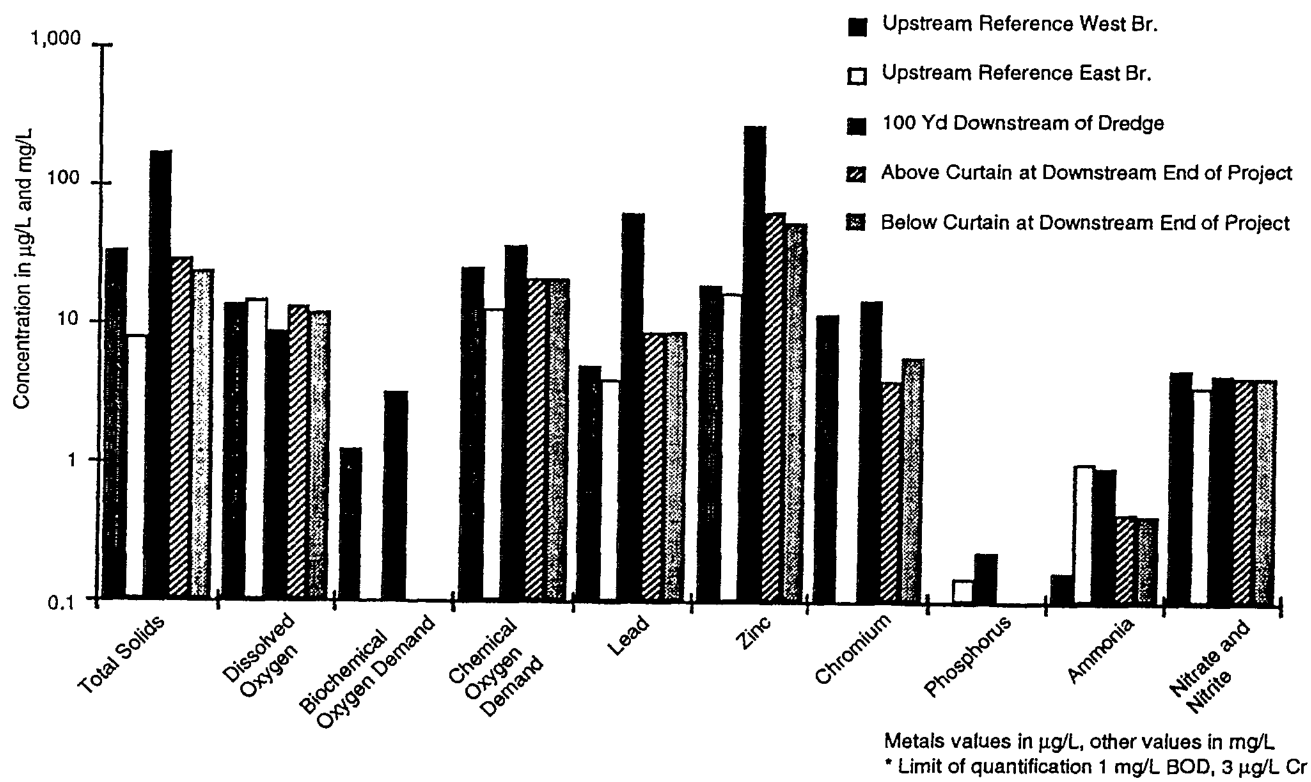

Figure 3. Selected water quality monitoring data, Starkweather Creek, December 3, 1992.

range of values measured over time at the undisturbed reference sites. Lead and zinc concentrations in water at the downstream end of the project were well below State Water Quality Criteria NR105 for acute and chronic toxicity in all water samples.

The silt curtains had little effect on the water quality of the stream—nearly all parameters were at the same levels above and below the curtains. Sediments and associated contaminants resuspended by the dredging work settled fairly quickly in the creek channel, and downstream loading to Lake Monona remained at background levels during the construction work. This project deployed the silt curtains normal to the streamflow (i.e., across the width of the channel) in an attempt to trap debris generated by the construction activity and to control resuspended sediments. The curtains were effective in trapping floating debris; however, they were not always effective in filtering solids from the streamflow. Figure 3 shows a slight drop in solids concentration across the silt curtain; however, the difference in concentration is fairly low and was not seen in most water sampling days. Field observations of the performance of the curtains showed that during all but the lowest base flow, the curtains would "billow out" to the downstream, allowing the streamflow to pass beneath the curtains.

Postremediation Monitoring

Routine water quality sampling will continue on a monthly basis for a least a year following the completion of construction work. Additional monitoring intended to document the restored conditions of the creek include fish shocking surveys, caged fish bioaccumulation, sediment bioassay, sediment chemistry, qualitative habitat assessment, and macroinvertebrate sampling (sediment and artificial substrate). These additional activities will be performed over the next 2 years to assess the success or failure of the restoration work, help to refine further work at other aquatic restoration projects, and guide the development of standard procedures for sediment assessment work.

Summary and Conclusion

Contaminated sediments can be managed to restore lost beneficial uses of a degraded waterway. The environmental restoration of Starkweather Creek has demonstrated that the knowledge and skills of various environmental programs can be successfully coordinated to accurately assess the degree of contamination, identify necessary sediment removal and disposal techniques, develop and implement a cross-program work plan, and carefully monitor the site disturbance and final restoration.

Some important aspects of this project that were critical to its successful implementation were cross-program coordination and communication, public communications and feedback, construction field supervision, and a significant investment in environmental monitoring to guide the development of the work plan and document the results of the restoration.

Wolf Lake Erosion Prevention

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Abstract

The U.S. Environmental Protection Agency (EPA), Region 5, in cooperation with the Lake County, Indiana, Soil and Water Conservation District, the City of Hammond, Board of Park Commissioners, and the U.S. Department of Agriculture, Soil Conservation Service, prevented bank erosion on over 300 m of the east shore of Wolf Lake. This project was funded through a $70,000 grant from EPA under Section 319(h) of the Clean Water Act. EPA had identified Wolf Lake as part of the Internal Joint Commission's Great Lakes Area of Concern, along with the Grand Calumet River Basin in northwest Indiana. Various sources of sediment were contaminating the lake, but the Park Board determined that the shoreline erosion was the highest priority. The bank was also one of the few remaining habitats of silverweed *(Potentilla anserina),* a plant on the Indiana endangered species list. A member of the rose family *(Rosaceae),* silverweed grows on wet, sandy shores in Canada south to Iowa, the Great Lakes, and coastal New England. When the Indiana Department of Natural Resources identified the plant at the site, the project was in jeopardy until a compromise was reached. Limestone riprap was chosen as the nonpoint source pollution/best management practice material to stabilize the 0.3- to 1.0-m bank. Wave action induced by wind was the cause of the bank erosion problem. Average fetch exposure, shore geometry, and shore orientation proved to be the significant factors in designing a successful shoreline protection system.

Introduction

The southern shoreline of Lake Michigan, in northwestern Indiana, is one of the major urban and industrial centers in the Great Lakes region and includes the cities of East Chicago, Gary, Hammond, and Whiting in Lake County, Indiana (1). The heavy industry in this area contains approximately 40 percent of the steel making capacity of the United States, and one of the largest petrochemical complexes in this country. This combination has created one of the most environmentally degraded areas within the entire Great Lakes basin.

Wolf Lake is located in the northwest corner of the region and is an important remnant of what once was a large Lake Michigan bay. As the Great Lakes' levels dropped from the Nipissing through the Algona to the present-day Lake Michigan, several coastal area lakes developed (2). Among these lakes were Calumet, Hyde, Wolf, Berry, and George. Today, only Calumet, Wolf, and small remnants of Lake George remain; the others were drained and filled to allow for development (3).

The present surface area of the lake is 156 ha in Indiana and 170 ha in Illinois. As would be expected because it was once a shallow bay, Wolf Lake is shallow, with a mean depth of only 1.5 m. The maximum depth is listed as 5.5 m in areas influenced by past sand mining (1). Wolf Lake is not protected by natural features such as hills or stands of trees. Therefore, strong winds frequently cause wave action to pound the eastern shoreline and create erosion and sediment.

Shoreline Erosion and Protection

Few things are a bigger eyesore and problem for lakeshore users than an eroding shoreline. A variety of lake shoreline protection practices are designed to stabilize and protect these areas against the forces of erosion, such as scour and erosion from wave action, ice action, seepage, and runoff from upland areas. These practices are both nonstructural (vegetation or beach sloping) and structural (flexible structures such as riprap and rigid structures such as seawalls).

Shoreline erosion is a significant problem in several areas along Wolf Lake's shoreline. The problem has been documented by historical photographs and personal accounts, but estimating the volume of shoreline eroded is difficult. Photographs indicate that the eastern shore has receded 15 m. Photographs from 1938, when compared with recent photographs, show that the area has receded at a rate of about 0.3 m/yr.

The lake's shallow water depth, long wind fetch, and motor boat use all contribute to the waves eroding the shoreline. The scarcity of rooted littoral vegetation and the sand, slag, and gravel texture of the scoured littoral sediment are further evidence of wave action. Fetch is defined as the distance a wind blows unobstructed over water, especially as a factor affecting the buildup of waves. The average fetch exposure, shore geometry, and shore orientation are significant factors in successful shoreline stabilization (4).

Vegetation effectively controls runoff erosion on slopes or banks leading down to the water's edge; however, vegetation is ineffective against direct wave action or seepage-caused bank slumping (5). Diverse, moderately dense stands of aquatic plants are desirable in a lake's littoral zone. Emergent aquatic plant communities protect the shoreline from erosion by damping the force of waves and stabilizing shoreline soils (6).

Riprap armoring is a flexible structure constructed of stone and gravel that is designed to protect steep shorelines from wave action, ice action, and slumping due to seepage. The riprap is flexible in that it will move slightly under certain conditions. This improves its ability to dissipate wave energy.

Seawalls, bulkheads, and retaining walls are rigid structures used where steep banks prohibit the sloping forms of protection. Seawalls do not primarily dissipate wave energy but rather redirect the wave energy away from the shore (7).

Site Evaluation

The Hammond Park Board had been in contact with the U.S. Environmental Protection Agency's (EPA's) Region 5 office in Chicago, Illinois, about an ongoing erosion problem at Wolf Lake in Hammond, Indiana. The site was actively eroding and endangering the east shoreline for 300 m. This was part of the Internal Joint Commission's Area of Concern and was identified in the area Remedial Action Plan (RAP) by the Indiana Department of Environmental Management (IDEM). The Park Board called on EPA for technical and financial assistance, and project development began.

In the fall of 1990, the eastern shoreline of Wolf Lake was surveyed by the Soil Conservation Service (SCS). The survey revealed a water depth ranging from 0.3 to 1.0 m, with a vertical dropoff. This area had been eroding for an undetermined amount of time and had reached a point where it would soon undercut a pedestrian trail connecting a picnic area with the beach. Over the years, the Park Board had allowed large pieces of broken concrete to be dumped along the shoreline to try to control the erosion. This had slowed the erosion process in some areas but accelerated it in others. Where the wave action could get between the concrete, the erosion continued to advance.

The undercutting of a fishing pier at the south end of the area demonstrated the strength of the wave action on the site. Although the average fetch at the site is about 1,000 m, the wave energy is funneled to the northeast and southeast shoreline by a manmade island located 200 m offshore. The maximum depth of the bay area created by this erosion is only 3 m, with the majority at no more than 1.5 m.

SCS recommended that the 300-m shoreline be stabilized with riprap. In the winter of 1990, the Lake County Soil and Water Conservation District applied to EPA for a Section 319 grant of $70,000 to stabilize the shoreline. SCS completed the designs, and the Park Board sought permit applications from IDEM, the Indiana Department of Natural Resources (IDNR), and the Army Corps of Engineers (COE). Several coordination meetings were held with the Park Board to keep them informed of the progress of the various activities. The Park Board approved the final plans in the spring of 1991, and permits were approved that summer.

During the permit review process, an IDNR biologist identified the presence of silverweed (Potentilla anserina) at the site. Silverweed, which is on the IDNR endangered species list, was growing in patches along the eastern shoreline. Silverweed is a prostrate species that sends up yellow flowers with leaves on a separate stalk. The leaves are strikingly silver beneath, divided into 7 to 25 paired, sharp-toothed leaflets that increase in size upward. The total plant length ranges from 0.3 to 1.0 m, and it flowers in June through August (8). This plant was also in danger of losing its habitat as the shoreline eroded back. The IDNR approved of the riprap project with the stipulation that care be taken to avoid main clusters of the plant.

Riprap Size and Placement

A stone revetment, riprap involves more than simply dumping rocks on the shoreline. The SCS area-office engineer developed a design, which was reviewed by the SCS state engineer. This design included the investigation of the average depth of the bay water, wave height, depth of dropoff, and the orientation of critical winds.

The largest wave that can reach shore is 0.8 times the depth of the water (9). This would generate a wave height of 1.2 m where the water depth is 1.5 m. A maximum wave height of 0.5 m would be reached for a 1,000-m fetch over 6-m deep water with a 16 m/sec wind speed (9). Therefore, NAS No. R-5 (46 cm maximum, D50 23 cm, minimum 13 cm) graded riprap was chosen for the armor stone (9). For the bedding or filter stone, NAS No. FS-2 (5 cm maximum, average No. 4, No. 100 minimum) would be used.

With the existing concrete in place, it was difficult to determine the amount of riprap needed. An estimate was made based on an average riprap thickness of 0.6 m and enough bedding stone to fill in the voids on a typical cross section 300 m long. The plans called for a 2:1 slope for the finished riprap, which meant 800 metric tons of bedding stone and 615 metric tons of riprap was needed.

The Park Board received bids for the work and awarded the contract in the late summer of 1992. The cost for actual purchase and placement of material was $133.00 per linear meter. Additional costs associated with the project were for design, administration, and construction supervision. The construction of the 300-m barrier took 7 working days, including hauling the stone from a quarry within 16 km. Stone was placed using a large hydraulic backhoe and a front-end loader.

Chapters 16 and 17 of the SCS *National Engineering Field Manual* (10) contain detailed discussions on the selection and placement of riprap for erosion control.

Discussion and Conclusion

The nonpoint source/best management practice (BMP) of limestone riprap was selected for the Wolf Lake project. Selection was based on the need for the practice to withstand wave energy, be cost effective, and be compatible with the endangered species plant found at the site. Revegetation was not selected as the BMP because the site was unstable and few plants could stand up to the wave action. The erosive force of wave action limits plants survival in open lakes. Aquatic macrophytes may not grow in areas where wind fetch exceeds 850 m (11). A seawall or other rigid BMPs were not selected because of their higher cost and the disturbance to the site that would be required for their installation. Another alternative not discussed here, because of the major site disturbance it would require, is regrading of the bank to a stable slope.

The design characteristics of the site taken into consideration were fetch exposure, shore geometry, and shore orientation. In addition, the resistance of dumped stone to displacement by waves depends on:

- Weight, size, shape, and composition of the stone.
- Gradation of the stone.
- Height of the wave.
- Steepness and stability of the protected area.
- Stability and effectiveness of the filter or bedding material (12).

References

1. Watson, L., R. Shedlock, K. Banaszak, L. Arihood, and P. Doss. 1989. Preliminary analysis of the shallow ground-water system in the vicinity of the Grand Calumet River/Indiana Harbor Canal, northwestern Indiana. U.S. Geological Survey Open-File Report 88-492. Indianapolis, IN.
2. Bell, J., and R. Johnson. 1990. Environmental site assessment of Wolf Lake. TAP Report No. TAP901126. Hammond, IN: Hammond Chamber of Commerce.
3. Holowath, M., M. Reshkin, M. Mukluk, and R. Tolpa. 1990. Working towards a remedial action plan for the Grand Calumet River and Indiana Harbor Ship Canal. Unpublished paper. U.S. EPA, Region 5, Chicago, IL; and Indiana University Northwest, Gary, IN.
4. Berc, J., and S. Ailstook. 1989. Shoreline stabilization on Navy property. J. Soil Water Conserv. 44(6):560-561.
5. McComas, S. 1986. Shoreline protection. Lake Reservoir Mgmt. 2:421-425.
6. Nichols, S.A. 1986. Innovative approaches for macrophyte management. Lake Reservoir Mgmt. 2:245-251.
7. Jones, W.W., and J. Marnatti. 1990. Cedar Lake enhancement study. Bloomington, IN: Indiana University.
8. Peterson, R. 1968. Yellow flowers: A field guide to wildflowers, Northeastern and Northcentral North America. Boston, MA: Houghton Mifflin Company.
9. National Crushed Stone Association. 1978. Quarried stone for erosion and sediment control.
10. Soil Conservation Service. 1989. National engineering field manual. Washington, DC: U.S. Department of Agriculture.
11. Harvey, R.M., J.R. Pickett, and R.D. Bates. 1987. Environmental factors controlling the growth and distribution of submerged aquatic macrophytes in two South Carolina reservoirs. Lake Reservoir Mgmt. 3:243-255.
12. Searcy, J.K. 1970. Use of riprap for bank protection. Hydraulic Engineering Circular No. 11. Washington, DC: U.S. Department of Transportation. Available as a reprint from U.S. GPO, Washington, DC.

Incorporating Ecological Concepts and Biological Criteria in the Assessment and Management of Urban Nonpoint Source Pollution

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Abstract

The health and well-being of the aquatic biota in surface waters are important barometers of how effectively we are achieving the goals of the Clean Water Act (CWA); namely, the maintenance and restoration of biological integrity and the basic intent of water quality standards. Yet, these tangible products of the CWA regulatory and water quality planning and management efforts are frequently not linked nor equated with the more popularized notion of chemical-physical water quality criteria and other surrogate indicators and endpoints. Simply stated, biological integrity is the *combined* result of chemical, physical, and biological processes. Nowhere in water quality management and assessment is the interaction of these three factors more apparent than with nonpoint sources. Management efforts that rely solely on comparatively simple chemical-physical water quality criteria surrogates frequently do not result in the full restoration of ecological integrity. Therefore, ecological concepts, criteria, and assessment tools must be incorporated into the prioritization and evaluation of nonpoint source pollution abatement efforts.

Introduction

The monitoring of surface waters and evaluation of the biological integrity goal of the Clean Water Act (CWA) have historically been predominated by nonbiological measures such as chemical-physical water quality (1). While this approach may have fostered an impression of empirical validity and legal defensibility, it has not sufficiently measured the ecological health and well-being of aquatic resources. An illustration of this point was demonstrated in a comparison of the abilities of chemical water quality criteria and biological criteria to detect aquatic life impairment based on ambient monitoring in Ohio. Out of 645 water-body segments analyzed, biological impairment was evident in 49.8 percent of the cases where no impairments of chemical water quality criteria were observed (2). While this discrepancy may at first seem remarkable, the reasons for it are many and complex. Biological communities respond to and integrate a wide variety of chemical, physical, and biological factors in the environment whether they are of natural or anthropogenic origin. Simply stated, controlling chemical water quality criteria alone does not ensure the ecological integrity of water resources (1).

The health and well-being of surface water resources are the *combined* result of chemical, physical, and biological processes (Figure 1). To be truly successful in meeting these goals, monitoring and assessment tools are needed that measure both the interacting processes and the integrated result of these processes (3). This is especially true for nonpoint sources because many of the effects involve the interactions of these factors. Biological criteria offer a way to measure the end result of nonpoint source management efforts and successfully accomplish the protection of surface water resources. Biological communities respond to environmental impacts that chemical-physical water quality criteria alone cannot adequately discriminate or even detect. Habitat degradation and sedimentation are two prevalent impacts of nonpoint source origin that simply cannot be measured by chemical-physical criteria alone. As illustrated by Figure 1, the combination of chemical and physical factors results in surface water use impairments from nonpoint sources.

The Ohio Environmental Protection Agency (EPA) recently adopted biological criteria in its water quality standards (WQS) regulations. These criteria are based on measurable endpoints regarding the health and well-being of aquatic communities. They are further structured into the state's WQS regulations within a system of tiered aquatic life uses from which numerical biological criteria are derived using a regional reference site approach (4-7). These numerical expressions of biological goal attainment criteria are essentially the end

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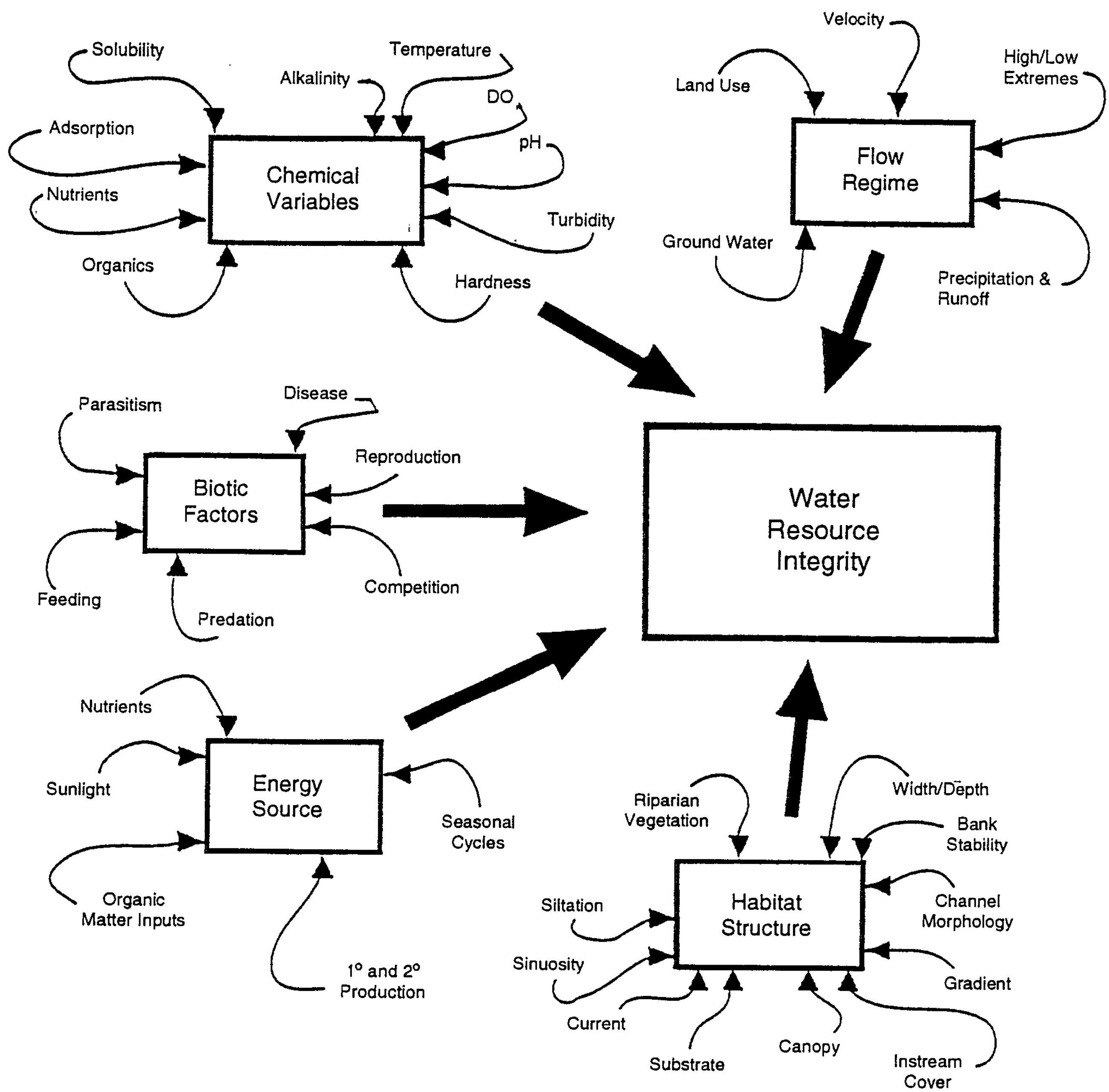

Figure 1. **The five principal factors, with some of their important chemical, physical, and biological components, that influence and determine the integrity of surface water resources (modified from Karr et al. [1]).**

product of an ecologically complex but structured derivation process. While numerical biological indices have been criticized for potentially oversimplifying complex ecological processes (8), distillation of such information to readily comprehendible expressions is both practical and necessary. The advent of new-generation evaluation mechanisms, such as the Index of Biotic Integrity (IBI) (1, 9, 10), the Index of Well-Being (Iwb) (11, 12), the Invertebrate Community Index (ICI) (5), and similar efforts (13-16), has filled important practical and theoretical gaps not always fulfilled by previously available single-dimension indices. Multimetric evaluation mechanisms, such as the IBI, extract ecologically relevant information from complex biological community data while preserving the opportunity to analyze such data on a multivariate basis. The problem of biological data variability is also addressed within this system. Variability is controlled by specifying standardized methods and procedures (17) that are then compressed through the application of multimetric evaluation mechanisms (e.g., IBI, ICI) and stratified by accounting for regional and physical variability and potential (e.g., ecoregions, tiered aquatic life uses). The results are evaluation mechanisms, such as the IBI and ICI, that have acceptably low replicate variability (18-20).

Ecoregional Biocriteria and Determination of Use Attainment

Biological criteria can play an especially important role in nonpoint source assessment and management because they directly represent an important environmental goal and regulatory endpoint (i.e., the biological integrity goal of the CWA). Numerous studies have documented this capability. Gammon et al. (21) documented a "gradient" of compositional and functional shifts in the fish and macroinvertebrate communities of small agricultural watersheds in central Indiana. Community responses ranged from an increase in biomass with mild enrichment to complete shifts in community function. Impacts from animal feedlots had the most pronounced effects. In the latter case, the condition of the immediate riparian zone was correlated with the degree of impairment.

Later work by Gammon et al. (22) suggests that nonpoint sources are impeding any further biological improvements observed in larger rivers due primarily to reduced point source impacts. This is similar to observations that Ohio EPA has made in the Scioto River downstream from Columbus. Urban nonpoint source impacts are well known and have also been documented by numerous investigators. Klein (23) documented a relationship between increasing urbanization and biological impairment, noting that the latter does not become severe until urbanization reaches 30 percent of the watershed area. Steedman (24) used a modification of the IBI to demonstrate the influence of urban land use and riparian zone integrity in Lake Ontario tributaries. Steedman developed a model relationship between the IBI and these two environmental factors.

Biological monitoring of nonpoint source impacts and pollution abatement efforts conducted in concert with the use of more traditional assessment tools (e.g., chemical-physical) can produce the type of evaluation needed to determine where nonpoint source management efforts should be focused, what some of the management goals should be, and what determines the eventual success (i.e., end result) of such efforts. At the same time, a well-conceived monitoring program can yield multipurpose information that can be applied to similar situations without the need to perform site-specific monitoring everywhere. This is best accomplished when a landscape-partitioning framework, such as ecoregions (25) and the subcomponents, is used as an initial step in accounting for natural landscape variability. Because of landscape variability, uniform and overly simplified approaches to nonpoint source management often fail to produce the desired results (26).

Biological criteria in Ohio are based on two principal organism groups: fish and macroinvertebrates. Numerical biological criteria for rivers and streams were derived from the results of sampling conducted at more than 350 reference sites that typify the "least impacted" condition within each ecoregion (5, 6). This information was used within the existing framework of tiered aquatic life uses in the Ohio WQS regulations to establish attainable, baseline biological community performance expectations on a regional basis. Biological criteria vary by ecoregion, aquatic life-use designation, site type, and biological index. The resulting criteria for two of the "fishable, swimmable" uses, Warmwater Habitat (WWH) and Exceptional Warmwater Habitat (EWH), are shown in Figure 2.

Procedures for determining the use attainment status of Ohio's lotic surface waters were also developed (5, 27). Using the numerical biocriteria as defined by the Ohio WQS regulations, use attainment status is determined as follows:

- *Full:* Use attainment is considered full if all of the applicable numeric indices exhibit attainment of the respective biological criteria; this means that the aquatic-life goals of the Ohio WQS regulations are being attained.
- *Partial:* At least one organism group exhibits nonattainment of the numeric biocriteria, but no lower than a narrative rating of "fair," and the other group exhibits attainment.
- *Non:* Neither organism group exhibits attainment of the ecoregional biocriteria, or one organism group reflects a narrative rating of "poor" or "very poor," even if the other group exhibits attainment.

Following these rules, a use attainment table is constructed on a longitudinal mainstem or watershed basis. Information included in the table includes sampling location (river mile index), biological index scores, the Qualitative Habitat Evaluation Index (QHEI) score, attainment status, and comments about important site-specific factors such as proximity to pollution sources. An example of how to construct a use attainment table is provided in Table 1.

Aquatic Ecosystems at Risk

Ecosystems that possess or reflect integrity (as envisioned by the biological integrity goal of the CWA) are characterized by the following attributes (1):

- The inherent potential of the system is realized.

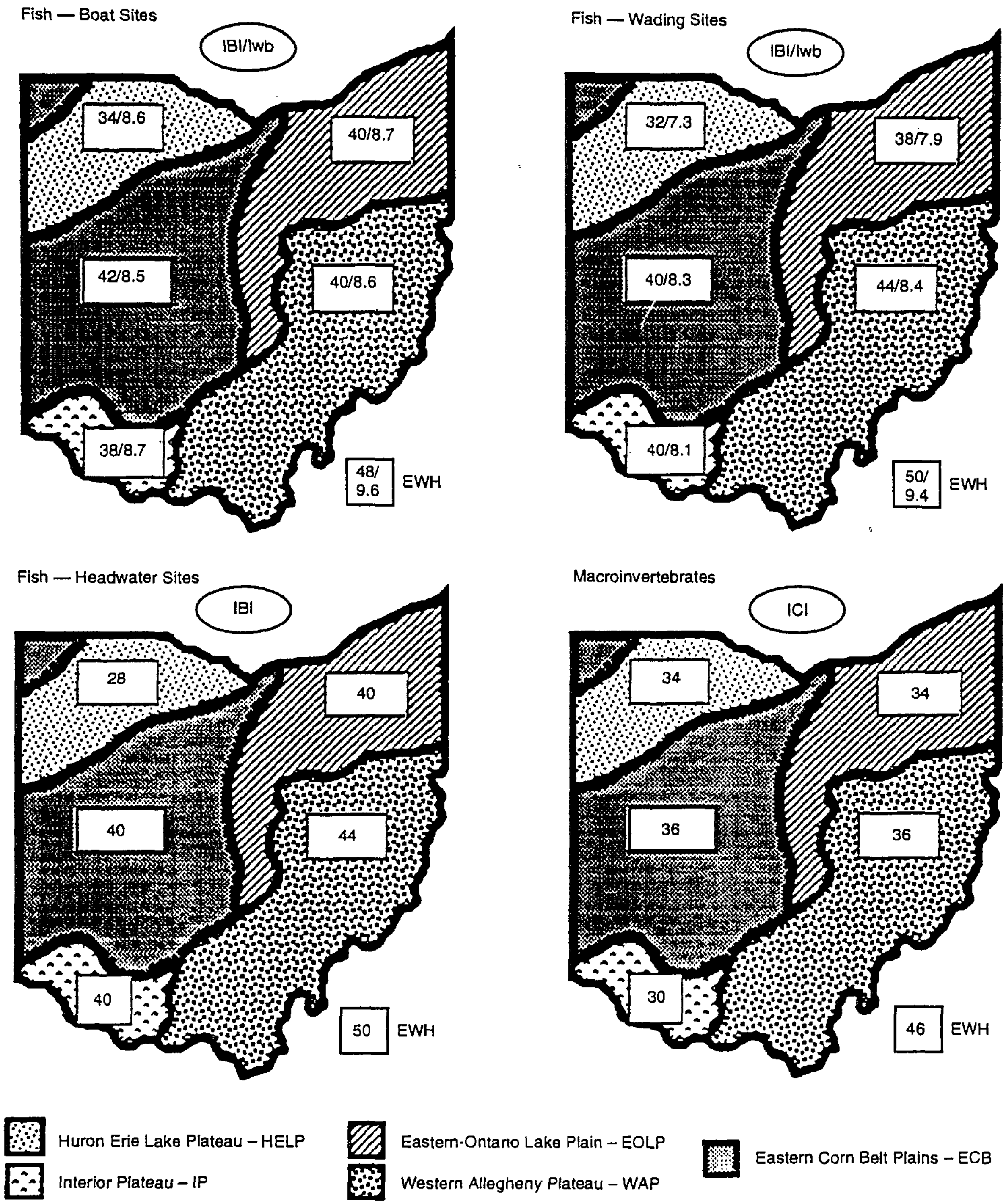

Figure 2. Biological criteria in the Ohio WQS for the Warmwater Habitat (WWH) and Exceptional Warmwater Habitat (EWH) use designations arranged by biological index, site type for fish, and ecoregion. The EWH criteria for each index and site type is located in the boxes located outside of each map.

- The system and its components are stable.
- The system retains a capacity for self-repair when perturbed or injured.
- Minimal or no external support for community maintenance is required.

Thus, ecosystems that are impaired and therefore lack integrity have had their capacity to withstand and rapidly recover from perturbations exceeded. Impaired ecosystems are likely to become even further degraded due to incremental increases in stress.

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Many rivers and streams nationwide fail to exhibit the characteristics of healthy ecosystems. Recent estimates indicate that as many as 98 percent of lotic ecosystems are degraded to a detectable degree (29). Karr et al. (30) illustrated the extent to which the Illinois and Maumee River basin fish communities have declined during the past 50 years: two-thirds of the original fauna were lost from the former and more than 40 percent from the latter. Losses of naiad mollusks and crayfish have been even greater. In Ohio, long-term declines in fish communities have been extensively documented by Trautman (31). More recent information indicates that the fraction of the fish fauna that is imperiled or declining has increased from 30 to 40 percent since 1980 (32). This information indicates that lotic ecosystems are threatened in both Ohio and nationwide, an indication that existing frameworks for water resource protection and management have been essentially ineffective in preventing large-scale losses of ecological integrity. This is particularly true for ecosystems affected by habitat degradation, riparian encroachment, excess sedimentation, organic enrichment, and nutrient enrichment. All or most of these forms of degradation are evident in areas affected by urban nonpoint sources.

Urban Nonpoint Source Pollution in Ohio

Urban watersheds in Ohio have exhibited a familiar and well-known legacy of aquatic resource degradation. Few, if any, functionally healthy watersheds exist in the older, heavily urbanized parts of the Midwest. Good quantitative estimates of the proportion of surface waters that are degraded by urbanization are lacking, however, particularly for headwater streams. It is also widely perceived that the restoration of beneficial aquatic life uses in most heavily urbanized areas is not practically attainable. This in itself presents a barrier to any notion of attaining existing use designations or upgrading use designations for waters classified for less than fishable and swimmable uses. The assignment of appropriate aquatic life and recreational uses is a challenge that Ohio EPA has dealt with over the past 15 years.

Urban and suburban development activities that have the greatest impacts on aquatic life in Ohio include the wholesale modification of watershed hydrology, riparian vegetation degradation and removal, direct instream habitat degradation via channelization, construction and other drainage enhancement activities, sedimentation and siltation caused by stream-bank erosion (which is strongly linked to riparian encroachment), and contributions of chemical pollutants. Statewide, urban and suburban sources are responsible for impairment (major and moderate magnitude sources) in more than 927 miles of streams and rivers and more than 23,000 acres of lakes, ponds, and reservoirs (32). These activities also threaten existing use attainment in nearly 160 miles of streams and rivers and may be a potential problem in more than 4,380 miles of streams and rivers that have not yet been fully monitored and evaluated (33).

While much attention is generally given to toxic substances in urban nonpoint source runoff, evidence suggests that nontoxic effects are more widespread, at least in Ohio and the Midwest. The second leading cause of impairment identified by the 1992 Ohio Water Resource Inventory, sedimentation (or siltation) resulting from urban and other land-use activities is the most pervasive single cause of impairment from nonpoint sources in Ohio. Sedimentation is responsible for more impairment (over 1,400 miles of stream and rivers and 23,000 acres of lakes, ponds, and reservoirs) than any other cause except organic enrichment/dissolved oxygen, with which it is closely allied in urban and agricultural areas. Since Ohio conducted the Ohio Water Resource Inventory in 1988 (34), this cause category has surpassed ammonia and heavy metals in rank. If the statewide monitoring database were distributed more equally across the state, sedimentation would likely be found to be the leading cause of impairment.

Although sediment deposition in both lotic and lentic environments is a natural process, it becomes a problem when the capability of the ecosystem to "assimilate" any excess delivery is exceeded. Sediment deposited in streams and rivers comes primarily from stream bank erosion and in runoff from upland erosion. The effects are much more severe in streams and rivers with degraded riparian zones and low gradient. Given similar rates of erosion, the effects of sedimentation are much worse in channel-modified and riparian zone-degraded streams than in more natural, intact habitats. In channel-modified streams, incoming silt and sediment remain within and continue to degrade the stream channel, instead of being deposited in the immediate riparian "floodplain" during high flow periods (35). This also adds to and increases the sediment bedload that continues to affect the substrates long after the runoff events have ceased.

One of the more prevalent results is substrate embeddedness, which occurs when an excess of fine materials, particularly clayey silts and fine sand, fills the otherwise open interstitial spaces between larger substrates (Figure 3). In extreme cases, the coarser substrates may be "smothered"; in other cases, the substrate can be cemented together, or "armor plated." In either event, the principal ecological consequence is the loss of available benthic surface area for aquatic organisms (particularly macroinvertebrates) and as a location for the development of fish eggs and larvae. The soft substrates afforded by the increased accumulation of fine materials also provide an excellent habitat for the growth of undesirable algae. Thus, to successfully abate the adverse impacts of sediment, we need to be as concerned with what each event leaves behind as

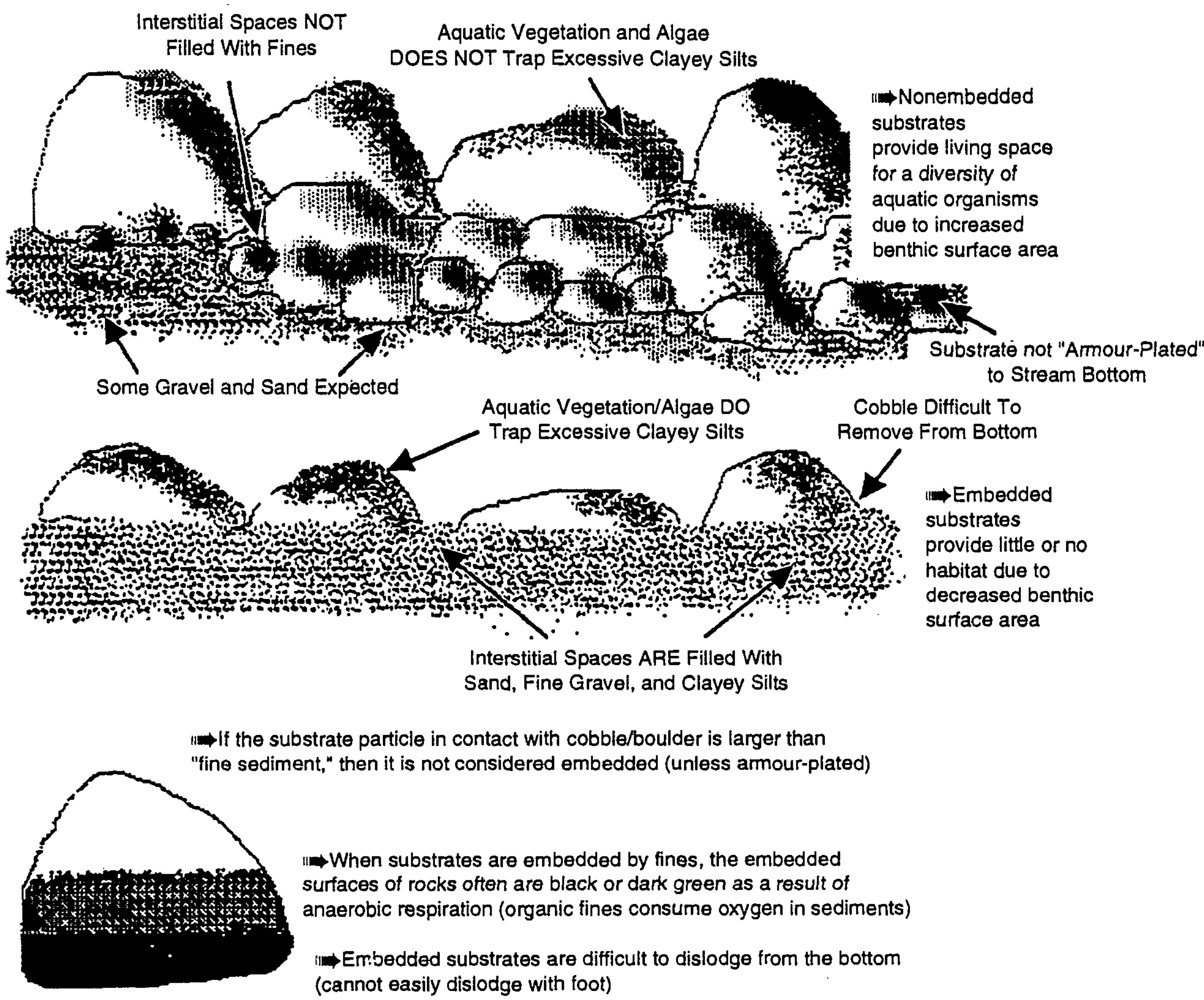

Figure 3. Characterization of substrate embeddedness with some of the key structural signatures and a summary of some of the ecological impacts of this form of stream substrate degradation.

much as with what takes place in the water column during each event.

The effects of sedimentation on aquatic life are the most severe in the ecoregions of Ohio where:

- Erosion and runoff are moderate to high.
- Clayey silts that attach to and fill the interstices between coarse substrates are predominant.
- Streams and rivers lack the ability to expel sediments from the low-flow channel, which results in a longer retention time and greater deposition of silt in the most critical habitats.

Estimates of gross erosion alone do not always correlate with adverse impacts to aquatic communities, although this is a frequently cited criterion for prioritizing nonpoint source management efforts. Some of the areas of Ohio that have the highest rates of gross erosion (e.g., East Corn Belt Plain, Interior Plateau, and Western Allegheny Plateau ecoregions) also have some of the most diverse and functionally healthy assemblages of aquatic life at the least affected reference and other sites (32). Many of the streams in these ecoregions have relatively intact riparian and instream habitat and thus are "buffered" against the naturally erosive conditions. The detrimental effects of sedimentation seem to be the worst in areas of the state where the proportion of clayey silts are highest, stream gradient is the lowest, and

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riparian encroachment and modification are extensive (i.e., Huron/Erie Lake Plain and portions of the East Corn Belt Plain and Erie/Ontario Lake Plain ecoregions).

The interaction between nonpoint source runoff and riparian and instream habitat must be appreciated and understood if impacts such as sedimentation are to be effectively dealt with. Figure 4 illustrates the interdependency of the rate of runoff, increased sediment delivery, in-channel habitat degradation, riparian zone condition, and substrate condition. An effect involving any one

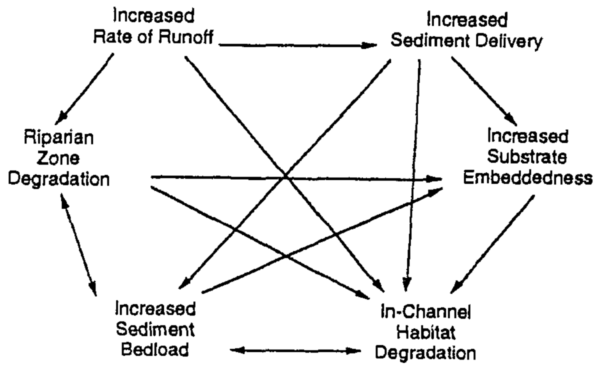

Figure 4. Illustration of the complex interaction of nonpoint source caused changes in hydrology and sediment delivery and how each singly and in combination can degrade instream and riparian habitat.

factor can set off a chain of events that results in cumulative changes reflected by most or even all of the interdependent factors. Two factors that are influenced in the conversion of watersheds by urban development are an increased rate of runoff and increased sediment delivery. These two factors then combine to influence other important aspects of stream habitat, such as riparian zone integrity and increased substrate embeddedness. In effect, a change in one of these factors can result in a cascading chain of events that eventually cause aquatic life use impairment or inhibit the ability of a degraded stream to be successfully rehabilitated. Thus, considerations of previously ignored aspects such as riparian and instream habitat and watershed dynamics must be included in urban nonpoint source assessment and abatement strategies.

The direct and indirect effects of sedimentation and the associated nutrient enrichment are becoming especially apparent in the larger mainstem rivers. Both sediment and nutrient enrichment impacts have largely been overlooked and will not only require a change in the status quo of water quality management but also in the interdisciplinary solutions and information gathering that demonstrates the character and magnitude of these impacts (36).

Bioassessment of Urban Watersheds

Biological criteria and bioassessment methods can and do play a key role in several areas of nonpoint source management. As a basis for determining use impairments, biocriteria have played a central role in the Ohio Nonpoint Source Assessments (33, 37), the biennial Ohio Water Resource Inventory (305b report) (32), and watershed-specific assessments of which Ohio EPA completes from 6 to 12 each year. Biological criteria represent a measurable and tangible goal against which the effectiveness of nonpoint source pollution abatement programs and individual projects can be judged. Biological assessments, however, must be accompanied by appropriate chemical-physical measures, land-use considerations, and source information necessary to establish linkages between the land-use activities and the instream responses.

A great deal of uncertainty exists about the link between steady-state water quality criteria and ecological indicators. While we have observed biocriteria attainment with chemical water quality criteria exceedences in only a fraction of the comparisons, the chemical data are largely from grab samples collected during summer-fall low flow situations. In many cases, we have failed to detect chemical criteria exceedences during low flows, yet biocriteria impairment is apparent. The correspondence of biocriteria attainment with water quality criteria exceedences measured under elevated flows has not been observed with any regularity. Nonetheless, we have surmised that much of the biocriteria nonattainment observed in affected urban watersheds is due to water quality criteria exceedences that have occurred during elevated flow events that preceded the biological sampling. Reaching such a conclusion, however, is made possible only by examining other evidence beyond water column data.

In many urban settings, sediment chemical concentrations frequently are highly or extremely elevated compared with concentrations measured at least-affected reference sites. Contaminated sediments enter the aquatic environment during episodic releases from point sources and during runoff events from nonpoint sources. The correspondence between increasingly elevated sediment concentrations and declining aquatic community performance is demonstrated by Figure 5. A sediment classification scheme derived by Kelly and Hite (38) for Illinois streams was used to classify results for sediment chemical analyses at sites with corresponding biological data. Sediment chemical concentrations are classified as nonelevated, slightly elevated, elevated, highly elevated, and extremely elevated as the concentrations increase beyond the mean concentration at background sites. The results for four heavy metal parameters (arsenic, cadmium, lead, and zinc) commonly encountered in urban settings show that the frequency

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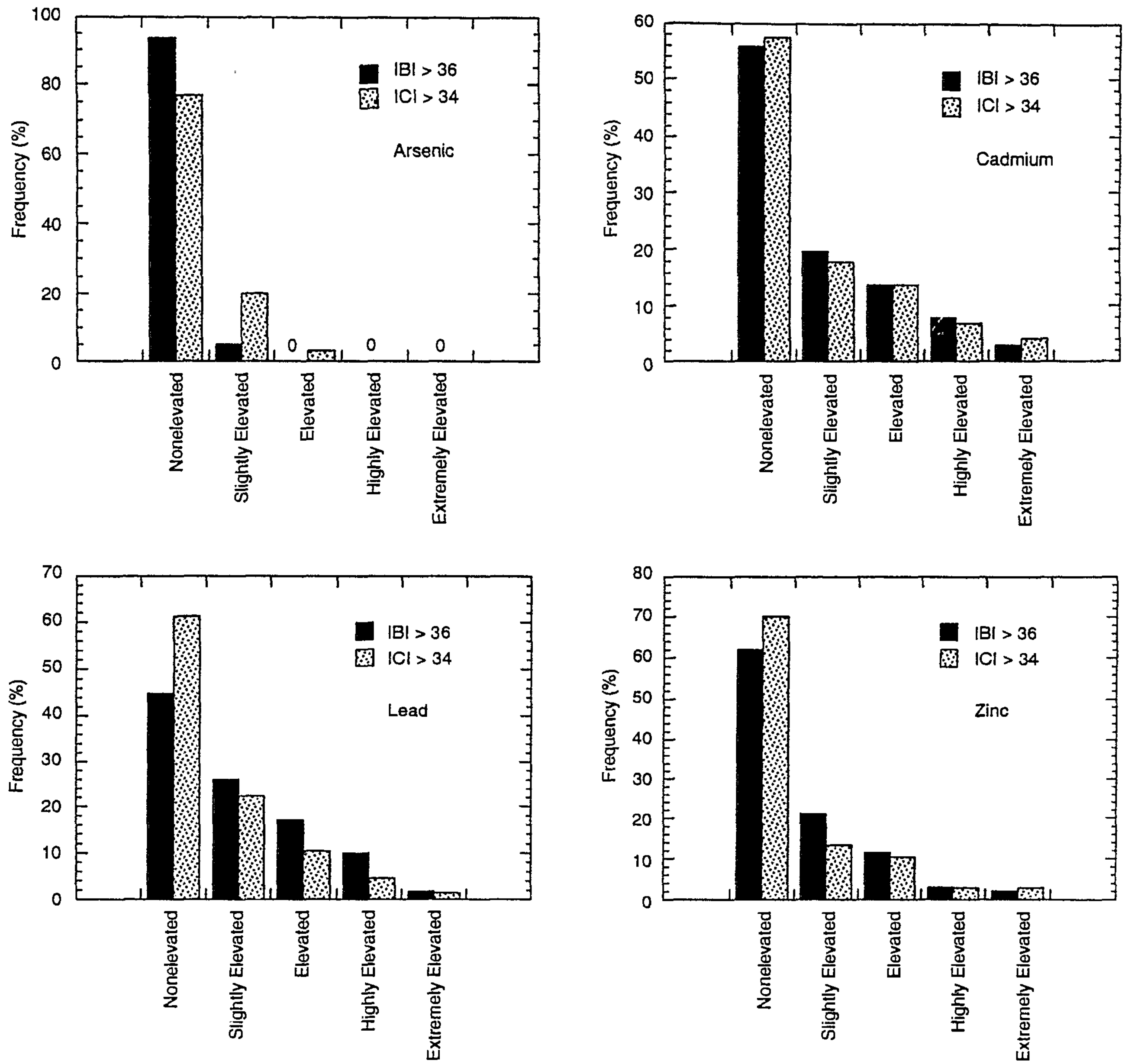

Figure 5. The frequency of occurrence of IBI and ICI scores which attain the warmwater habitat biocriteria under increasingly contaminated levels of four heavy metals in bottom sediments. Based on data collected by Ohio EPA throughout Ohio between 1981 and 1989.

of sites attaining the WWH use designation criteria for the IBI and ICI sharply decline as the sediment concentrations of these metals increase. For arsenic, no sites with highly or extremely elevated concentrations attain the biocriteria. For the remaining three parameters, in a few instances in each case, biocriteria attainment exists with highly elevated or extremely elevated sediment concentrations, but these are exceptions to the overall pattern.

For bioassessments to achieve their maximum effective use in the assessment of urban nonpoint sources, sampling and analysis should be based on a watershed design. An example of the use of biological criteria to evaluate aquatic life-use attainment/nonattainment in an urban watershed involves the Nimishillen Creek basin in northeastern Ohio (Table 1). This watershed is subject to a variety of point and nonpoint source impacts and is extensively affected by intensive urbanization in several

Table 1. Aquatic Life-Use Attainment Status for the Existing and Recommended Aquatic Life-Use Designations in the Nimishillen Creek and Selected Tributaries Based on Data Collected From June to September, 1985

Use Designation	RIVER MILE Fish/ Invertebrate	IBI	Mlwb	ICI[a]	QHEI[b]	Attainment Status[c]	Comment
Nimishillen Creek							
WWH	14.2/14.2	30[d]	6.7[d]	22[d]	60	Non	Dst. East and Middle Branches
	12.7/12.7	22[d]	6.0[d]	22[d]	71.5	Non	Cherry Ave.
	11.7/11.7	20[d]	4.8[d]	12[d]	81	Non	Dst. West Branch (Gregory Galvanizing)
	11.2/11.1	17[d]	3.3[d]	8[d]	81.5	Non	Dst. Hurford Run (Ashland Oil)
WWH	10.2/10.3	19[d]	3.1[d]	10[d]	72.5	Non	Ust. Canton WWTP
	8.8/8.8	19[d]	2.3[d]	8[d]	85	Non	Baum Rd.
	6.7/6.7	16[d]	3.6[d]	2[d]	80.5	Non	Howenstine Rd.
	3.2/3.2	24[d]	4.2[d]	6[d]	91	Non	Main St.
	0.6/0.6	20[d]	3.9[d]	0[d]	92	Non	Ust. at mouth
Sherrie (Sherrick) Run							
LRW	5.3/5.3	12[d]	N/A	P[d]	33.5	Non	
WWH	4.1/4.1	17[d]	N/A	P[d]	70 T	Non	Dst. Osnaburg Ditch
	0.1/—	22	N/A	P[d]	52	Non	
Osnaburg Ditch							
MWH	0.7/0.7	15[d]	N/A	P[d]	42 T	Non	Ust. East Canton WWTP
	0.1/0.1	12[d]	N/A	P[d]	39	Non	Dst. East Canton WWTP
Hurford Run							
LRW	2.0/—	12[d]	N/A	—	34.5	Non	Ust. Ashland Oil
	1.8/—	12[d]	N/A	—	27	Non	Dst. Ashland Oil
MWH	1.2/—	12[d]	N/A	—	52.5	Non	Dst. Domer Ditch
WWH	0.3/—	12[d]	N/A	—	66	Non	
	0.1/—	18[d]	N/A	—	50.5	Non	
Domer Ditch							
WWH	0.5/0.4	23[d]	N/A	MG	60	Non	Ust. Timken
	0.1/0.1	18[d]	N/A	P[d]	54.5	Non	Dst. Timken
West Branch Nimishillen Creek							
WWH	5.9/5.9	27[d]	N/A	18[d]	53	Non	At cemetery
	3.2/3.2	17[d]	4.8[d]	20[d]	59.5	Non	Dst. McDowell Ditch
	1.6/1.6	22[d]	5.5[d]	20[d]	43.5	Non	Ust. Tuscarawas St.
	0.8/—	24[d]	6.2[d]	—	34.5	(Non)	Ust. Gregory Galvanizing
	0.1/0.1	21[d]	3.1[d]	12[d]	65	Non	Dst. Gregory Galvanizing
McDowell Ditch							
MWH	1.8/1.8	21[d]	N/A	F	34	Partial	Ust. Everhard Rd.
	0.1/0.1	21[d]	N/A	F	41	Partial	At mouth
Zimber Ditch							
WWH	3.8/3.8	40[ns]	N/A	G	57	Full	Regional reference site
	1.8/2.4	29[d]	N/A	F	42	Non	Dst. Hoover Industrial Park
MWH	0.9/1.1	23[d]	N/A	F	31	Partial	Ust. North Canton Ditch
	0.6/0.6	23[d]	N/A	F	31.5	Partial	Dst. North Canton Ditch
Rettig Ditch							
Undesignated	0.9/0.9	29[d]	N/A	F	39	Non	Channel modified
North Canton Ditch							
LRW	0.1/0.1	32	N/A	P	46	Full	Partially culverted (80-m zone)

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Table 1. Aquatic Life-Use Attainment Status for the Existing and Recommended Aquatic Life-Use Designations in the Nimishillen *Creek and Selected Tributaries Based on Data Collected From June to September, 1985 (Continued)*

Use Designation	RIVER MILE Fish/ Invertebrate	IBI	Mlwb	ICI[a]	QHEI[b]	Attainment Status[c]	Comment
Middle Branch Nimishillen Creek							
WWH	11.4/11.4	45	N/A	30[ns]	50	Full	
	10.4/10.4	27[d]	5.8[d]	22[d]	38	Non	Ust. State St.
	8.0/8.0	34[ns]	7.7[ns]	30[ns]	74	Full	Dst. Werner-Church Rd.
	6.8/6.8	35[ns]	8.0	40	47	Full	Regional reference site
	5.0/—	37[ns]	7.6[ns]	—	—	(Full)	Ust. 55th St.
	2.5/2.5	38	8.3	28[d]	—	Partial	Ust. Martindale Rd.
	1.6/—	43	8.5	—	—	(Full)	Dst. State Route 62
	—/0.8	—	—	10[d]	—	(Non)	
	0.2/0.1	28[d]	7.2[d]	14[d]	60	Non	Cookes Park
Swartz Ditch							
MWH	2.6/2.6	26	N/A	F	34	Full	Ust. Smith-Kramer Rd.
	1.2/1.2	33	N/A	P[d]	31	Non	Ust. Church Rd.
	0.2/0.3	34	N/A	F	45.5	Full	Dst. Hartville Ditch
Gulley (Hartville) Ditch							
MWH	—/4.1	—	—	P[d]	—	(Non)	Ust. Teledyne
	3.4/—	26	N/A	—	27	(Full)	Ust. Hartville WWTP
	2.3/2.3	33	N/A	P[d]	32	Partial	Dst. Smith-Kramer Rd.
	0.4/0.4	36	N/A	F	44	Full	Gans Rd.-Dst. Culvert
East Branch Nimishillen Creek							
WWH	8.6/8.6	39[ns]	N/A	40	64.5	Full	Regional reference site
	6.4/6.3	33[d]	6.8[d]	26[d]	51	Non	Ust. J&L Steel
WWH	4.7/4.7	29[d]	6.4[d]	4[d]	80	Non	Dst. J&L Steel
	4.2/4.2	23[d]	3.8[d]	14[d]	66	Non	Dst. Louisville South WWTP
	3.4/2.8	24[d]	4.5[d]	20[d]	66	Non	Dst. Louisville North WWTP
	1.9/1.9	24[d]	5.1[d]	20[d]	67.5	Non	Ust. LTV Steel
	0.1/0.1	31[d]	8.2[d]	14[d]	60.5	Partial	At mouth

Ecoregion Biocriteria: Erie/Ontario Lake Plain

INDEX - Site Type	WWH	EWH	MWH[e]
IBI - Headwaters	40	50	24
IBI - Wading	38	50	24
Mlwb - Wading	7.9	9.4	5.8
ICI	34	46	22

[a] Narrative criteria used in lieu of ICI: E = exceptional, G = good, MG = marginally good, F = fair, P = poor.
[b] All QHEI values are based on the most recent version of the index (28).
[c] Use attainment is parenthetically expressed when based on one organism group.
[d] Significant departure from ecoregion biocriteria; poor and very poor results are underlined.
[e] For channel modified areas.
Dst. = downstream
LRW = Limited Resource Waters
Mlwb = modified Iwb
MWH = Modified Warmwater Habitat
ns = nonsignificant departure from WWH and EWH biocriteria (4 IBI or ICI units; 0.5 Mlwb units).
Ust. = upstream
WWTP = wastewater treatment plant

areas. As with many of the Ohio watersheds that are more heavily affected by point and nonpoint sources, the majority of sampling sites either fail to attain the applicable biological criteria or are only in partial attainment. Out of 57 sampling sites in the entire watershed, only 11 (19 percent) fully attained the applicable biological criteria. These results demonstrate the degree of degradation that exists in most urban watersheds and the multiple source causes.

Another issue of critical importance to the management of urban watersheds is also apparent in Table 1, use attainability. Many of the use designations listed for the various streams of the Nimishillen Creek basin are recommended uses, meaning that a different aquatic life use applied at the time of the sampling. An important objective of the biological sampling conducted by Ohio EPA is to determine the appropriate aquatic life-use designation. If the results of the sampling and data analysis suggest that the existing use designation is inappropriate (or the stream is presently unclassified), the appropriate use is recommended. These recommendations are then proposed in a WQS rulemaking procedure and adopted after consideration of public input.

Figure 6 illustrates the relative distribution of IBI scores based on biological monitoring conducted by Ohio EPA in several urban and suburban watersheds throughout Ohio. These range in size from relatively small headwater streams (less than a 20-square-mile watershed area) to increasingly larger streams and rivers. For the smaller watersheds, there is a pattern of lower IBI scores and a subsequent loss of biological integrity with an increasing degree of urbanization. The baseline biological criterion for the WWH use designation is not attained by any (or only a few) sampling sites in the older urban watersheds, such as the Cuyahoga River and Little Cuyahoga River of northeastern Ohio and Mill Creek in Cincinnati. The IBI scores in these watersheds are indicative of poor and very poor water resource quality. The Rocky River basin is largely a suburban area of Cleveland upon which municipal wastewater discharges have had an extensive impact, but despite this the basin exhibits higher IBI scores. The highest IBI scores were observed in Rocky Fork (Columbus area), Taylor Creek (Cincinnati area), and Little Miami River (southwest Ohio) tributaries, which have only recently begun to be suburbanized. These three watersheds also lack some of the companion impacts of the older urban areas, namely, combined sewer overflows and industrial discharges.

For the larger streams and rivers, the pattern was similar, with the older urban areas exhibiting the lowest IBI scores and the less urbanized and suburban watersheds exhibiting higher scores, some of which attain the WWH criteria. The major exceptions, however, involve the two large mainstem rivers (Great Miami River and Scioto River) which exhibit higher IBI scores despite flowing within urban settings. This illustrates the influence of river and upstream watershed size on the ability of a river or stream to withstand increased urbanization. Both the Great Miami River and Scioto River mainstems originate in rural areas and are quite large when they enter the Dayton and Columbus urban areas. Thus, stream size relative to the watershed and the influence of land-use patterns are important to understanding and managing local nonpoint source impacts.

Applications to Nonpoint Source Management

Steedman (24) observed the IBI to be negatively correlated with urban land use. The land use within the 10 to 100 km^2 area upstream from a site was the most important in predicting the IBI, which suggests that "extraneous" information was likely included if whole watershed land-use area was used. Steedman (24) also determined that the condition of the riparian zone was an important covariate (a measure of independent variation) with urban land use in addition to other factors, such as sedimentation and nutrient enrichment. A model relationship between these factors and the IBI was developed and provided the basis to predict when the IBI would decline below a certain threshold level with certain combinations of riparian zone width and percent of urbanization. In the Steedman (24) study, the domain of degradation for Toronto area streams ranged from 75-percent riparian removal at 0-percent urbanization to 0-percent riparian removal at 55-percent urbanization. These results indicate that it is possible to establish the bounds within which the combination of watershed land use and riparian zone condition must be maintained for a target level of biological community performance to persist. It seems plausible that such relationships could be established for many other watersheds, provided the database is sufficiently developed not only for biological communities but also for land-use composition and riparian corridor condition. Additionally including the concept of ecoregions and subecoregions should lead to the development of criteria for land use and riparian zones that would ensure the maintenance of biocriteria performance levels in streams and rivers over fairly broad areas without the need to develop a site-specific database everywhere.

Well-designed biological surveys can fit well into the watershed approach to nonpoint source management. Because the biota respond to and integrate all of the various factors that affect a particular water body, they are essentially the end product of what happens within watersheds. The important issue is that ambient monitoring be conducted as part of the nonpoint source assessment and management process, and that it be performed correctly in terms of timing, methods, and design. Monitoring alone is not enough, however. Federal, state, local, and private efforts to remediate nonpoint source impairments must include an interdisciplinary approach that goes beyond water column chemistry impacts to include the cumulative range of factors responsible for ecosystem degradation that has been documented over the past century. Existing regulations and standards have only been locally successful in reducing water resource declines attributable to watershed and riparian zone degradation. Effective protection and rehabilitation strategies require the targeting of large areas and individual sites (39) as well as the

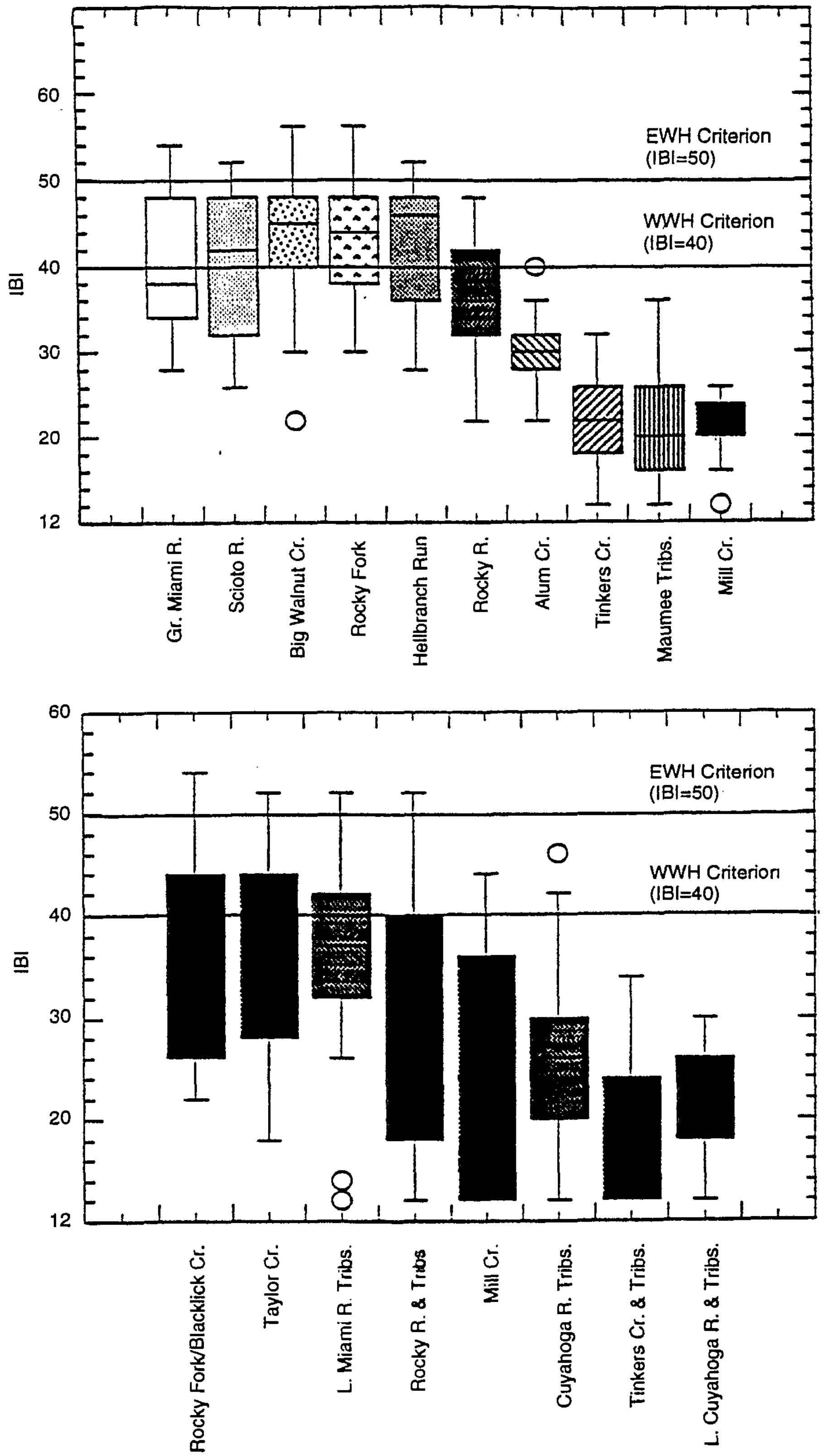

Figure 6. IBI values observed in selected Ohio headwaters streams (drainage area <20 mi.^{2}; upper) and larger Ohio streams and rivers between 1981 and 1992. Box and whisker plots include all values recorded in each stream or stream/river assemblage.

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incorporation of ecological concepts in the status quo of land-use management practices and policies.

Ohio EPA has initiated the development of policies that will ensure a holistic approach to nonpoint source management. For example, we have specified a minimum width of two to three times the bank full channel width as necessary to protect riparian zones and ensure the integrity of instream habitat. This also ensures that the ability of the stream to assimilate nonpoint source runoff will be maintained. To be completely successful, however, this measure must be accompanied by the application of best management practices in the uplands. Such an approach goes well beyond a singular concern for the concentration of pollutants in the water column and must be incorporated into the total maximum daily load approach envisioned by the U.S. Environmental Protection Agency as an integral part of urban nonpoint source runoff management.

Thus, it seems that we have a choice in the management of urban nonpoint sources, as portrayed by Figure 7. Extending the traditional process by which we have managed chemical pollutants discharged by point sources during the past 15 to 20 years to nonpoint sources is exemplified by treating streams as once-through flow conduits that are essentially isolated from interactions with the landscape. This is commonly exemplified by simplified mass-balance approaches to establishing water quality-based effluent limitations for point sources using steady-state assumptions. While this approach has been successful in reducing point source loadings of commonly discharged substances, it holds much less promise for highly dynamic inputs from diffuse sources. For nonpoint source management to truly result in the restoration and preservation of biological integrity, we must regard streams as an interactive component of the landscape where multiple inputs and influences act together to determine the health of the aquatic resource.

Urban watershed management and protection issues will continue to develop as new information is revealed and relationships between instream biological community performance and watershed factors are better developed. Nonetheless, some of what we know now should be included in current management strategies. Urban and suburban development must become proactive; that is, developments must be designed to accommodate the features of the natural landscape and include common sense features such as setbacks from riparian zones. Regulatory agencies also share responsibility, particularly in resolving use attainability issues. Watersheds that exhibit the attainment of aquatic life-use biocriteria should be protected to maintain the current conditions. Frequently our attention seems to emphasize high quality or unique habitats; however,

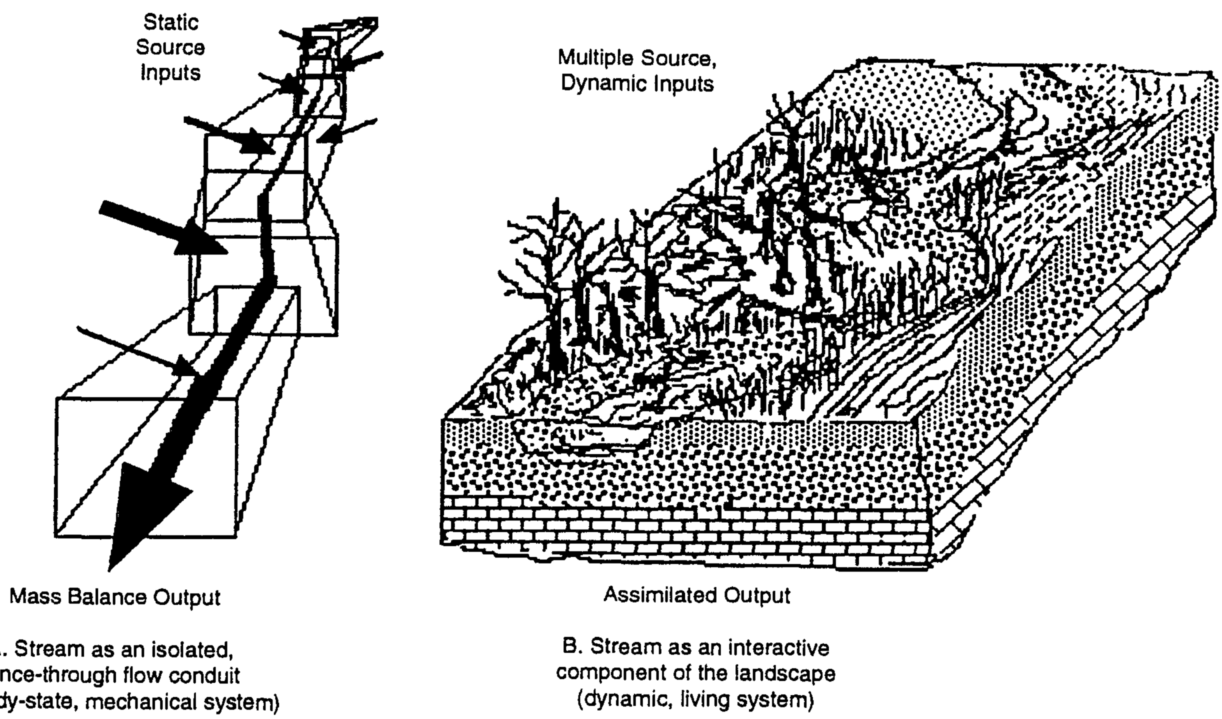

Figure 7. Two views of a stream ecosystem: A. The stream is viewed as an isolated conveyance for static source wastes and runoff with the net water column output as a mass balance function of flow and concentration. B. The stream as an interactive component of the landscape with dynamic and multiple source inputs and assimilated output as affected by the surrounding land use, habitat, geology, soils, and other biotic and abiotic factors.

water quality standards must be maintained where they are presently attained, if even minimally so. Strategies should also include the restoration of degraded watersheds where that potential exists. In systems where the degree of degradation is so severe that the damage is essentially irreparable, minimal enhancement measures should still be required, even though full use attainment is not expected. Biocriteria and bioassessments have an important and central role to play in this process.

References

1. Karr, J.R., K.D. Fausch, P.L. Angermeier. P.R. Yant, and I.J. Schlosser. 1986. Assessing biological integrity in running waters: A method and its rationale. Special Publication No. 5. Champaign, IL: Illinois Natural History Survey.
2. Ohio Environmental Protection Agency. 1990. Ohio's nonpoint source pollution assessment. Columbus, OH: Ohio EPA, Division of Water Quality Planning and Assessment.
3. Karr, J.R. 1991. Biological integrity: A long-neglected aspect of water resource management. Ecol. Applic. 1(1):66-84.
4. Ohio Environmental Protection Agency. 1987. Biological criteria for the protection of aquatic life, Vol. I. The role of biological data in water quality assessment. Columbus, OH: Ohio EPA, Division of Water Quality Planning and Assessment.
5. Ohio Environmental Protection Agency. 1987. Biological criteria for the protection of aquatic life, Vol. II. User's manual for biological field assessment of Ohio surface waters. Columbus, OH: Ohio EPA, Division of Water Quality Planning and Assessment.
6. Ohio Environmental Protection Agency. 1989. Biological criteria for the protection of aquatic life, Vol. III. Standardized biological field sampling and laboratory methods for assessing fish and macroinvertebrate communities. Columbus, OH: Ohio EPA, Division of Water Quality Planning and Assessment.
7. Yoder, C.O. 1989. The development and use of biocriteria for Ohio surface waters. In: Flock, G.H., ed. Water quality standards for the 21st century. Proceedings of a U.S. EPA National Conference, Washington, DC.
8. Suter, II, G.W. 1993. A critique of ecosystem health concepts and indexes. Environ. Toxicol. Chem. 12:1,521-1,531.
9. Karr, J.R. 1981. Assessment of biotic integrity using fish communities. Fisheries 6(6):21-27.
10. Fausch, K.D., J.R. Karr, and P.R. Yant. 1984. Regional application of an index of biotic integrity based on stream fish communities. Trans. Am. Fishery Soc. 113:39-55.
11. Gammon, J.R. 1976. The fish populations of the middle 340 km of the Wabash River. Technical Report 86. Purdue University Water Resources Research Center.
12. Gammon, J.R., A. Spacie, J.L. Hamelink, and R.L. Kaesler. 1981. Role of electrofishing in assessing environmental quality of the Wabash River. In: Bates, J.M., and C. Weber, eds. Ecological assessments of effluent impacts on communities of indigenous aquatic organisms. ASTM STP 730. Philadelphia, PA: American Society for Testing and Materials.
13. U.S. EPA. 1989. Rapid bioassessment protocols for use in rivers and streams: Benthic macroinvertebrates and fish. EPA/444/4-89-001. Washington, DC.
14. Lyons, J. 1992. Using the Index of Biotic Integrity (IBI) to measure environmental quality in warmwater streams of Wisconsin. Gen. Tech. Rep. NC-149. St. Paul, MN: U.S. Department of Agriculture.
15. U.S. EPA. 1991. Development of index of biotic integrity expectations for the ecoregions of Indiana, Vol. I. Central corn belt plain. EPA/905/9-91/025.
16. Kerans, B.L., and J.R. Karr. 1992. An evaluation of invertebrate attributes and a benthic index of biotic integrity for Tennessee Valley rivers. In: U.S. EPA. 1992. Proceedings of the 1991 Midwest Pollution Control Biologists' Conference. EPA/905/R-92/003.
17. Ohio Environmental Protection Agency. 1989. Addendum to biological criteria for the protection of aquatic life, Vol. II. User's manual for biological field assessment of Ohio surface waters. Columbus, OH: Ohio EPA, Division of Water Quality Planning and Assessment.
18. Davis, W.S., and A. Lubin. 1989. Statistical validation of Ohio EPA's invertebrate community index. In: Davis, W.S., and T.P. Simon, eds. Proceedings of the 1989 Midwest Pollution Control Biologists' Meeting, Chicago, IL. EPA/905/9-89/007. pp. 23-32.
19. Rankin, E.T., and C.O. Yoder. 1990. The nature of sampling variability in the Index of Biotic Integrity (IBI) in Ohio streams. In: Davis, W.S., ed. Proceedings of the 1990 Midwest Pollution Control Biologists' Conference, Chicago, IL. EPA/905/9-90/005. pp. 9-18.
20. Stevens, J.C., and S.W. Szczytko. 1990. The use and variability of the biotic index to monitor changes in an effluent stream following wastewater treatment plant upgrades. In: U.S. EPA. 1991. Proceedings of the 1990 Midwest Pollution Control Biologists' Meeting, Chicago, IL. EPA/905/9-90/005. pp. 33-46.
21. Gammon, J.R., M.D. Johnson, C.E. Mays, D.A. Schiappa, W.L. Fisher, and B.L. Pearman. 1983. Effects of agriculture on stream fauna in central Indiana. EPA/600/S3-83/020.
22. Gammon, J.R., C.W. Gammon, and M.K. Schmid. 1990. Land use influence on fish communities in central Indiana streams. In: U.S. EPA. 1990. Proceedings of the 1990 Midwest Pollution Control Biologists' Conference. EPA/905/R-92/003. pp. 111-120.
23. Klein, R.D. 1979. Urbanization and stream quality impairment. Water Res. Bull. 15(4):948-963.
24. Steedman, R.J. 1988. Modification and assessment of an index of biotic integrity to quantify stream quality in southern Ontario. Can. J. Fish. Aquatic Sci. 45:492-501.
25. Omernik, J.M. 1987. Ecoregions of the conterminous United States. Ann. Assoc. Am. Geogr. 77(1):118-125.
26. Omernik, J.M., and G.E. Griffith. 1991. Ecological regions versus hydrologic units: Frameworks for managing water quality. J. Soil Water Conserv. 46:334.
27. Yoder, C.O. 1991. The integrated biosurvey as a tool for evaluation of aquatic life use attainment and impairment in Ohio surface waters. In: U.S. EPA. 1991. Biological criteria: Research and regulation. Proceedings of a U.S. EPA National Conference, Washington, DC.
28. Rankin, E.T. 1989. The Qualitative Habitat Evaluation Index (QHEI): Rationale, methods, and applications. Columbus, OH: Ohio EPA, Division of Water Quality Planning and Assessment.
29. Benke, A.C. 1990. A perspective on America's vanishing streams. J. N. Am. Benthic Soc. 9(1):77-88.
30. Karr, J.R., L.A. Toth, and D.R. Dudley. 1985. Fish communities of midwest rivers: A history of degradation. BioScience 35(2):90-95.
31. Trautman, M.B. 1981. The fishes of Ohio, 2nd ed. Columbus, OH: Ohio State University Press.
32. Rankin, E.T., C.O. Yoder, and D. Mishne, eds. 1992. Ohio water resource inventory, Vol. I. Summary, status, and trends, 1992. Columbus, OH: Ohio EPA, Division of Water Quality Planning and Assessment.

33. Rankin, E.T., C.O. Yoder, and D. Mishne, eds. 1990. Ohio water resource inventory, Vol. I. Summary, status, and trends, 1990. Columbus, OH: Ohio EPA, Division of Water Quality Planning and Assessment.

34. Rankin, E.T., ed. 1988. Water Quality Inventory—1988 305(b) report, Vol. I. Columbus, OH: Ohio Environmental Protection Agency.

35. Hill, M.T., W.S. Platts, and R.L. Beschta. 1991. Ecological and geomorphological concepts for instream and out-of-channel flow requirements. Rivers 2:198-210.

36. Dickson, K.L. 1986. Neglected and forgotten contaminants affecting aquatic life. Env. Tox. Chem. 5:939-940.

37. Ohio Environmental Protection Agency. 1991. Ohio nonpoint source assessment. Columbus, OH: Ohio EPA, Division of Water Quality Planning and Assessment.

38. Kelly, M.H., and R.L. Hite. 1984. Evaluation of Illinois stream sediment data: 1974-1980. Springfield, IL: Illinois Environmental Protection Agency.

39. Schaefer, J.M., and M.T. Brown. 1992. Designing and protecting river corridors for wildlife. Rivers 3(1):14-26.

Overview of Contaminated Sediment Assessment Methods

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Urban runoff has significantly contributed to the contamination of lakes, rivers, and streams. After years of accumulation in the water, toxic chemicals have found their way to the bottom sediments. These contaminants can be directly toxic to fish and other aquatic organisms as well as significant sources of contaminants to wildlife. Human health effect concerns arise primarily from consumption of contaminated fish and water fowl. Assessing contaminated sediments is a difficult task due to the complex naturė of the sediment matrix, contaminant mixtures, and the physical dynamics of the waterways. To determine the scope and extent of the sediment contamination at a particular site, a comprehensive sediment assessment program must be developed.

In recognition of the significance of the problem, the Assessment and Remediation of Contaminated Sediments (ARCS) program was authorized for 6 years—by Congress under Section 118(c)(3) of the Water Quality Act of 1987 and the Great Lakes Critical Program Act of 1990—to develop and demonstrate new and innovative methods both to assess and to treat contaminated sediments. The ARCS program developed an "Integrated Contaminated Sediments Assessment Approach" for use in the Great Lakes Areas of Concern (1). This approach includes:

- Sampling design and quality assurance
- Sample collection
- Chemical analysis
- Toxicity testing
- Benthic community structure survey
- Tumors and abnormalities

These six topics are the focus of this paper.

Assessment Components

Sample Design and Collection

The ultimate goal of assessment is to determine the scope and extent of contamination, including the magnitude and spatial bounds of the problem. Assessment needs direct sample design. Sediment sampling programs are most often undertaken to achieve one or more of the following objectives: to fulfill a regulatory testing requirement, to determine characteristic ambient levels, to monitor trends in contamination levels, to identify hot spots of contamination, and to screen for potential problems. These different objectives lead to different sampling designs. For example, a study for a dredging project may have a specific set of guidelines on sampling frequency, sample site selection methodology, and other parameters already determined by existing, specific guidance. The design for a study to track sediment contamination trends would expend its resources to sample fewer sites more frequently. A study to identify hot spots would concentrate efforts on fewer sites within zones known to be mostly contaminated, while an initial screening study might take few randomly distributed samples for analysis together with some "observation" samples to supplement the analytical results.

The most appropriate sample collection device for a specific study depends on the study objectives, sampling conditions, parameters to be analyzed, and cost. Three general types of devices are used to collect sediment samples: dredges, grab samplers, and corers. Core samples give by far the most complete information; thus, corers should be the sampler of choice whenever possible. Deep core sampling gives a three-dimensional picture of the situation. This allows characterization of the depth of contamination. Before a river or lake bottom is dredged in an effort to remove contamination, knowing whether more serious contamination will be uncovered is vital. All of this information guides remediation decisions.

The ARCS program concentrated on three levels of sampling data:

- *Historical data* can give some preliminary clues to what may be present at a site. Consideration of historical data can help to move the sample design process in the proper direction. Historical data have some limitations, however, that bear consideration. Often data are only available for surface sediments, and quality assurance may be in question.
- *Reconnaissance sampling data* involve characterizing a large area with "quick and dirty" screening tests on fewer samples. This data can help eliminate some of the parameters of concern, thus allowing more extensive testing of toxic substances present at the site.
- *Detailed assessment data* involve the more extensive chemistry and biological testing to fully characterize a hot spot.

Chemical and Physical Analysis

Sampling efforts are performed with a variety of objectives in mind. Therefore, minimal chemical and physical parameter testing requirements vary between studies or programs. Some chemical and physical parameters, however, should be common to most programs unless evidence precludes their consideration:

- *Particle or grain size* is a physical parameter that determines the distribution of particles. Size is important because finer grained sediments tend to bind contaminants more than coarse sediments do.
- *Total organic carbon (TOC)* is an important indicator of bioavailability for nonionic hydrophobic organic pollutants.
- *Acid volatile sulfides (AVS)* have been found to be closely related to the toxicity of sediment-related associated metals.
- *Polyaromatic hydrocarbons (PAHs)* are semivolatile organic pollutants, several of which are potential carcinogens and are linked to tumors in fish.
- *Polychlorinated biphenyls (PCBs)* are chlorinated organic compounds once used for numerous purposes, including as a dielectric fluid in electrical transformers.
- *Pesticides* are synthetic compounds predominantly used in agriculture to control crop-damaging insects.
- *Other semivolatiles* include acid/base neutral compounds (ABNs) such as phenols, naphthenes, and toluenes.
- *Heavy metals* are naturally occurring in the environment, but an excess of metals can be an indication of anthropogenic contamination; heavy metals can be toxic to benthic organisms.

For a typical Great Lakes site, grain size, TOC, and AVS analyses should be done; the other five analyses should be performed accordingly. For example, if heavy metals in a particular area are not a problem, they could be omitted from the scheme. Also, if certain other contaminants are suspected in an area, they should be included as test parameters (e.g., tributyl tin and methyl mercury).

Toxicity Testing

Although chemical analysis is an illuminating part of the assessment process, chemical analysis alone does not determine impacts. Bioavailability is key to determining whether or not toxic contaminants will cause effects. For example, it is possible to find a situation where high concentrations of contaminants are present but no toxic effects are manifested in the benthic community; in such a situation, the contaminants may not be bioavailable to the benthic community. In any case, further toxicity testing would be required. One way to evaluate bioavailability is by performing toxicity tests. Toxicity tests measure the effects of sediment contamination test organisms. Test organisms can be exposed directly to sediments (solid phase) or to sediment slurries called elutriates.

The ARCS program evaluated over 40 toxicity tests during the assessment program at three priority areas of concern. Based on the results of the ARCS program, a battery of tests should include Microtox and *Daphnia magna* (7-day, three-brood survival reproduction solid phase assay) because they are good screening assays, relatively sensitive, discriminatory, and well correlated with other assay responses. In addition, one or two of the following tests should be included in the assay battery: *Pimephales promelas* (larval growth solid phase), *Hyalella azteca* (7-day survival solid phase), *Ceriodaphnia dubia* (three-brood survival and reproduction, solid or elutriate phase), and *Hexagenia bilineata* (10-day survival and molting, solid or elutriate phase).

Benthic Community Survey

Benthic communities are communities of organisms that live in or on sediment. In most benthic community structure assessments, primary emphasis is placed on determining the species that are present and the distribution of individuals among those species. Information on benthic community composition and abundance is typically used in conjunction with information in the scientific literature to infer the distribution of species and individuals. Because sediment quality affects all major structural and functional attributes of benthic communities in generally predictable ways, benthic community structure assessment is a valuable tool for evaluating sediment quality and its effects on a major biological component of freshwater ecosystems. Specific assessment methods are available to complement the chemical and toxicological portions of the sediment quality assessment.

Freshwater benthic macroinvertebrate communities are used in the following ways to assess the quality of the water resource:

- Identification of the quality of ambient sites through a knowledge of the pollution tolerances and life history requirements of benthic macroinvertebrates.
- Establishment of standards based on community performance at multiple reference sites throughout an ecoregion or other regionalization categories.
- Comparison of the quality of reference sites with test sites.
- Comparison of the quality of ambient sites with historical data to identify temporal trends.
- Determination of spatial gradients of contamination for source characterization.

Tumors and Abnormalities

Tumors and other abnormalities are another useful assessment tool. These abnormalities are believed to be caused by contaminants present in the sediments, specifically PAHs. A typical use of this type of study would be to analyze for tumors and abnormalities before and after cleanup to see if a change in the incidence rate occurred. In the ARCS program, investigation of tumors and abnormalities helped to characterize the different areas of concern. For example, in the Ashtabula and Buffalo Rivers we found numerous liver and external abnormalities in Brown Bullhead, such as lip papillomas, preneoplastic lesions, and neoplastic lesions.

Interpretation and Use of Data

All data are useless without an interpretation scheme. Using or looking at data in isolation can lead to false conclusions. Therefore, it is important to look at all aspects of data using some type of integrated process to aid decision-making.

Data Depiction

Data cannot be easily interpreted from tables. Data need to be depicted in a visual manner, such that hot spots, gradient depth information, and trends are evident. One way to accomplish this goal is to make a map of the site and plot data results on the map. A three-dimensional map can be most useful in data depiction.

Sediment Quality Values

As stated before, the numbers obtained from chemical testing are not very significant by themselves. If you have a gray-area situation, in which the chemistry numbers are high but toxicity or biological alteration is not necessarily evident, deciding whether this is or will become a problem may be difficult. In such a case, comparison of one's particular program numbers with existing numbers could give information on how to proceed. There are three general types of sediment quality values (2):

- *Equilibrium partitioning* is a theoretical approach that focuses on predicting the chemical interactions between sediments, interstitial water (i.e., the water between sediment particles), and contaminants. Chemically contaminated sediments are expected to cause adverse biological effects if the predicted interstitial water concentration for a given contaminant exceeds the chronic water quality criterion for that contaminant.
- *The empirical effects-based approach* (e.g., sediment quality triad or apparent effects threshold) combines measures of sediment chemistry, sediment toxicity, and/or benthic infauna communities to determine the overall sediment quality.
- *National status and trends* is a statistical approach that uses chemical data assembled from modeling laboratory and field studies to determine the ranges in chemical concentration that are rarely, sometimes, and usually associated with toxicity.

Each approach has advantages and disadvantages. The best approach is selected based on each programs' particular needs.

Risk Assessment

After studying the data received from the chemistry, toxicity, and environmental impact analysis, the final assessment step is an evaluation of associated risk to human, aquatic, and wildlife. What is the risk now, and what is it potentially? This involves evaluating exposure to and impacts resulting from contact with contaminated sediments and media contaminated by sediment contaminants. If several sites are involved, a prioritization system may be needed as a decision-making tool for remedial actions.

The ARCS program used two levels of evaluation: baseline and comprehensive hazard evaluations. Baseline human health hazard evaluations were performed for all five priority demonstration areas and were developed from available site-specific information. The baseline hazard evaluations described the hazards to receptors under present site conditions. This baseline assessment also examined all potential pathways for human exposure to sediments for each given location. Comprehensive *hazard* evaluations were performed for the Buffalo River and Saginaw Bay areas. Results from ARCS studies showed that consumption of contaminated fish provided the greatest risk to human health.

Conclusions

There are a number of approaches to the assessment process. The main components are sample design, chemical and physical analysis, biological testing and data interpretation. Within that framework, choices are made as to what course to follow. Regardless of which assessment path one takes, each phase of the assessment process should be carefully considered and tailored to the needs and goals of that particular program. All data must be integrated for decisions to be based on a preponderance of evidence and to yield the most definitive of results.

References

1. U.S. EPA. 1992. ARCS: *Assessment and Remediation of Contaminated Sediments.* 1992 work plan. Chicago, IL: Great Lakes National Program Office.
2. U.S. EPA. 1992. Sediment classification methods compendium. EPA/823/R-92/006. Washington, DC.

Linked Watershed/Water-Body Model

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Abstract

With passage of the state's Surface Water Improvement and Management (SWIM) Act of 1987, the Southwest Florida Water Management District realized a need for an integrated eutrophication model incorporating both a watershed loading model and a water-body response model. In addition, because many watershed models depend on land use and soils mapping data, a modeling system that could take advantage of data already stored in the district's geographical information system (GIS) would be useful.

This paper describes the desirable attributes of such a modeling system, the means used to select the appropriate model components, the actual modeling system developed, and an application of the model. The modeling system is constructed around two U.S. Environmental Protection Agency supported models—Storm Water Management Model (SWMM) and Water Quality Analysis Simulation Program Model (WASP4)—and is linked to the ARC/INFO GIS. Rather than the details of SWMM or WASP4, the paper focuses on the SWMM/WASP Interactive Support Program (SWISP), the interactive, menu-driven user environment that allows for the easy execution of the linked watershed/water-body modeling system of programs. With SWISP, the user can view and edit input data sets as well as execute and graphically postprocess the results.

The modeling system is being tested and refined sequentially on three test sites. The paper presents the results of testing to date on a specific case study: Lake Thonotosassa, a hypereutrophic, 800-acre lake in Hillsborough County, Florida. The objective of the modeling is to allow for the assessment of various restoration strategies for improving in-lake water quality. The modeling system, which is PC based and in the public domain, will be available for public release in the fall of 1993, along with a user's manual.

Introduction

With passage of the state's Surface Water Improvement and Management (SWIM) Act of 1987, the Southwest Florida Water Management District (SWFWMD) realized a need for an integrated eutrophication model incorporating both a watershed pollutant loading model and a water-body response model. In addition, because many watershed models depend on land use and soils mapping data, a modeling system that could take advantage of data already stored in the district's geographical information system (GIS) would be useful. The stated objective of the watershed/water-body modeling project was "to select and/or link a watershed(s) and water-body eutrophication model for use in prioritizing land-use management and pollution control strategies and evaluating the effects of implementation of best management practices (BMPs) on in-lake water quality and natural systems."

A variety of watershed models exist that make it possible, within limited degrees of certainty, to evaluate the effects of land-use practices on receiving waters. These models are used to prioritize watersheds that contribute the greatest loading to a water body. When coupled with an appropriate model of the receiving water body, the model system can be used to predict how changes in land use will affect the receiving body, both in terms of water quantity and quality.

A watershed model is an important planning tool for evaluating the contributions from existing conditions and projecting contributions under different scenarios. A watershed/water-body model system allows those using them to make decisions regarding alternative land use, zoning, treatment, and BMP options, thus altering constituent loadings to a receiving water body.

Water quality/ecological models are designed to mimic in-waterbody dynamics as the result of inputs and to predict trophic state or other conditions of interest. These models allow the modeler to predict lake conditions based on known or projected inputs, and thus evaluate how changes in loading will affect the overall health of a water body. Decisions with regard to how much of a load reduction is required to produce desired in-lake effects can be made, and the benefits of implementing a particular corrective strategy can be assessed.

From a water-body management perspective, it is desirable to have as a decision tool a linked model that couples the attributes of both watershed and water-body models. With such a model, it would be possible to evaluate how changes in land use will, for example, affect the trophic state (and other states) of a surface water body.

Model Attributes

Prior to selecting a consultant, district staff developed a list of 13 desirable attributes of a linked watershed/water-body model (LWWM):

- Data can be input directly into the linked model from the district's GIS (ARC/INFO) database.
- The model system should consist of "off the shelf" watershed and water-body models, although some customizing may be required. (Proprietary software is not acceptable.)
- Calibration and validation data requirements should not be excessive.
- The model can be applied to most Florida aquatic systems with the watershed component suitable for estuarine systems.
- The model has a storm event or seasonally based watershed component, yet it is capable of yielding annualized values.
- The output of the watershed model component should be fully compatible with the input of the water-body model component.
- The model should be user-friendly, menu-driven, interactive, and fully documented.
- The water-body model considers the physical, chemical, and biological parameters and processes necessary to simulate the eutrophication process and attendant water quality conditions.
- The model is sensitive to eolian, sediment, and ground-water inputs.
- The water-body model should consider the temporal and spatial variation as required to simulate critical water quality conditions and processes.
- The model should be sensitive to trophic dynamics and exchanges between trophic levels.
- The water-body model should predict the trophic state using existing empirical relationships already developed for Florida lakes.

Model Selection

Dames and Moore, Inc., was selected to develop the district's LWWM. The district also established a modeling technical advisory committee (TAC) composed of various recognized modeling and GIS experts from other agencies, academia, and private consulting firms. The primary goal of the TAC was to aid the district and its consultant in finalizing modeling goals and the list of desirable model attributes to be used in an evaluation of existing candidate models. One of the initial tasks accomplished by Dames and Moore was a literature and model comparison report (1) with recommended models to be used in the proposed LWWM. This review focused on model capabilities with regard to the overall LWWM project objectives and did not include a rigorous investigation of the background and theory behind each model.

Dames and Moore, following the examples of Basta and Bower (2) and Donigian and Huber (3), developed specific evaluation criteria to objectively review candidate models consistent with district objectives. Dames and Moore, with the aid of the TAC and before identifying available models, developed four criteria to be used on a preselection basis to identify candidate models for further consideration:

- The models must have written documentation.
- The models must be maintained, either formally (i.e., funded model caretaker) or informally (through active use and application).
- The models must be PC based or have the capability of being easily transportable to the PC environment.
- The models must be nonproprietary.

Based on the above criteria and considering district requirements for review of certain specifically named models, a first-cut list of candidate models was developed followed by a final list of candidate models (Table 1).

The modeling TAC was relied on heavily to eliminate models from further consideration and ultimately arrived at the two selected models, SWMM and WASP4. The rationale for eliminating certain models is detailed by Dames and Moore (1); it was decided that the modeling system should rely on a single watershed model. After considerable discussion, certain models were

Table 1. List of Final Candidate Models Evaluated by Dames and Moore, Inc., for Possible Incorporation in the SWFWMD's Linked Watershed/Water-Body Model System (1)

Watershed Models	Water-Body Models
AGNPS	BATHTUB
ANSWERS	BETTER
CREAMS	CE-QUAL-R1
DR3M-QUAL	CE-QUAL-W2
EPA-FHWA	HSPF
EUTROMOD	NUTRIENT LOADING/TROPHIC STATE (EUTROMOD)
GLEAMS	QUAL2EU
HSPF	WASP4
NPSLAM	WQRRS
STORM	
SWMM	
SWRRB	

eliminated because of their primarily rural or agricultural applicability, other models were eliminated on the basis of limited maintenance, and considerable in-house debate and discussion centered on the advantages and disadvantages of "mechanistic" versus "empirical" type models. Despite its selection, there was concern that SWMM was too complicated to use without extensive training and experience and that this would affect the desirable attribute of being user friendly and easy to apply (or misapply); this was considered a disadvantage common to all "mechanistic" models considered. SWMM is primarily an urban model, and although it has been applied in nonurban areas successfully, the erosion and sedimentation capabilities are not as detailed as most rural or agricultural models. Another disadvantage of SWMM is that subbasins must be defined homogeneously with respect to land use for the water quality routines, and this restriction would limit to some extent the enhancement that could be easily afforded by a GIS linkage (1). Similar type considerations as those mentioned above were used to eliminate candidate water-body models from further consideration.

Eventually, WASP4 was selected as the appropriate "mechanistic" model to complement the watershed loading model. The TAC noted that the model was well maintained, tested, and documented. Although identified as the most complex of the selected water-body models, it was also the most flexible because of its ability to simulate processes, which allows it to be used at either a screening or predictive level depending on the availability of data, the experience of the user, and the objective of the application. Although flexible, the TAC indicated that WASP4 was still perceived as being extremely data intensive (1).

Ultimately, SWMM and WASP4 were selected because these models were determined to be "sufficiently complex to be usable for the most data intensive studies, but have the capability of 'turning off' or 'zeroing out' components such that the model can be made simple. The models are public domain, and both are supported by the EPA. In addition, full documentation is available for both models, and they have each been well tested, including several applications in the southwest Florida area" (1). The models selected were not the best for every application; however, they were considered to be those that best met the objectives of the SWFWMD.

Linked Watershed/Water-Body Modeling System Development

The LWWM incorporates three major environmental modeling components:

- Runoff (point and nonpoint)
- Hydrodynamic/Hydraulic routing
- Time variable water quality modeling

In essence, the LWWM operates as follows:

- It obtains land-use and soil-type information from ARC/INFO coded output.
- It incorporates this information into the runoff component of SWMM.
- SWMM calculates event-driven runoff loads of both point and nonpoint sources.
- The LWWM uses the hydrodynamic model, RIVMOD, to describe the longitudinal distributions of flow in the investigated water body.
- WASP4 incorporates these loads, flow distributions, and water quality information and simulates water-body interactions.

A schematic of the above program linkage is shown in Figure 1.

The LWWM was developed to allow engineers and scientists to rapidly evaluate the effects of both point and nonpoint source loads on receiving waters. The LWWM model obtains land-use information from a GIS that can be used to swiftly generate land-use and soil-type data for the runoff component of the LWWM system, SWMM. The SWMM model calculates event-driven runoff loads for both nonpoint and point sources. This time series of loads and water quantity runoff is then used as input for the receiving water model, WASP4 (EUTRO4). The information generated by the models will be accessible to users via interactive graphs and other user-friendly interfaces.

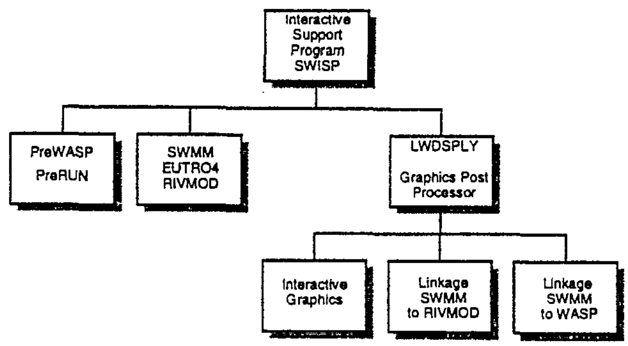

Figure 1. Linked watershed/water-body model (LWWM).

Geographical Information System Interface

A GIS is a computer program used for the entry, management, analysis, and display of geographic or mappable information. GIS systems typically include all of the functions of a computer-aided design (CAD) system, as well as the powerful analytical and modeling capabilities of a full-featured relational database. The power of a GIS lies in its ability to derive problem-solving information from existing data through such techniques as map overlays and modeling, and to store this information in an organized, usable form.

GIS analytical techniques are applied to generate automatically the input data sets for the SWMM watershed model. The software used for development of these data sets is ARC/INFO, an industry-standard GIS from Environmental Systems Research Institute (ESRI). This software is the primary GIS platform in use at the SWFWMD and at all other water management districts throughout the state. Several other federal, state, regional, and local agencies have also adopted ARC/INFO as a standard and are preparing comprehensive geographic databases in this format. The SWFWMD has compiled an extensive geographic database of the entire district in an ARC/INFO format, including detailed coverages for the U.S. Department of Agriculture Soil Conservation Service (SCS) soils, land use and cover, and basin boundaries. These data are compiled using automated ARC/INFO techniques to generate an input data file for the LWWM.

SWMM

SWMM (4) is a comprehensive mathematical model for the simulation of urban water quantity and quality in storm and combined sewer system. All aspects of urban hydrologic and water quality cycles are simulated. SWMM was developed between 1969 and 1971 by a consulting team under contract with the U.S. Environmental Protection Agency (EPA). It was one of the first such models and has been continually maintained and updated. The SWMM model is perhaps the best known and most widely used urban quantity/quality models in existence today.

SWMM simulates real storm events on the basis of rainfall hyetographs, land use, topography and system characterization to predict outcomes in the form of quality and quantity values. SWMM is composed of various computational blocks that can be run as stand-alone programs. The LWWM simplifies this process by selecting the appropriate blocks to run. The blocks used by LWWM and their function are as follows:

- *Runoff block:* Performs hydrologic and water quality modeling with elementary hydraulic routines.
- *Combine block:* Combines interface files to aggregate results of multiple runs.
- *Rain block:* Processes National Weather Service (NWS) precipitation data from magnetic tape or disk.

All other computational blocks within SWMM are either not applicable to the LWWM model or their function is already incorporated within the LWWM (i.e., graphic and tabular processing of output).

The LWWM model uses SWMM Version 4.2 but has been tested successfully with older versions.

RIVMOD Implementation

RIVMOD is a dynamic numerical, hydrodynamic riverine model that describes the longitudinal distributions of flows in a one-dimensional water body through time. The primary criteria for selecting RIVMOD is the need to describe spatially varying flows in a water body through time. The model is applicable to rivers, streams, tidal estuaries, reservoirs, and other water bodies where the one-dimensional assumption is appropriate. RIVMOD solves the governing flow equations in a manner that allows prediction of gradually or highly varying flows through time and space. The model has the capability of handling flow or head as boundary conditions. The specification of head as a boundary condition allows use of the model where an open boundary is required (e.g., an estuary or a river flowing into a lake). Algorithms are employed in RIVMOD to allow it to provide WASP4 with flows, volumes, and water velocities.

WASP Implementation

The WASP4 modeling system (5) was designed to provide the generality and flexibility necessary for analyzing a variety of water quality problems in a diverse set of water bodies. The model considers the hydrodynamics of large branching rivers, reservoirs, and estuaries; the mass transport in ponds, streams, lakes, reservoirs, rivers, estuaries, and coastal waters; and the kinetic interactions of eutrophication-dissolved oxygen and sediment-toxic chemicals.

WASP4 is a dynamic compartment modeling program for aquatic systems, including both the water column and the underlying benthos. The time-varying processes of advection, dispersion, point and diffuse mass loading, and boundary exchange are represented in the basic program. The flexibility afforded by the Water Quality Analysis Simulation Program is unique. WASP4 permits the modeler to structure one-, two-, and three-dimensional models; allows the specification of time-variable exchange coefficients, advective flows, waste loads, and water quality boundary conditions; and permits tailored structuring of the kinetic processes, all within the larger modeling framework, without having to write or rewrite large sections of computer code.

WASP4 simulates the movement and interaction of pollutants within the water using two programs to simulate two of the major classes of water quality problems: conventional pollution (involving dissolved oxygen, biochemical oxygen demand, nitrogen, phosphorus, and eutrophication) and toxic pollution (involving organic chemicals, metals, and sediment).

Because of WASP4's generalized framework and dynamic structure, it is relatively easy to link it to other simulation models. WASP4 was modified to read loads from an external file created by SWMM. This allows WASP4 to update its point and nonpoint source loading information daily.

SWMM/WASP Interactive Support Program (SWISP)

SWISP (Figure 2) is an interactive, menu-driven user environment that allows for the easy execution of the LWWM system of programs. SWISP allows you to view and edit WASP/RIVMOD/SWMM input datasets as well as execute and postprocess the results. SWISP is the Windows of the LWWMs; once the user executes SWISP, the user can perform all functions related to all the simulation models. SWISP provides file management, which allows the user to select a file or a set of

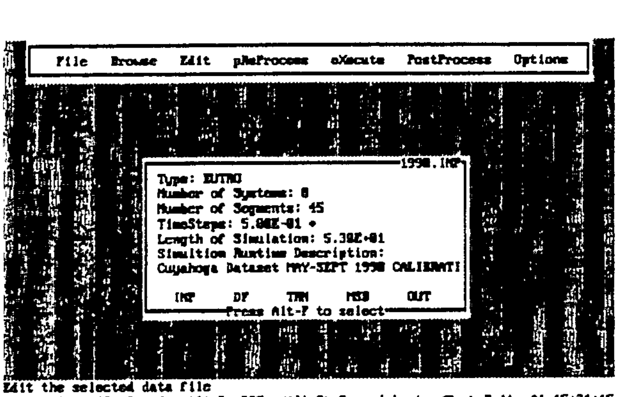

Figure 2. SWMM/WASP Interactive Support Program (SWISP).

files to activate for manipulation and/or execution. SWISP automatically loads the correct simulation model based on the type of input dataset selected; upon execution of the model, SWISP provides the input data file names that will be executed. When the simulation is completed, SWISP is automatically reloaded so that the results may be postprocessed.

SWMM Runoff Preprocessor (PreRUN)

The PreRUN program (Figure 3) was developed to aid the user in the development of SWMM RUNOFF block input datasets (SWMM Version 4.2x and higher). PreRUN provides intuitive data entry forms that successful guide the user through the development of syntactically correct datasets. Additionally, the PreRUN program can import a GIS file that is created before executing the preprocessor. The GIS interface file provides soil-type and land-use classifications to the PreRUN program so that the user can quickly give parameters to the SWMM Runoff block. PreRUN is designed to work with or without the GIS interface file.

Landuse WorkSheet

		Land Use Delineation (%)					
		Hi Residen	Me Residen	Lo Residen	Agricultur	Industrial	
ID	Area	1	2	3	4	5	Total
(No)	(acres)	%	%	%	%	%	%
Land Use Worksheet							
90001	[illegible]	3.46	5.78	33.78	49.63	6.87	99.44
90002	417.15	4.27	6.53	69.86	9.68	8.34	89.88
90003	623.81	25.18	19.86	34.54	17.94	2.28	99.88
90004	748.88	12.45	19.56	38.14	21.65	7.56	99.36
90005	911.72	48.44	14.98	27.98	7.74	8.53	99.59
90006	535.13	13.78	16.78	•24.77	37.83	6.65	99.73
90007	76.31	8.88	4.87	45.73	28.57	8.88	78.37
90008	881.75	34.88	21.15	19.89	21.48	3.31	99.83
90009	235.52	25.86	15.38	28.31	38.18	8.24	99.17
90010	346.85	3.46	5.78	33.78	49.63	6.87	99.44
90011	417.15	4.27	6.53	69.86	9.68	8.34	89.88
90012	623.81	25.18	19.86	34.54	17.94	2.28	99.88
90013	748.88	12.45	19.56	38.14	21.65	7.56	99.36
90014	911.72	48.44	14.98	27.98	7.74	8.53	99.59
90015	535.13	13.78	16.78	24.77	37.83	6.65	99.73
90016	76.31	8.88	4.87	45.73	28.57	8.88	78.37

Sub-basin area in acres

Figure 3. SWMM Runoff Preprocessor (PreRun).

The power of the PreRUN preprocessor lies in its ability to import a GIS interface file. The GIS file contains land-use and soil classification data for user-delineated watershed subbasins; this information is used by PreRUN to develop area weighted calculations for the SWMM model.

PreWASP Interactive Preprocessor (PreWASP)

The PreWASP program (Figure 4) aids the user in the development of a WASP4 eutrophication input dataset. The preprocessor provides predefined environments (ponds, lakes, rivers, estuaries) that can be modified to match site-specific geometries, or the user may elect to build one from scratch. The PreWASP program allows the user to rapidly develop an input dataset by providing forms that can be filled out quickly using several "Quick Fill" edit functions. The PreWASP program allows the user to select the level of complexity at which to apply

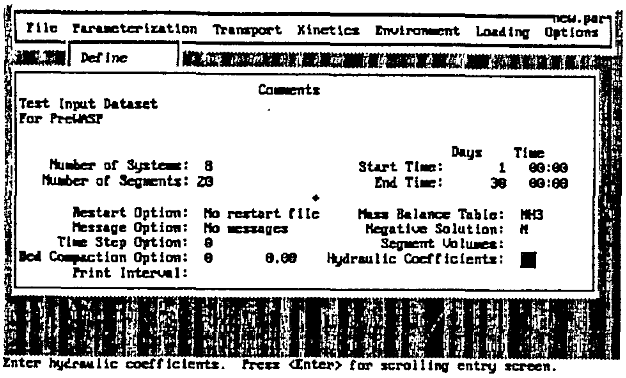

Figure 4. PreWASP Interactive Processor (PreWASP).

the model and provides data forms that are needed to accomplish that level of complexity.

Linked Water-Body/Watershed Postprocessor (LWDSPLY)

The interactive graphical postprocessor LWDSPLY allows the user to rapidly visualize the results of WASP, RIVMOD, DYNHYD, and SWMM simulations. LWDSPLY and SWISP are the only software needed to process the large array of result files that can be produced from simulations of the models contained in the LWWM. LWDSPLY allows the user to view the results both graphically and tabularly and has options for exporting data to spreadsheets. LWDSPLY has the capabilities to process more than one simulation result file at a time (the files must be from the same model), and allows the plotting of up to four graphs on the screen simultaneously. These four plots (view ports) can be manipulated individually to show different results. As with all the programs, context-sensitive help is available at any time within the program by simply pressing F1 for help or ALT-H for a listing of the keyboard map (Figure 5).

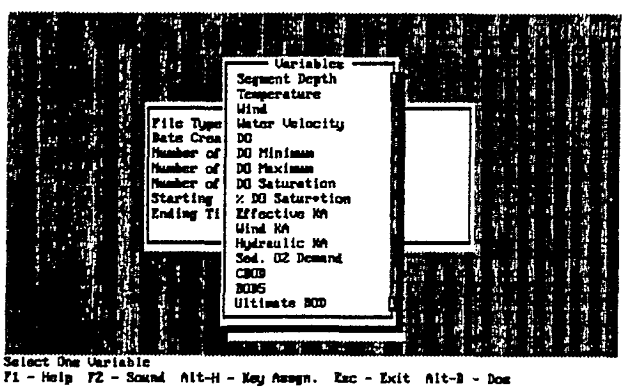

Figure 5. Linked Water-Body/Watershed Postprocessor (LWDSPLY).

The LWDSPLY program allows the user to view (Figure 6), plot, and export information very rapidly. All simulation results can be plotted or written to an ASCII text table or exported to a spreadsheet file. LWDSPLY also provides the algorithms for formatting the output of one model into the input of another.

Linking SWMM to WASP4

SWMM and WASP4 are linked using the LWDSPLY program. The linkage is generic and allows the user to link SWMM results to either the WASP organic or eutrophication model. This linkage is accomplished by creating a SWMM combine block interface using the ASCII combine block option. PreRUN is set to create this file by default. The user must select the WASP4 (TOXI or EUTRO) model with which the SWMM file is to be linked; this allows LWDSPLY to configure itself for the correct output.

Once the appropriate linkage type has been selected, the user is then required to map the appropriate SWMM conduit IDs to WASP segments (Figure 7). Note that you can map more than one conduit's ID to a WASP segment; LWDSPLY will combine the output. LWDSPLY will not check any errors regarding the mapping, so the burden is on the user to fill this table out correctly. The figure below shows the data entry screen for the basin to segment mapping. Note that all the conduit IDs do not need to be mapped out to WASP segments; the user only needs to be concerned with the conduits that affect the water body.

Once the conduit to segment mapping has been completed, the SWMM runoff constituents must be mapped to the WASP4 state variables. The user must map the SWMM state variables to the WASP state variables. The linkage allows the user to fractionate a SWMM state variable to several WASP state variables. The example given below shows the mapping of total nitrogen (calculated by SWMM) into three state variables of WASP's EUTRO4 (NH_3, NO_3, and organic nitrogen). To accomplish this, the user must specify the percentage of the total SWMM constituent runoff mass that will go into each WASP system. This option is presented to the user because SWMM typically calculates mass runoff for total nitrogen and total phosphorus, while WASP needs nitrogen loaded as ammonia, nitrate, and organic nitrogen, as well as phosphorus loaded as orthophosphate and organic phosphorus. There is no error checking done here. The percentages converted can be less than or greater than 100 percent.

When the user is completed with the mapping functions, LWDSPLY will prompt the user for a filename to which to write the nonpoint source interface file. WASP expects the nonpoint source files to have the extension .NPS.

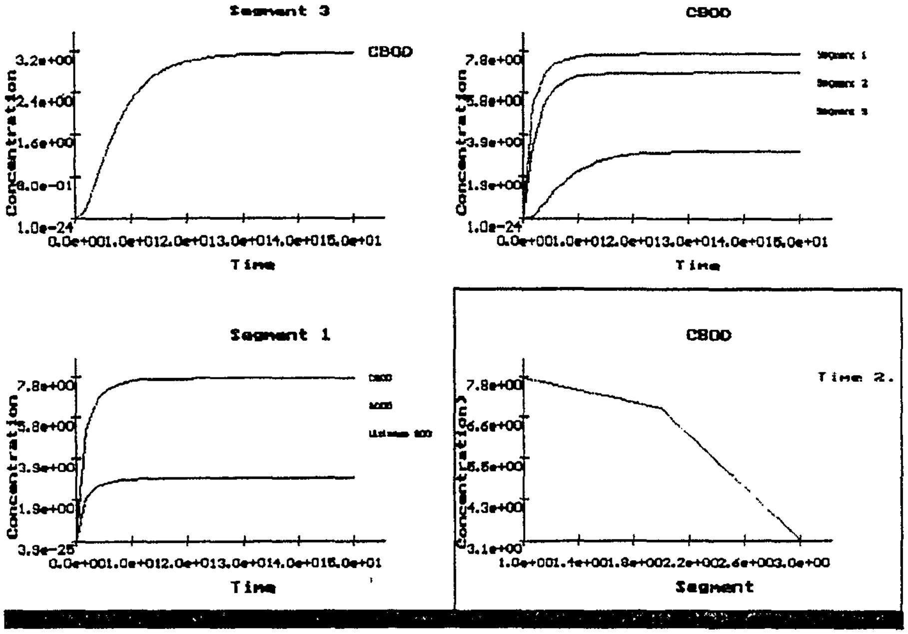

Figure 6. Viewing data in the LWDSPLY.

SWMM Constituent to WASP System Mapping

Variable Name	Number of Systems	System1 Name	Pct1	System2 Name	Pct1	System2 Name	Pct1
Map Variables to Systems							
FLOW CFS	0		0		0		0
Total N	3	NH4	10	NO3	20	ON	70
Total P	2	OPO4	15	OP	85		0
Var3	I		0		0		0
Var4	0		0		0		0
DUMMY VARIAB	0		0		0		0
DUMMY VARIAB	0		0		0		0
DUMMY VARIAB	0		0		0		0
DUMMY VARIAB	0		0		0		0
DUMMY VARIAB	0		0		0		0
DUMMY VARIAB	0		0		0		0
DUMMY VARIAB	0		0		0		0
DUMMY VARIAB	0		0		0		0
DUMMY VARIAB	0		0		0		0
DUMMY VARIAB	0		0		0		0
DUMMY VARIAB	0		0		0		0

Number of Wasp Systems to be mapped to the Swmm Variable (max. 3)

Figure 7. Mapping SWMM conduit IDs to WASP segments.

Model System Application—Lake Thonotosassa, Florida

Study Area Description

Lake Thonotosassa is located in northeast Hillsborough County, Florida (Figure 8). The lake has a surface area of 813 acres, with a maximum depth of approximately 16 feet. It is tributary to the Hillsborough river system, a source of water supply for Tampa, and a part of the Tampa Bay ecosystem providing freshwater to the estuary.

The watershed is approximately 55 square miles and extends east to Plant City and south to Sydney (Figure 8). Elevation in the watershed ranges from 35 ft National Geodetic Vertical Datum (NGVD) along the shoreline of the lake to 145 ft in the eastern section of the catchment. The area in general has relatively mild slopes but is steeper on the eastern section when compared with the southern and western sections. This lake was chosen in part due to the relatively large database available as a result of recently completed diagnostic/feasibility studies (6).

Modeling

Available data included topographic maps, land use, soils, rainfall, wind, solar radiation, water levels, and water quality. These data were utilized in the model setup and calibration processes. Modeling consisted of developing a database linkage from the GIS, watershed modeling with the SWMM model, and water-body modeling with RIVMOD and WASP4. The modeling scenarios are described below.

Digitized land use and soils data were obtained from the SWFWMD on magnetic tapes and downloaded to the Dames and Moore ARC/INFO system. Drainage divides that define subbasins were digitized as an additional overlay. These data provided the basis for developing the *.GDF file, which was linked with the SWMM model via the PRESWMM program package. These maps were directly output from the GIS. In addition, the GIS was used to provide aggregate maps for soils and land use.

The GIS identified 42 land uses at up to Level III for the watershed. SWMM is capable of utilizing five land uses in its watershed modeling. A decision was therefore made to aggregate land uses to provide five classes with similar characteristics. The classes selected were urban, agriculture, open, wetlands, and uplands. To maintain flexibility in redefining aggregates during the

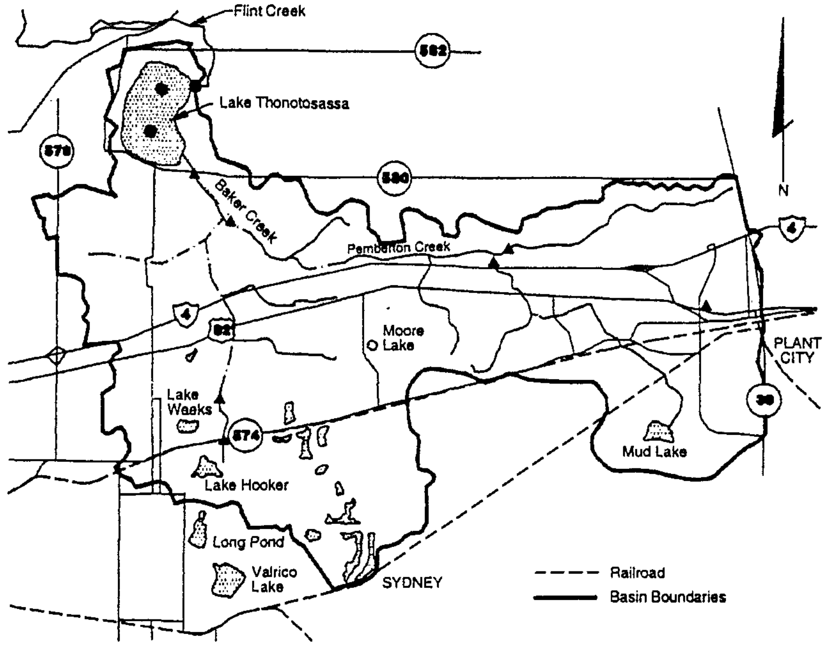

Figure 8. Lake Thonotosassa location map.

modeling process, the unaggregated GIS database served as model input to PRESWMM. PRESWMM then provided the aggregated land-use data for modeling purposes.

SCS soils data on the GIS are more detailed than required for modeling purposes. These data were aggregated in the GIS to provide mapping of hydrologic soil groups A, B, C, or D, as provided by the Hillsborough County soils map and document (7).

The SWMM model (RUNOFF block) was used to simulate both water quantity and water quality inflows to the lake. Before the input file was set up, the watershed was segmented into 34 subbasins. The subbasins were defined by examining topographic, land-use, and soils maps.

To set up SWMM, PRESWMM was used to create an input file consisting of information from the GIS system and user control input (UCI). The GIS system provided land-use and soils information, as previously discussed. These data served as input to PRESWMM, which created the input file for SWMM. In addition, UCIs were input into the PRESWMM interactive program. These UCIs include data on catchment slopes, overland Mannings roughness coefficient (n), evaporation, infiltration rates, basin widths, percent of directly connecting impervious area (DCIA), depression storage, channel slopes, channel lengths, channel geometry, and channel Mannings roughness coefficient (n). Channel basin linkages are also defined so that the model can route flows from the land segment to channels, and from channels to other channels.

After the model was set up, a data period was selected for calibration. The period was from June 11, 1991, to April 24, 1992, and was selected to coincide with available discharge measurement records. The model was calibrated by conducting a series of model runs, comparing simulated and measured data, and adjusting parameters.

The calibration was based primarily on data collected at two stations, LT-4 and LT-5. Station LT-5 is located on Pemberton Creek just upstream of the Baker Creek confluence, which represents 40 percent of the total watershed. The other calibration point is station LT-4, which covers 98 percent of the lake's watershed. The difference in flows between these stations is that contributed by Baker Creek draining the southern portion of the catchment. The final calibration plot for LT-4 is shown in Figure 9.

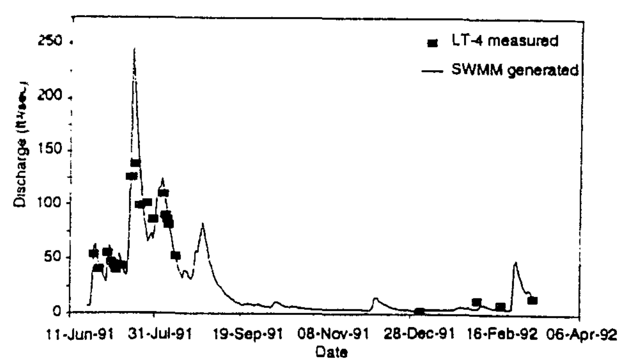

Figure 9. Lake inflow calibration.

The SWMM water quality setup used the same setup as for the water quantity except that coefficients that define buildup/washoff rates and rating curves were added to the routine. The calibration was performed by comparing water quality concentrations for measured and simulated total nitrogen and total phosphorus. The procedure was a sequence of model runs, comparing results, and adjusting parameters.

Water-Body Modeling

Water and pollutant loading inflows generated by SWMM were used as input to the lake, and the lake water quality was simulated. The following two models were used: 1) RIVMOD was used to simulate the dynamics of the inflows, outflows, and change storage in the lake, and 2) EUTRO4 used the simulated hydrodynamics and relevant quality parameters to simulate the lake's water quality.

Sources of pollutants to the lake were identified, with emphasis on nutrient loading. An in-lake model was applied by utilizing ambient water quality data and flows and pollutant loadings from the watershed to model current in-lake processes. The model was calibrated for nitrogen, phosphorus, and chlorophyll-*a*. WASP4 was the lake model used in simulating the in-lake processes.

The lake and inlet channel was subdivided into 10 segments. Four of the segments were in the inlet channel (Baker Creek). These segments were included to allow some flexibility in modification, if necessary, of the nutrient input to the lake during the lake water quality calibration process. The lake had six segments; this was believed to be adequate considering that there were only two water quality data collection stations. The final segment represents the lake outflow point. The segmentation is shown in Figure 10.

The eutrophication water quality model (EUTRO4) was set up as a system of 10 water column segments (Figure 10) to coincide with the hydrodynamic setup. Model time step was one day, with simulation for all eight systems of the WASP4 Intermediate Eutrophication Kinetics package. The eight systems are ammonia, nitrate+nitrate, orthophosphate, chlorophyll-*a*, biochemical oxygen demand, dissolved oxygen, organic nitrogen, and organic phosphorus. Water column segments interact with each other both by advective flows and diffusive exchange.

The SWMM model generated loads of total nitrogen, total phosphorus, and biochemical oxygen demand (BOD). For water quality modeling, data on nitrate-nitrate nitrogen, organic nitrogen, ammonia nitrogen, orthophosphate, and organic phosphorus were required. These constituents were estimated by applying stoichiometric ratios obtained from the data collected during the extensive data collection period. Loads of

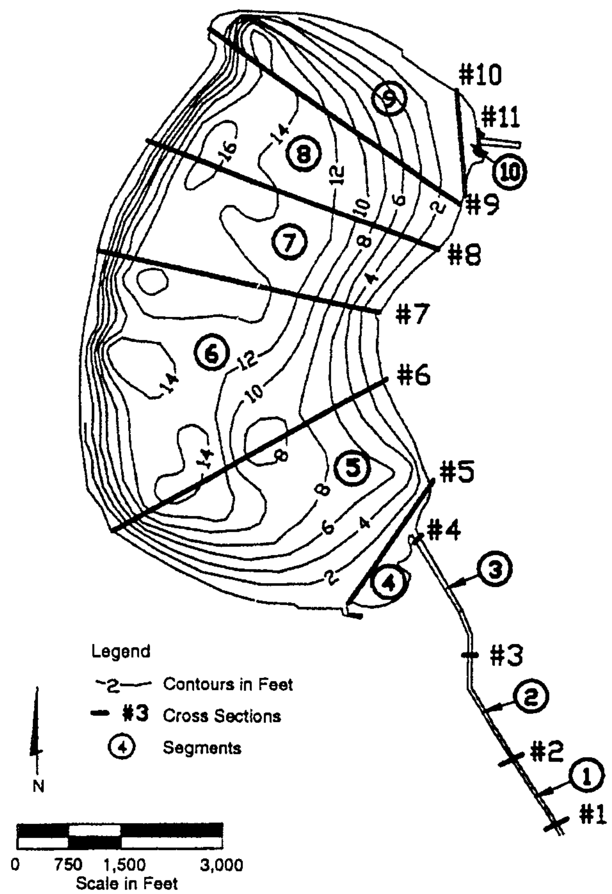

Figure 10. Lake Thonotosassa modeling segmentation and bathymetric map.

dissolved oxygen were also included in the model. These were obtained by applying monthly dissolved oxygen data to SWMM simulated flows.

Seven environmental parameters were included in the setup. The parameters defined values for salinity, segment temperature, ammonia flux, phosphate flux, and sediment oxygen demand. Salinity and temperature were derived from field measurements. Some of the constants associated with the environmental parameters were pointers used in combination with various time functions to define time series of water temperature, solar radiation, fraction daylight hours, and wind velocity. Time series of water temperature, solar radiation, and wind velocity were derived from the available data discussed above. Fraction of daylight hours was obtained from latitude-dependent information presented in Chow (8).

Initial constituent concentration was based on the measurements of June 26, 1991, and initial model time. Organic phosphorus was assumed to be the difference between total phosphorus and orthophosphate. It is recognized, however, that organic phosphorus may be overestimated because of particulate forms of inorganic phosphorus. Organic nitrogen was calculated from total Kjeldahl nitrogen and ammonia.

The model was set up with the constants required for eutrophication simulation. Values for these constants were derived primarily from the literature (9), although some field measurements were used as guidance to determine constants. These constants were primarily calibration factors.

Calibration was accomplished by adjusting constants within reasonable limits until a satisfactory fit between measured and simulated data was obtained (Figures 11 to 13). In some instances, although the model fit was by no means perfect, the model was considered calibrated within the constraints of the various estimates of inflows and environmental parameters. Constraints were associated with each of the eight systems in the eutrophication package: ammonia, nitrate-nitrate, orthophosphate, phytoplankton, BOD, dissolved oxygen, organic nitrogen, and organic phosphorus. Ammonia, nitrate-nitrate, and organic nitrogen are subsystems of the nitrogen cycle; orthophosphate and organic phosphorus are subsystems of the phosphorus cycle; and BOD and dissolved oxygen are subsystems of the dissolved oxygen balance. All systems interact.

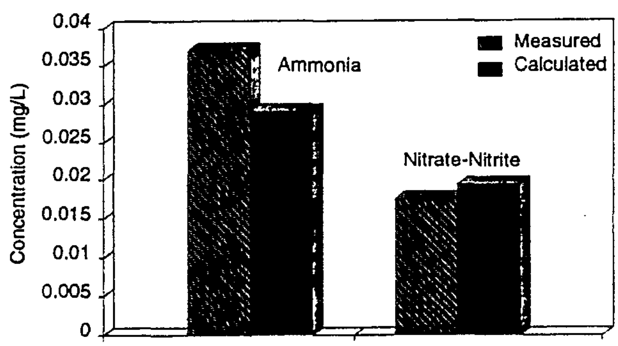

Figure 11. Ammonia and nitrate-nitrite calibration, Lake Thonotosassa.

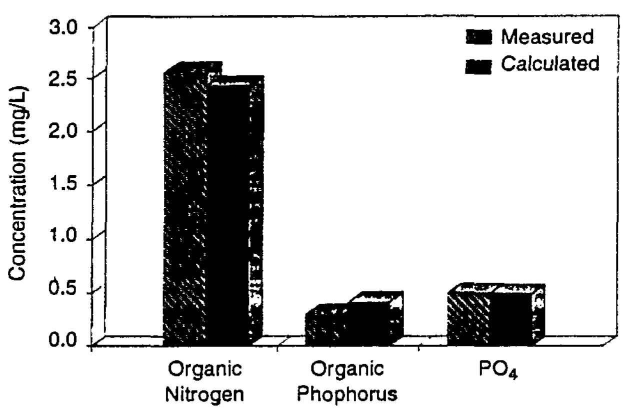

Figure 12. Organic nitrogen, organic phosphorus, and PO4 calibration, Lake Thonotosassa.

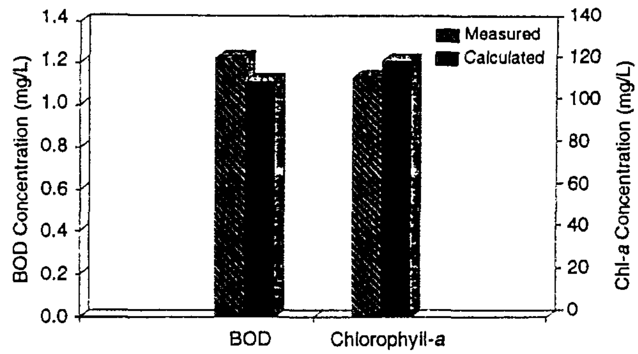

Figure 13. BOD and chlorophyll-*a* calibration, Lake Thonotosassa.

Summary

The development and model components of the LWWM system and its user environment, SWISP, have been described. The LWWM has been applied to Lake Thonotosassa and its watershed. Water quantity and quality originating from the watershed were modeled as pollutant loading to the lake. In-lake processes were then simulated. Refinements are being made to the LWWM system in anticipation of project completion in September 1993. The resultant modeling system will be tested on two other systems, one a river flowing into an estuary (i.e., Little Manatee) and one a series of 19 interconnected lakes (i.e., the Winter Haven chain of lakes). It is anticipated that the resultant modeling system will become the district standard for eutrophication modeling of its surface water bodies. The final code and user's manual for SWISP will be public domain, and it is hoped that this modeling system will be used by other water resource managers in developing pollutant load reduction strategies for their water bodies.

References

1. Dames and Moore, Inc. 1992. Linked watershed/water-body model development literature review. Prepared for the Surface Water Improvement and Management (SWIM) Department, Southwest Florida Water Management District, Tampa, FL.

2. Basta, D.J., and B.T. Bower, eds. 1982. Analyzing natural systems. Washington, DC: Resources for the Future, Inc.

3. Donigian, A.S., Jr., and W.C. Huber. 1990. Modeling of nonpoint source water quality in urban and nonurban areas. Contract No. 68-03-3513. Prepared for the U.S. Environmental Protection Agency, Environmental Research Laboratory, Athens, GA.

4. Huber, W.C., and R.E. Dickinson. 1988. Storm Water Management Model, Version 4: User's Manual. Prepared for the U.S. Environmental Protection Agency, Environmental Research Laboratory, Athens, GA.

5. Ambrose, R.B., T.A. Wool, J.L. Martin, J.P. Connolly, and R.W. Schanz. 1991. WASP4, a hydrodynamic and water quality model: Model theory, user's manual and programmer's guide. Prepared for the U.S. Environmental Protection Agency, Athens, GA.

6. Dynamac Corporation. 1992. Final report: Lake Thonotosassa *diagnostic feasibility study. Prepared for the Southwest Florida* Water Management District, Tampa, FL.

7. U.S. Department of Agriculture Soil Conservation Service. 1989. Soil Survey of Hillsborough County, Florida.

8. Chow, V. 1964. Handbook of applied hydrology. New York, NY: McGraw-Hill.

9. U.S. Environmental Protection Agency. 1985. Rates, constants, and kinetic formulations in surface water quality modeling.

AUTO_QI: An Urban Runoff Quality/Quantity Model With a GIS Interface

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Abstract

This paper describes the development and application of the AUTO_QI model, which the authors developed at the Illinois State Water Survey in Champaign, Illinois. The paper includes background information on the Illinois Urban Drainage Area Simulator (ILLUDAS), on which AUTO_QI is hydrologically based. AUTO_QI stands for AUTOmated Quality-ILLUDAS. The model is automated in the sense that it includes an optional geographic information system (GIS) interface using ARC/INFO software. The Quality-ILLUDAS portion of the name indicates that the model simulates quality as well as quantity of runoff from an urban area.

AUTO_QI uses a continuous simulation of soil moisture to provide reliable estimates of antecedent moisture conditions for the simulation of selected runoff events. The soil moisture simulation requires a continuous precipitation record for the period of interest. The user may then specify some base rainfall above which the runoff volume and pollutant loading are then simulated for each event in the record. The resulting series of runoff volumes or pollutant loadings may then undergo statistical analysis. For each catchment in the study area, the user must provide soils and land cover information as well as buildup and washoff factors for each pollutant of interest. The model can simulate multiple drainage outfall points for a given rainfall record and group the results for different receiving waters. The user may incorporate specific best management practices (BMPs) into the simulation for comparison of loadings with and without BMPs. The paper also discusses use of the GIS interface including processing of remotely sensed data.

Introduction

Models for simulation of urban runoff hydrographs such as the Illinois Urban Drainage Area Simulator (ILLUDAS) (1), Stormwater Management Model (SWMM) (2, 3), and Storage, Treatment, Overflow, Runoff Model (STORM) (4) have been used for some time. Their wide usage reflects their reliability for stormwater drainage design. Models that incorporate urban runoff water quality are available but are less common. The main reasons for this are:

- The water quality component is less reliable.
- The models require extensive input data.
- The models lack verification.

The relatively infrequent use of a water quality component is unfortunate because urban water quality modeling is a convenient tool for assessing pollutant loadings. Considering the high cost of monitoring and the lack of extensive data for using a statistical approach, the proper model with field data verification is a logical and feasible method for water quality assessments.

The principal investigators have developed an approach (5) that greatly reduces the cost of applying a deterministic model Q-ILLUDAS (6) to a relatively large area. This approach incorporates the ARC/INFO geographic information system (GIS) for data management. The savings comes from automation of input files. Readily available automated data include the U.S. Geological Survey (USGS) LUDA Level II land use data and the U.S. Census Bureau's DIME or TIGER/LINE file for population, housing, and street density. The streams, soils, and other data are also available in the Illinois and other state and federal GIS databases. This method is very effective for simulating regional urban runoff loadings that involve large databases and multiple outfalls. The model and GIS interface are known as AUTO_QI.

Literature Review

Shaw (7) describes the special hydrologic problems of urban runoff as follows. The problem of estimating runoff from storm rainfall depends on the character of the catchment surface. The degree of urbanization (extent of impervious area) greatly affects the volume of runoff obtained from a given rainfall. Retention of rainfall by initial wetting of surfaces and absorption by vegetation and pervious areas reduces the amount of storm runoff. These surface conditions also affect the time distribution of the runoff. Computational methods used to obtain runoff from the rainfall should allow for the characteristics of the surface area to be drained. Thus, the first efforts in urban runoff modeling were to relate runoff from storm rainfall to the catchment characteristics.

The first stormwater sewer design method was the rational method by Kuchling (8). Sherman (9) introduced the unit hydrograph method. After the development of digital computers, early urban hydrologic models were developed, such as those by James (10), Papadakis and Preul (11), Terstriep and Stall (1), and McPherson and Schneider (12). One characteristic of urban runoff is that during the early minutes of a storm, urban runoff mainly derives from the impervious surfaces. Contributions from the pervious portion of the basin are highly variable and more difficult to define. Other research results may be found in Novotny and Chesters (13), Hann et al. (14), and Shaw (7).

Many conducted early urban runoff water quality modeling research, including Sartor and Boyd (15), Hydrologic Engineering Center (4), McPherson (16), Sutherland and McCuen (17), U.S. EPA (18-20), and Noel and Terstriep (6). Donigian and Huber (21) prepared a comprehensive review of modeling of nonpoint source water quality in urban and nonurban areas. Other reviews that consider surface runoff quality models include Feldman (22), Huber and Heaney (23), Kibler (24), Whipple et al. (25), Barnwel (26, 27), Huber (28, 29), Bedient and Huber (30), and Viessman et al. (31).

Table 1. Urban Runoff Quality Model

Model	Authors	Year
QUAL-II	Hydrologic Engineering Center	1975
SWMM	Huber et al.	1975
STORM	Hydrologic Engineering Center	1977
MUNP	Sutherland and McCuen	1978
Q-ILLUDAS	Noel and Terstriep	1982
QQS	Geiger and Dorsh	1980
HSPF	Johanason et al.	1980

Table 1 shows a partial list of urban water quality models.

For a detailed description of each of the models, the reader may review the respective references. This section will limit its discussion to the deposition and accumulation of pollutants on impervious surfaces and removal of solids from the street surface.

As reported by Sonnen (32), the state of the mathematical urban water quality model was fairly dismal a decade ago. Little has changed since then because the physical processes are so complex that they defy efforts to reduce them to mathematical statements. Consequently, semiempirical methods are often used.

Deposition and Accumulation of Pollutants on Impervious Surfaces

As described by Novotny and Chesters (13), the primary sources of pollutants are wet and dry atmospheric deposition, litter, and traffic. Pollutants deposited on the surface during a dry period can be carried by wind and traffic and accumulate near the curb or median barrier. Thus, many studies report the street pollutant loading by unit length of curb.

The street refuse that runoff washes to storm sewers contains many contaminants. Significant amounts of organics, heavy metals, pesticides, and bacteria are commonly associated with street refuse. Factors that affect the pollutant accumulation rates are atmospheric fallout, wind, traffic, litter deposition, vegetation, and particle size distribution.

Pollutant accumulation in an urban area has a significant random component; thus, no mathematical model yields totally reliable results. Consequently, one common concept used is the storage-input-output schematic approach, which assumes that the amount of accumulated pollutants on a surface can be described as a simple mass balance formula:

$$dP/dt = A - r \qquad \text{(Eq. 1)}$$

where

A = pollutant accumulation rate (lb/day)
r = pollutant removal rate (lb/day)
P = amount of street refuse or dust/dirt present on the street (lb)
t = time in days

Integrating Equation 1, then:

$$P = A/r\,[1 - \exp(-rt)] + C \qquad \text{(Eq. 2)}$$

where

exp = exponential function
C = undefined constant

Using the empirical data from U.S. EPA (33), the parameters were defined for the Washington, DC, area as follows:

$$A = (ATMFL + LIT)\,(SW/2) + 1.15\,TD$$

$$r = 0.00116 \exp [0.0884 (TS + WS)]$$
$$C = 0$$

where

ATMFL = atmospheric fallout rate (g/m²/day)
LIT = litter deposition rate (g/m²/day)
SW = street width (m)
TD = traffic density (thousand axles/day)
TS = traffic speed (km/hr)
WS = wind speed (km/hr)

Sutherland and McCuen (17) made another attempt by developing a set of refuse accumulation functions using average daily traffic volume and pavement condition expressed by the present serviceability index (PSI). The results are a set of accumulation equations in terms of these input factors.

The accumulation of street refuse is the main pollution source in urban areas. Novotny and Chesters (13) reported on typical urban street refuse. Table 2 also presents findings from research on this topic.

The Chicago results indicate that multiple-family areas generate about three times more street dirt than single-family areas. The commercial and industrial areas generate about five and seven times more than the single-family areas.

The street refuse accumulation rate based on the eight American cities (15, 35) is two to four times higher than the Chicago dust/dirt accumulation rate. This reflects the wide variations in pollutant accumulation rates in existing measured field data for different cities.

Refuse Washoff by Surface Runoff

When surface runoff occurs on impervious surfaces, the splashing effect of rain droplets and the drag forces of the flow put particles in motion. Sedimentation literature includes many hydraulic models that are potentially applicable to the problem of particle suspension and transport. Two models used frequently in urban runoff modeling are described below.

Yalin Equation

Of numerous equations published in the literature, the Yalin equation (36) is probably one of the best for describing suspension and transport of particles by shallow flow typical for rills and street gutters. The equation has been reported in the following form:

$$p = 0.635\, s\, [1 - \ln (1 + as) / (as)] \qquad \text{(Eq. 3)}$$

where

p = particle transport per unit width of flow (g/m/sec)
$s = (Y/Ycr) - 1$
$a = 2.45 r_s^{-0.4} \sqrt{Ycr}$
ln = natural log function

The variables are defined as follows:

Y = particle bed load tractive force $= \dfrac{\mu^*}{[(\rho_s - 1)gD]}$
ρ_s = particle density (g/c-cm³)
Ycr = the critical tractive force at which sediment movement begins (newton/m²)
D = particle diameter (m)
μ^* = sheer velocity (m/sec)
g = gravity acceleration (m/sec²)

Based on Yalin's equation, Sutherland and McCuen (17) developed a washoff model. The model is based on the relationship between percentage removal of total solids in a particle range (0.001 to 1.0 mm) due to a total rainfall volume of 1/2 in. and correlation factor Kj such that:

$$TSj = Kj\,(TSi) \qquad \text{(Eq. 4)}$$

where

TSj = percentage removal of total solids in a particle range due to total rainfall volume j, measured in mm

Table 2. Street Refuse Accumulation

	Solids Accumulation			
	Chicago (34) Dust and Dirt		Eight American Cities (15, 35) Total Solids	
Land Use	g/curb miles/day	lb/acre/day	g/curb miles/day	lb/acre/day
Single family	10.4	2.1[a]	48	9.5[a]
Multiple family	34.2	6.8[a]	66	13.1[a]
Commercial	49.1	9.7[a]	69	13.7[a]
Industrial	68.4	13.5[a]	127	25.1[a]

[a]The curb density in Chicago and eight American cities was assumed by the authors to be 90 m/acre.

Kj = factor relating TSj and TSi
TS = percentage removal of total solids in the particle range due to a total rainfall of 1/2 in.

Sartor et al. Washoff Function

The Sartor et al. washoff function is based on the first-order washoff function (15, 35):

$$dP/dt = - Ku\ r\ P \qquad \text{(Eq. 5)}$$

where

P = amount of solids remaining in pounds
t = time in days
Ku = constant depending on street surface characteristics (called urban washoff coefficient)
r = rainfall intensity (in./hr)

The constant Ku was found independent of particle size within the studied range of 10 to 1,000 μm. The integrated form of the equation can be expressed as:

$$P_t = P_o\ [1 - \exp\ (-Ku\ r\ t)] \qquad \text{(Eq. 6)}$$

where

P_o = initial mass of solids in the curb storage
P_t = mass of material removed by rain with duration t
exp = exponential function

In spite of the Sartor concept's highly empirical nature and arbitrarily chosen constants, many urban runoff models such as SWMM (2, 3) and STORM (4) have incorporated it.

AUTO_QI Model

Model Overview

AUTO_QI actually comprises three programs known as HYDRO, LOAD, and BMP. These programs run in series, each using output from the previous program as input along with additional information from the user. HYDRO performs a continuous simulation of soil moisture based on a daily and hourly rainfall record that the user provides. It also computes runoff volume for each event above some user-specified rainfall amount. LOAD uses these runoff volumes along with additional pollutant accumulation and washoff information to calculate pollutant loadings for each runoff event. The BMP program then reduces these loadings in accordance with user-specified best management practices (BMPs) and reports the results both with and without BMP conditions. The simulation process may be examined by looking at wet and dry periods.

Runoff

Runoff may only occur during a "wet period," a day during which rainfall occurs. During these potential runoff periods, the model requires hourly rainfall amounts. The basin is assumed to have three types of area: directly connected paved area, supplemental paved area, and contributing grassed area. As the name implies, runoff from the directly connected paved area flows directly to the storm system. Runoff from the supplemental paved area flows first across the grassed area and is thus subjected to infiltration losses. The remainder of the basin is assumed to be grassed area, so all rain falling on this surface is also subjected to infiltration losses.

Paved Area Runoff

The model distinguishes between directly connected paved area and supplemental paved area. The losses from directly connected paved area consist of initial wetting and depression storage. These losses are combined and treated as an initial loss; they are subtracted from the beginning of the rainfall pattern. After subtracting these losses from the rainfall pattern, the remainder of the rainfall appears as effective rainfall and thereby as runoff from the paved area.

Grassed Area Runoff

Computation of grassed area runoff includes runoff from the supplemental paved area because both are subjected to infiltration. As in the case of paved area runoff, rainfall is the primary input for grassed area runoff calculations. The modifications that must change the rainfall pattern to grassed area runoff are much more complex than in the paved area case. The procedure followed here first adds in supplemental paved area runoff, then subtracts initial and infiltration losses.

In this model, rainfall on the supplemental paved area is simply distributed by linear weighting over the entire grassed area, thereby modifying the actual rainfall for grassed areas such that:

$$R' = R\ (1.0 + SPA/CGA) \qquad \text{(Eq. 7)}$$

where

R′ = effective rainfall on the grassed area
R = actual rainfall
SPA = supplemental paved area
CGA = contributing grassed area

In an urban basin, bluegrass turf most often covers the area that is not paved. When rain falls on this turf, there are two principal losses. The first is associated with depression storage and the second with infiltration into the soil. In this model, depression storage fills and maintains, and infiltration is satisfied before any runoff takes place. Depression storage is normally considered to be 0.20 in., but the model provides for this to be varied.

The dominant and far more complex loss of rainfall on grassed areas is caused by infiltration. The theoretical approach to evaluating infiltration rates uses the physical properties of the soil to estimate the water storage available in the soil mantle, and evaluates the role of this water storage as rain water infiltrates into and through the soil mantle. The original ILLUDAS manual provides details of water storage in soil and infiltration rates through soil. The following text offers only brief descriptions.

Water Storage in Soil

The amount of water that the soil mantle can store depends on the total pore space available in the soil between the soil particles. This model divides the total water stored in the soil mantle into two principal parts. The first of these is gravitational water. This is the water that will drain out of soil by gravity. The second is evapotranspiration (ET) water. This is the water that plants can remove through evapotranspiration.

Soil moisture storage capacity varies with soil type and may be classed by hydrologic soil group. This model considers seven hydrologic soil groups. The U.S. Soil Conservation Service describes the hydrologic soil groups as follows:

A = low runoff potential and high infiltration rate (consists of sand and gravel)
AB = soil having properties between soil types A and B
B = moderate infiltration rate and moderately well drained
BC = soil having properties between soil types B and C
C = slow infiltration rate (may have a layer that impedes downward movement of water)
CD = soil having properties between soil types C and D
D = high runoff potential and very slow infiltration rate (consists of clays with a permanent high water table and high swelling potential)

Appendix B supplies default values of soil moisture storage capacity for different soil types. Users can change these values to suit their own experience. For further references, see Eagleson (37) and Richey (38).

Infiltration Rate

Knowing the water storage available for infiltration within a soil mantle makes it possible to compute the infiltration rate at any time from the Horton equation, as given by Chow (39):

$$f = f_c + (f_0 - f_c)\ \exp(-kt) \qquad \text{(Eq. 8)}$$

where

f_c = final infiltration rate (in./hr)
f_0 = initial infiltration rate (in./hr)
k = shape factor
t = time from start of rainfall (hr)
exp = exponential function

This equation is solved by the Newton-Raphson technique for given f_c and f_o values that depend on soil properties supplied by the user. A shape factor (k) of 2 was used to provide the shape best reflecting natural conditions.

The total amount of infiltration during a storm event depends on the total amount of soil moisture (ET water and gravitational water) in storage. The higher the amount of available soil moisture, the lower the amount of infiltration, and vice versa. This model distributes the total amount of infiltration among ET storage and gravitational storage in a preassigned 60:40 ratio. AUTO_QI continuously simulates soil moisture so that a reliable soil moisture is available at the beginning of any event.

During dry periods, the model operates on two different time steps: daily if there is no rainfall on the current day and hourly if there is rainfall at some time during the current day. During dry periods, depression storage and soil moisture depend on:

- Evaporation, at a user supplied rate, from depression storage.
- Infiltration from depression storage, with the infiltration volume separated in a 60:40 ratio into ET water and gravitational water.
- Evapotranspiration, at a user specified rate, from ET water storage.
- Percolation, at a constant rate f_c, from gravitational water storage.

Spatial Distribution of Runoff Processes

The model assumes all of the wet period and dry period processes are spatially distributed, and simulates by the use of a triangular distribution. Figure 1(a) shows a distribution assumed to vary linearly from zero to twice

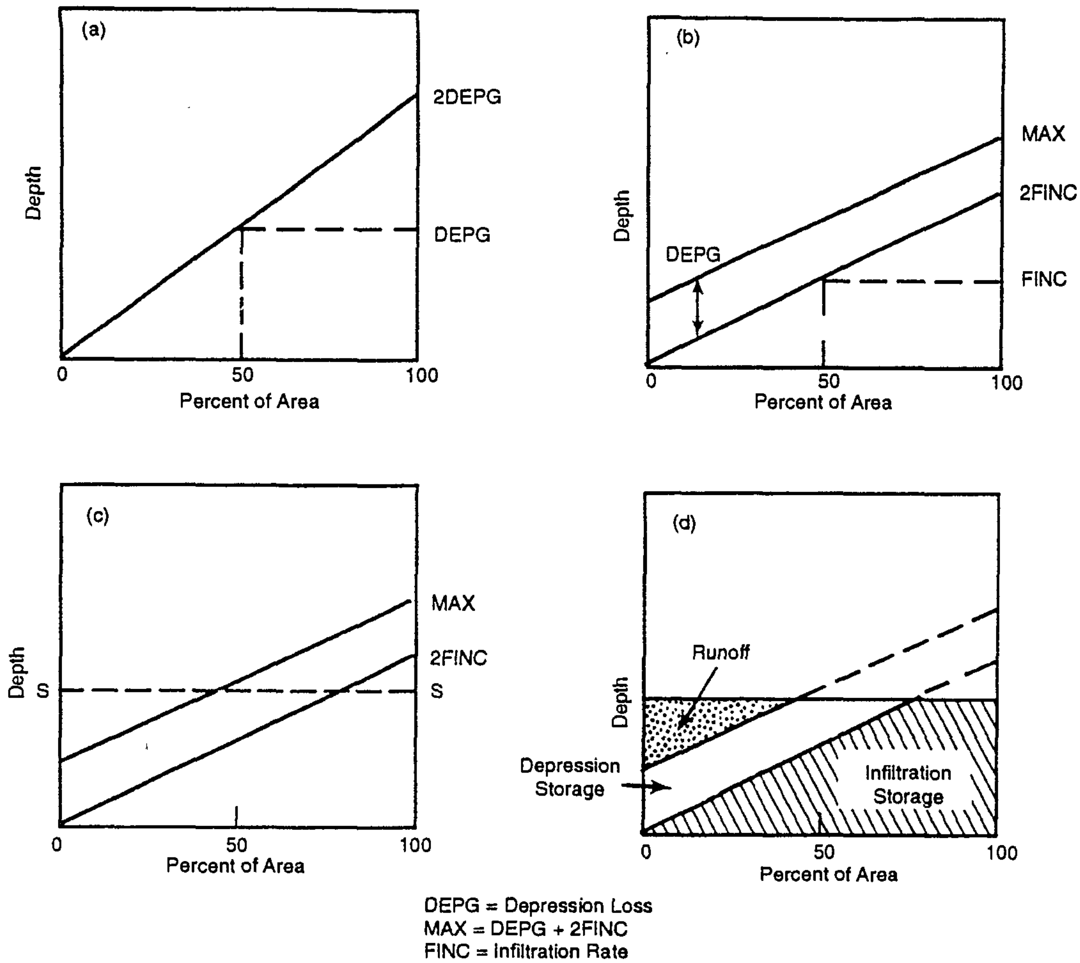

Figure 1. Triangular spatial distribution of runoff.

the user-specified mean value over the subcatchment area. DEPG, as an example, is the mean pervious depression storage. Figure 1(b) shows the concurrent processing of depression storage and infiltration potential. Although both filling of depression storage and infiltration are assumed to be spatially distributed, they are also assumed to be totally independent of one another physically. Depression storage may therefore have a uniform distribution with respect to infiltration potential.

The concurrent processing of infiltration and depression storage, Figures 1(c) and 1(d), assumes that infiltration potential varying from zero to 2FINC is satisfied for a particular level of supply, S, before considering depression storage. The supply rate S is defined as the sum of the rainfall and the uniformly distributed volume of depression storage at the start of the interval. The volume below S and between curves 2FINC and MAX represents the moisture supply to depression storage in the interval and is processed according to the above discussion of Figures 1(a) and 1(b). The volume remaining below S and above the curve bounded by MAX is the surface runoff volume for the hour.

Pollutant Generation

After generating an effective hyetograph for both pervious and impervious areas, these rainfall depths are supplied as input to the program LOAD. LOAD then generates the washoff of different pollutants from the storm event. LOAD uses linear accumulation and exponential washoff equations. The user supplies the number of pollutants and associated characteristics such as daily accumulation rate and daily removal rate.

Dry Periods

One form of mass balance formula in discrete form is the linear accumulation equation, which generates the antecedent pollutant load at the beginning of an event as follows:

$$P_t = P_{t-1}(1-r) + A \qquad \text{(Eq. 9)}$$

where

P_{t-1} = initial load at time t-1

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P_t = load at time t
r = background removal rate
A = daily accumulation rate

Wet Periods

At the start of rainfall, the amount of a particular pollutant on a surface that produces runoff will be Po, in lb/acre. Assuming that the pounds of pollutant washed off in any time interval, dt, are proportional to the pounds remaining on the ground, P, the first order differential equation is:

$$-dP/dt = kP \quad \text{(Eq. 10)}$$

When integrated, this converts into the exponential washoff function for the removal of the surface loads as follows:

$$P_0 - P = P_0(1 - \exp(-kt)) \quad \text{(Eq. 11)}$$

where

$P_0 - P$ = washoff load (lb/acre)
k = proportionality constant
t = storm duration in hours

To determine k, the model uses the same assumption as the SWMM model. Therefore, k varies in direct proportion to the rate of runoff such that:

$$k = iB$$

where

i = runoff (in./hr)
B = constant

To determine B, it was assumed that a uniform runoff of 1/2 in./hr would wash away 90 percent of the pollutant from paved areas and 50 percent of the pollutant from grassed areas in 1 hour. That leads to a value for B of 4.6 for paved areas and 1.4 for grassed areas. These are default values that the user can modify.

To find the washoff load, apply each constituent's loading parameters to the buildup function to determine the initial load (by land use). Then apply the exponential washoff equation for impervious and pervious areas. The event mean concentration (EMC) is determined by dividing the total washoff loads by the runoff volume for each land use.

Best Management Practices

BMPs are the measures implemented to reduce pollutants from source areas, or in streams and receiving waters. Many factors govern BMP pollutant removal ability. Schueler (40) outlined three primary interrelated factors:

- The removal mechanisms used.
- The fraction of the annual runoff volume that is efficiently treated.
- The nature of urban pollutants being removed.

The AUTO_QI model does not model specific BMP processes but represents the effectiveness of BMPs by a removal efficiency factor. The model can handle one or more BMPs in a catchment or portion of a catchment. The pollutant removal factor may be inferred from field performance monitoring, laboratory experiments, modeling analyses, or theoretical considerations. Most model users, however, must rely on literature values as a starting point.

The particulate related pollutants, such as sediment and lead, are relatively easy to remove by common removal mechanisms, such as settling. Soluble pollutants, such as nutrients, are much more difficult to remove. The settling mechanism has little or no effect on these pollutants. Therefore, biological mechanisms, such as uptake by bacteria, algae, rooted aquatic plants, or terrestrial vegetation, are often used. A detailed description of individual BMPs can be found in Schueler (40) and Novotny and Chesters (13).

The model allows users to test the potential enhancement of water quality by implementing one or more BMPs in a catchment or group of catchments. The user specifies what portion, in percent, of a catchment the desired BMPs will affect and the removal efficiency of the BMPs. The model output lists the load and EMC without BMPs, followed by the load and EMC expected with BMPs. The user may apply this same procedure to reflect existing conditions if one or more BMPs are already in place.

Data Preparation

Interfacing the GIS Database and AUTO_QI

Urban runoff quantity and quality are highly dependent on the land use and hydrologic soil type. To tabulate the land use/soil complex for a large basin is a time-consuming process. To simplify the data collecting process, an optional ARC Macro Language (AML) program was developed to retrieve the land use/soil layers in a format suitable for model input.

The AML includes a menu-driven data review feature with two windows on the screen. The right window displays an index map of the whole drainage basin and the subbasin boundaries. The user can select a subbasin and display the land use, soil layers, streets, and storm sewers. If the user wants the land-use input file of a specific subbasin, the AML retrieves the attribute data and generates an ASCII file for the model input.

AML Programs

The AML programs link and provide the user interface between the GIS, which runs on a PRIME, and the AUTO_QI program, which runs on a PC. These programs process the data that AUTO_QI uses and also enable the user to view the graphic data at the subbasin level via a menu. The programs should be used with ESRI's ARC/INFO software on a PRIME computer and are grouped into two functions: the preprocessor programs and the menu system programs. PREPROCESSORLANDSOIL.AML, PREPROCESSORBMP.AML, and RUNIT.AML are the names of the three main programs.

PREPROCESSORLANDSOIL.AML uses the soil, land use, and BMP coverages to create a soil/land-use file for input to the AUTO_QI model. PREPROCESSORBMP.AML uses land-use and BMP coverages to create BMP application files for the AUTO_QI model. RUNIT.AML accesses the ARC/INFO menu system to view the coverages and INFO data. This menu also allows the user to choose and view individual subbasins and their data layers.

GIS Database Layers

Soil Layer

In 1985, funding from the Illinois Department of Mines and Minerals (IDMM) allowed for the digitization of the statewide "General Soil Map of Illinois" for the Illinois GIS system. This map contains 57 general soil associations in Illinois. The attribute data include the soil surface color, surface code, and the hydrologic class (well drained, moderately well drained, somewhat well drained, and poorly drained). The AUTO_QI model needs this hydrologic soil classification for hydrologic modeling. The source map scale for the soil associations is 1:500,000.

Land Use Layer

The statewide land-use maps are available from the U.S. Geographical Survey LUDA digital database (41). The land uses are classified based on LUDA Level II, which contains 37 land-use categories (Appendix D). Digital Landsat image data or scanning aerial photographs have updated land-use/cover information (42-44). The Illinois State Water Survey has developed image analysis capability using the ERDAS image processing package (45). The results of a classified land use can easily be transferred to the ARC/INFO system.

Street Layer (DIME file/TIGER/LINE file)

Either the 1980 DIME file or the 1990 TIGER/LINE file, which were created by the U.S. Census Bureau, can provide the street coverage. The DIME and TIGER/LINE files comprise street segment records. A segment is defined as the length of a street feature between two distinct vertices or nodes. Other features are political boundaries and topologic features (e.g., rivers, shorelines, canals, railroads, airports). Additional demographic information is also available in the attribute data. This includes state, county, and standard metropolitan statistical area codes, aggregate family income, aggregate rental cost for occupied dwelling units, and numerous other demographic statistics. The data can be plotted by census tract. The source map scale is 1:100,000. The street layer is valuable for estimating the pollutant accumulation rate and the imperviousness of the drainage basin.

Sewer Network

The database may also include an automated storm sewer network. The AML menu system provides for this coverage. The coverage is not required by the AML, however, and is not needed by AUTO_QI.

Model Verification

Overview

Due to the lack of observed data in the Lake Calumet area, the AUTO_QI model was verified by using the Boneyard Creek Basin in Champaign-Urbana, Illinois. The USGS has continuously gauged this station since 1948. The watershed area was reduced from 4.7 to 3.6 square miles in 1960 by a diversion. The basin contains a portion of Urbana, the commercial center of Champaign, and the University of Illinois campus. The central business district of Champaign makes up 7.5 percent of the drainage area and is nearly 100 percent impervious. Other city properties, including predominantly residential along with some commercial and light industrial, constitute an additional 81.2 percent of the basin. The remaining 11.3 percent of the basin is in parks, open space, and other land-use classes. Measurements have found the basin to be approximately 44 percent total paved area, which includes approximately 24 percent of direct connected paved area, 13 percent of supplemental paved area, and 7 percent of nonconnected paved area. The soils of the basin are predominantly Flanigan silt loam of hydrologic class B (8).

Runoff Simulation

For runoff simulation, rainfall data for 3 years were chosen. These years represent low (25 percent), average (50 percent), and high (75 percent) annual exceedence of rainfall. Table 3 displays these data.

Land uses in the basin were simplified into two categories. Table 4 lists the land-use parameters for these categories which were used to verify the model.

Table 3. Selected Years and Total Annual Rainfall

Year	Total Rainfall (in.)	Chance of Exceedence (percent)	Comments
1959	35.94	50	Average year
1976	32.63	75	Dry year
1977	42.44	25	Wet year

Table 4. Land-Use Parameters

Land Use	USGS Land Use Level 2 Code	% PA	% SPA	DEPI (in.)	DEPG (in.)
Residential	11	15	20	0.1	0.1
Commercial	12	90	5	0.1	0.1

% PA = paved area in percent
% SPA = supplemental paved area in percent
DEPI = impervious depression storage depth
DEPG = pervious depression storage depth

Results of Runoff Simulation

The events selected allowed the actual event runoff volume to be distinguished with reasonable confidence from the continuous runoff data. Table 5 presents the actual events for the "average year" of 1959.

Figure 2 shows that AUTO-QI does an acceptable job of reproducing runoff volumes for dry, average, and wet years. The simulated runoff/rainfall ratio for these 3 years is approximately 20 percent, which is consistent with the observed data and with what has been found previously (1).

Water Quality Simulation

Water quality data for Boneyard Creek were available for eight events in 1982 from a study by Bender et al. (46). Simulated water quality data were compared with those 1982 data.

Water Quality Parameters

Table 6 tabulates the pollutant accumulation/decay parameters required by the model and used in this study.

The accumulation rate and removal rate were selected based on typical Midwest urban runoff basins. No attempt was made to adjust these parameters to fit the observed data.

Table 7 tabulates the comparisons between simulated washoff and actual washoff of total suspended solids (TSS), phosphorus (P), and lead (Pb). The results of this verification are disappointing. They demonstrate, however, the problems of water quality simulation without verification and calibration data. The buildup and washoff factors in the model could be adjusted to "calibrate" the model to this data set and produce better results, but that was not the intent here.

Table 6. Water Quality Parameters

	ARi (lb/acre/day)	ARp (lb/acre/day)	RRi (%)	RRp (%)
For residential land use:				
Suspended solids	7.6300	3.9900	4.50	4.50
Phosphorus	0.0138	0.0070	6.00	5.00
Lead	0.0100	0.0053	6.00	5.00
For commercial land use:				
Suspended solids	9.5500	5.5500	3.00	4.50
Phosphorus	0.0100	0.0053	4.50	4.50
Lead	0.0110	0.0060	6.00	5.00

ARi = Accumulation rate for impervious area
ARp = Accumulation rate for pervious area
RRi = Removal rate for impervious area
RR = Removal rate for pervious area

Table 5. Summary of Runoff Simulation for Selected Events in 1959

Date	Dry Days	Rainfall (in.)	Event Duration (hr)	Observed Runoff (in.)	Simulated Runoff (in.)	Simulated Grass Runoff (%)
7/23/59	3.21	0.51	6.00	0.07	0.08	3
7/27/59	3.17	0.80	5.00	0.15	0.16	4
8/29/59	6.00	0.23	5.00	0.02	0.03	3
9/01/59	2.63	0.39	6.00	0.035	0.07	1
9/09/59	8.00	0.18	2.00	0.024	0.02	2
10/10/59	3.63	2.52	9.00	0.51	0.60	7
11/04/59	0.08	0.82	8.00	0.185	0.19	4
11/13/59	0.13	1.39	23.00	0.32	0.31	2
12/10/59	5.67	0.68	15.00	0.106	0.11	1

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Summary

A new comprehensive computer package was developed on the basis of two proven models for urban water quantity/quality assessment, ILLUDAS and Q-ILLUDAS. The package consists of three main parts:

- Water quantity/quality model, called AUTO_QI.
- A convenient menu system called QIMENU for preparing and editing inputs, viewing the outputs, running the model, and assisting users.
- A GIS interface called RUNIT, and other GIS processing programs.

The AUTO_QI model, which provides continuous simulation, consists of three main components: HYDRO, LOAD, and BMP. HYDRO uses a runoff/soil moisture accounting procedure, pervious and impervious depression storage, interception, Horton infiltration curves, and water storage in the soils to generate runoff volumes for each event in the record. LOAD is the water quality simulator that uses the output from HYDRO along with the pollutant accumulation and exponent washoff functions to generate loads and EMCs. BMP is the best management practices simulator that handles numerous separate or overlapping BMPs and produces the model output. The user may simulate the impacts of pollution reduction at multiple stormwater outfall points. The results can be viewed at one outfall point or multiple outfall points.

QIMENU aids users with preparation of input files, selection of parameters, running the model, testing the BMPs, and viewing the output.

The GIS interface uses the AML and automates the generation of the major input files for AUTO_QI. It also provides the user with a menu-driven program to review GIS coverages on the screen.

The model was verified by using data from the Boneyard Creek drainage basin in Urbana, Illinois. The three sets of rainfall data selected represent wet, average, and dry years. The input data consist of daily and hourly rainfalls, percent impervious and supplemental paved areas, depression storage, initial and final infiltration rates, gravitational and evapotranspiration soil storage, pollution accumulation and removal rate, and washoff factor. When comparing the outputs with the observed data for the Boneyard Creek basin, the results indicated that the model performed well for runoff volume. The simulations of pollutant loadings using the uncalibrated model were poor and indicate the need for further testing and calibration.

Acknowledgments

This research was funded by Region 5 Water Division, Watershed Management Unit, EPA, Chicago, Illinois, and the Great Lakes National Program Office, EPA, Washington, DC. The EPA Project Officer was Thomas E. Davenport.

The principal investigators of this report were Michael L. Terstriep and Ming T. Lee. Thomas Davenport, EPA Regional Nonpoint Source Coordinator, reviewed the early versions of this report and provided a number of helpful comments and suggestions. Douglas Noel developed the program for the original Q-ILLUDAS model, consulted on this project, and provided a general outline for the revised computer program. M. Razeur Rahman wrote the LOAD and BMP portion of the model. Evan P. Mills wrote the menu-driven program QIMENU for handling the inputs and outputs. Amelia V. Greene wrote the AML program for the GIS interface. John Brother prepared the graphical work.

Table 7. Washoff Load Simulation for Selected Events of 1982

			TSS		Phosphorus		Lead	
Date	**Rainfall (in.)**	**Runoff (in.)**	**Sim. (lb)**	**Obs. (lb)**	**Sim. (lb)**	**Obs. (lb)**	**Sim. (lb)**	**Obs. (lb)**
3/19/82	0.52	0.08	12,312	18,777	18	18	15	11
4/02/82	0.66	0.11	6,954	89,179	10	75	8	77
4/15/82	0.12	0.01	2,388	3,332	10	7	3	4
4/16/82	0.60	0.10	19,549	52,087	28	46	23	48
5/15/82	0.43	0.07	25,409	25,857	36	29	29	15
6/15/82	1.17	0.21	3,302	30,969	5	48	5	35
6/28/82	0.98	0.16	29,808	22,931	43	31	35	5
7/18/82	1.14	0.30	5,070	19,001	8	26	6	11

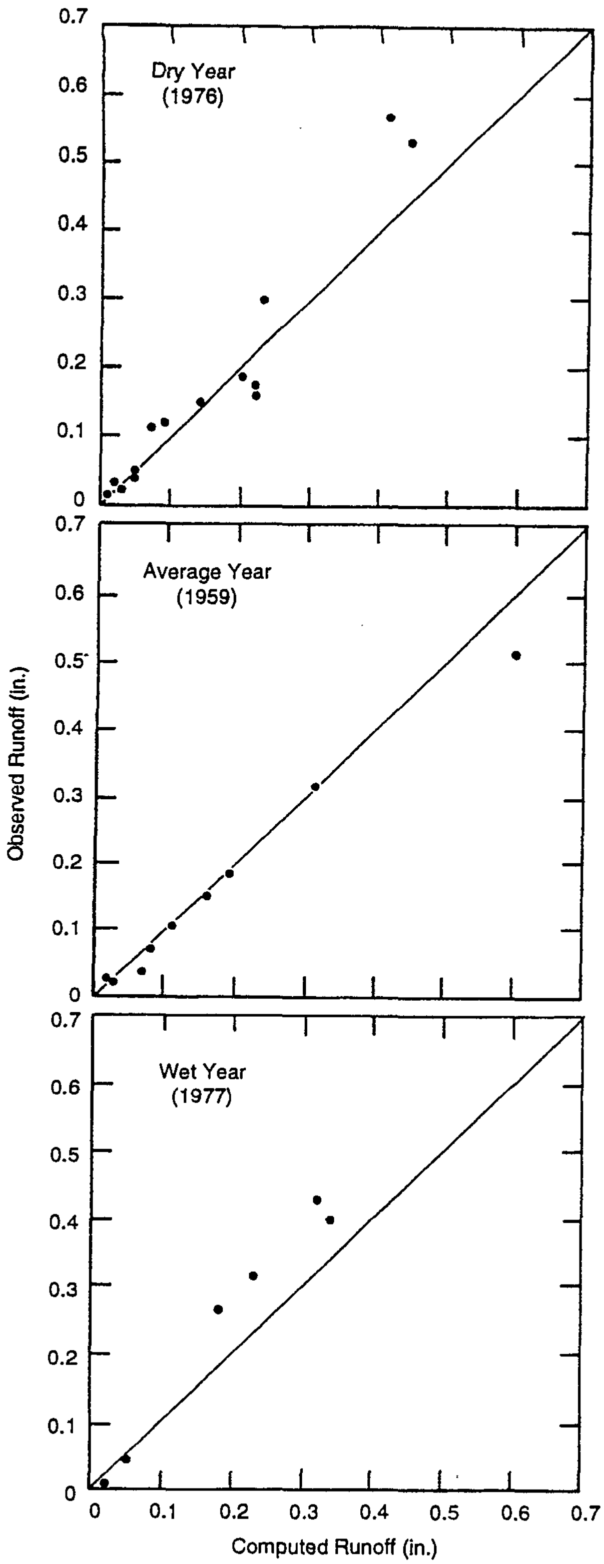

Figure 2. Comparison of observed and computed event runoff volumes in Boneyard Creek basin, Champaign-Urbana, Illinois.

References

1. Terstriep, M.L., and J.B. Stall. 1974. *The Illinois Urban Drainage Area Simulator, ILLUDAS*. Illinois State Water Survey Bulletin 58.
2. Metcalf and Eddy, Inc./University of Florida/Water Resources Engineers, Inc. 1971. Stormwater management model, Vols. I-IV. EPA Report No. 11024 DOC 07/71, 08/71, 09/71, 10/71. Washington, DC.
3. U.S. EPA. 1975. Stormwater management model user's manual, Version II. EPA/670/2-75/017. Cincinnati, OH.
4. Hydrologic Engineering Center, Corps of Engineers. 1977. Urban storm runoff. STORM Computer Program No. 723-S8-L2520. Davis, CA.
5. Terstriep, M.L., and M.T. Lee. 1989. Regional stormwater modeling, Q-ILLUDAS and ARC/INFO. Proceedings of ASCE Sixth Conference on Computing for Civil Engineering, Atlanta, GA.
6. Noel, D.C., and M.L. Terstriep. 1982. Q-ILLUDAS: A continuous urban runoff/washoff model. Presented at the International Symposium on Urban Hydrology, Hydraulics, and Sediment Control, University of Kentucky, Lexington, KY.
7. Shaw, E.M. 1983. Hydrology in practice, 2nd ed. London, UK: International Van Nostrand Reinhold.
8. Kuchling, E. 1889. The relation between the rainfall and the discharge of sewers in populated districts. Trans. ASCE 20:1-60.
9. Sherman, L.K. 1932. Streamflow from rainfall by unit-graph method. Engineering News Record 108:501-505.
10. James, L.D. 1965. Using a digital computer to estimate the effects of *urban development on flood peaks*. Water Resour. Res. 1(2):223-234.
11. Papadakis, C.N., and H.C. Preul. 1973. Testing of methods for determination of urban runoff. J. Hydraul. Div., ASCE HY9:1,319-1,335.
12. McPherson, M.B., and W.J. Schneider. 1974. Problems in modeling urban watersheds. Water Resour. Res. 10(3):434-440.
13. Novotny, V., and G. Chesters. 1981. Handbook of nonpoint pollution, sources, and management. New York, NY: Van Nostrand Reinhold Environmental Engineering Series.
14. Hann C.T., H.P. Johnson, and D.L. Brakensiek, eds. 1982. Hydrologic modeling of small watersheds. ASAE Monograph No. 5. St. Joseph, MI.
15. Sartor, J.D., and G.B. Boyd. 1972. Water pollution aspects of street surface contaminants. Report No. EPA-R2-72-081. Washington, DC.
16. McPherson, M.B. 1978. Urban runoff control, quantity, and quality. Presented at the American Public Works Association, Urban Drainage Workshop, Omaha, NE (March).
17. Sutherland, R.C., and R.H. McCuen. 1978. Simulation of urban and nonpoint source pollution. Water Resour. Bull. 14(2):409-428.
18. U.S. EPA. 1988. Stormwater management model user's manual, Version 4. EPA/600/3-88/001a (NTIS PB88-236641/AS). Athens, GA.
19. U.S. EPA. 1980. Quantity-Quality Simulation (QQS): A detailed continuous planning model for urban runoff control, Vol. 1. Model description, testing, and applications. EPA/600/2-80/011. Cincinnati, OH.
20. U.S. EPA. 1980. User's manual for hydrological simulation program: FORTRAN (HSPF). EPA/600/9-80/015. Athens, GA.

21. Donigian, A.S., Jr., and W.C. Huber. 1990. Modeling of nonpoint source water quality in urban and non-urban areas. Draft report to U.S. EPA, Environmental Research Laboratory, Office of Research and Development, Athens, GA.

22. Feldman, A.D. 1981. HEC models for water resources system simulation: Theory and experience. Advances in hydroscience, Vol. 12. New York, NY: Academic Press. pp. 297-423.

23. Huber, W.C., and J.P. Heaney. 1982. Analyzing residuals generation and discharge from urban and non-urban land surfaces. In: Basta, D.J., and B.T. Bower, eds. Analyzing natural systems, analysis for regional residuals: Environmental quality management resources for the future. Baltimore, MD: Johns Hopkins University Press (NTIS PB-83-223321). pp. 121-243.

24. Kibler, D.F., ed. 1982. Urban stormwater hydrology. Water Resources Monograph 7. Washington, DC: American Geophysical Union.

25. Whipple, D.J., N.S. Grigg, T. Grizzard, C.W. Randall, R.P. Shubinski, and L.S. Tucker. 1983. Stormwater management in urbanizing areas. Englewood Cliffs, NJ: Prentice-Hall.

26. Barnwell, T.O., Jr. 1984. EPA's Center for Water Quality Modeling. Proceedings of the Third International Conference on Urban Storm Drainage, Chalmers University, Goteborg, Sweden, Vol. 2. pp. 463-466.

27. Barnwell, T.O., Jr. 1987. EPA computer models are available to all. Water Quality International, IAWPRC, No. 2. pp. 19-21.

28. Huber, W.C. 1985. Deterministic modeling of urban runoff quality. In: Torno, H.C., J. Marsalek, and M. Desbordes, eds. Urban runoff pollution. NATO ASI Series, Series G. Ecological Sciences 10:167-242. New York, NY: Springer-Verlag.

29. Huber, W.C. 1986. Modeling urban runoff quality: State of the art. In: Urbonas, B., and L.A. Roesner, eds. Proceedings of Conference on Urban Runoff Quality, Impact, and Quality Enhancement Technology. New York, NY: Engineering Foundations, ASCE. pp. 34-48.

30. Bedient, P.B., and W.C. Huber. 1989. Hydrology and floodplain analysis. Reading, MA: Addison-Wesley Publishers.

31. Viessman, W., Jr., G.L. Lewis, and J.W. Knapp. 1989. Introduction to hydrology, 3rd ed. New York, NY: Harper and Row.

32. Sonnen, M.B. 1980. Urban runoff quality: Information needs. J. Tech. Councils, ASCE 106(TC1):29-40.

33. U.S. EPA. 1975. Contribution of urban roadway usage to water pollution. EPA/600/2-75/004. Washington, DC.

34. American Public Works Association. 1969. Water pollution aspects of urban runoff. WP-20-15. U.S. Department of Interior, FWPCA (present EPA). Washington D.C.

35. Sartor, J.D., G.B. Boyd, and F.J. Agardy. 1974. Water pollution aspects of street surface contaminant. JWPCF 46:458-667. Washington, DC.

36. Yalin, M.S. 1963. An expression for bed load transportation. J. Hydraul. Div., ASCE 89:221-250.

37. Eagleson, P.S. 1970. Dynamic hydrology. New York, NY: McGraw-Hill. pp. 262-264.

38. Richey, C.B. 1961. Agricultural engineer's handbook. New York, NY: McGraw-Hill.

39. Chow, V.T. 1964. Handbook of applied hydrology. New York, NY: McGraw-Hill. pp. 14-17.

40. Schueler, T.R. 1987. Controlling urban runoff: A practical manual for planning and designing urban BMPs. Washington, DC: Department of Environmental Programs, Metropolitan Washington Council of Governments.

41. Anderson, J.R., E.E. Hardy, J.T. Roach, and R.E. Witner. 1976. A land use and land cover classification system for use with remote sensor data. U.S. Geological Survey Professional Paper 964. Washington, DC: U.S. Government Printing Office.

42. Hsu, S.Y. 1978. Texture-tone analysis for automated land use mapping. Photogrammetric Engineering and Remote Sensing 44(11):1,393-1,404.

43. Lee, M.T., and Y. Ke. 1990. Updating land use classifications of urbanized areas in Northeastern Illinois by using SPOT and TM satellite data. Illinois State Water Survey Contract Report 487.

44. Lee, M.T., J.J. Kao, and Y. Ke. 1990. Integration of GIS, remote sensing, and digital elevation data for a hydrologic model. Proceedings of 1990 Hydraulic Division Conference, San Diego, CA (July).

45. ERDAS. 1989. ERDAS user's manual, Version 7.2. Atlanta, GA.

46. Bender, G.M., D.C. Noel, and M.L. Terstriep. 1983. Nationwide runoff project, Champaign, Illinois: Assessment of the impact of urban storm runoff on an agricultural receiving stream. Illinois State Water Survey Contract Report 319.

Source Loading and Management Model (SLAMM)

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Introduction

The Source Loading and Management Model (SLAMM) was developed to more efficiently evaluate stormwater control practices. It soon became evident that to accurately evaluate the effectiveness of stormwater controls at an outfall, the sources of the pollutants, or problem water flows, must be known. SLAMM has evolved to include a variety of source area and end-of-pipe controls and the ability to predict the concentrations and loadings of many different pollutants from many potential source areas. SLAMM calculates mass balances for both particulate and dissolved pollutants and runoff flow volumes for different development characteristics and rainfalls. It was designed to give relatively simple estimates (pollutant mass discharges and control measure effects) for a very large variety of potential conditions.

SLAMM was developed primarily as a planning level tool, for example, to generate information needed to make planning level decisions while not generating or requiring superfluous information. Its primary capabilities include predicting flow and pollutant discharges that reflect a broad variety of development conditions and the use of many combinations of common urban runoff control practices. Control practices evaluated by SLAMM include detention ponds, infiltration devices, porous pavements, grass swales, catchbasin cleaning, and street cleaning. These controls can be evaluated in many combinations and at many source areas as well as the outfall location. SLAMM also predicts the relative contributions of different source areas (e.g., roofs, streets, parking areas, landscaped areas, undeveloped areas) for each land use investigated. As an aid in designing urban drainage systems, SLAMM also calculates U.S. Department of Agriculture Soil Conservation Service (SCS) curve numbers (CNs) that reflect specific development and control characteristics. These CNs can then be used in conjunction with available urban drainage procedures to reflect the water quantity reduction benefits of stormwater quality controls.

SLAMM is normally used to predict source area contributions and outfall discharges, but SLAMM (1) has also been used in conjunction with a receiving water model (HSPF) to examine the ultimate effects of urban runoff.

The development of SLAMM began in the mid-1970s, primarily as a data reduction tool for use in early street cleaning and pollutant source identification projects sponsored by the U.S. Environmental Protection Agency's (EPA's) Storm and Combined Sewer Pollution Control Program (2-4). Much of the information contained in SLAMM was obtained during EPA's Nationwide Urban Runoff Program (NURP) (5), especially the early Alameda County, California (6), and the Bellevue, Washington (7) projects. The completion of the model was made possible by the remainder of the NURP projects and additional field studies and programming support sponsored by the Ontario Ministry of the Environment (8), the Wisconsin Department of Natural Resources (9), and EPA Region 5 (this report). Early users of SLAMM included the Ontario Ministry of the Environment's Toronto Area Watershed Management Strategy (TAWMS) study (8) and the Wisconsin Department of Natural Resources' Priority Watershed Program (9). SLAMM can now be effectively used as a tool to enable watershed planners to obtain a better understanding of the effectiveness of different control practice programs.

A logical approach to stormwater management requires knowledge of the problems that are to be solved, the sources of the problem pollutants, and the effectiveness of stormwater management practices that can control the problem pollutants at their sources and at outfalls. SLAMM is designed to provide information on the last two aspects of this approach.

Stormwater Problems

Before stormwater control programs can be selected and evaluated, it is necessary to understand the stormwater problems in local receiving waters. Table 1 lists typical receiving water problems associated with both the long-term accumulation of pollutants and the short-term (event-related) buildup of pollutants. Many of these problems have been commonly found in urban receiving waters in many areas of the United States (10). Because these problems are so diverse, an equally wide variety of individual stormwater controls must usually be used together. Unfortunately, combinations of controls are difficult to analyze using conventional stormwater models or the results of monitoring activities. SLAMM was developed to effectively examine control practices and land uses that may affect these receiving water problems.

Table 1. Typical Receiving Water Problems

Long-Term Problems Associated With Accumulations of Pollutants	• Sedimentation in stormwater conveyance systems and in receiving waters. • Nuisance algae growths from nutrient discharges. • Inedible fish, undrinkable water, and shifts to less sensitive aquatic organisms caused by toxic heavy metals and organics.
Short-Term Problems Associated With High Pollutant Concentrations or Frequent High Flows (Event Related)	• Swimming beach closures from pathogenic microorganisms. • Water quality violations. • Property damage from increased flooding and drainage system failures. • Habitat destruction caused by frequent high flow rates (e.g., bed scour, bank erosion, flushing of organisms downstream).

SLAMM Computational Processes

Figure 1 illustrates the development characteristics that affect stormwater quality and quantity. This figure shows a variety of drainage systems, from concrete curb and gutters to grass swales, along with directly connected roof drainage systems and drainage systems that drain to pervious areas. "Development characteristics" define the magnitude of these drainage efficiency attributes, along with the areas associated with each surface type (e.g., road surfaces, roofs, landscaped areas). The use of SLAMM shows that these characteristics greatly affect runoff quality and quantity. Land use alone is usually not sufficient to describe these characteristics. Drainage type (curbs and gutters or grass swales) and roof connections are probably the most important attributes affecting runoff quantity and quality. These attributes are not directly related to land use, but some trends are obvious; most roofs in strip commercial and shopping center areas are directly connected, and the roadside is most likely drained by curbs and gutters, for example. Different land uses, of course, are also associated with different levels of pollutant generation. For example, industrial areas usually have the greatest pollutant accumulations.

Figure 2 shows how SLAMM considers a variety of pollutant and flow routings that may occur in urban areas. SLAMM routes material from unconnected sources directly to the drainage system or to adjacent directly connected or pervious areas, which in turn drain to the collection system. Each of these areas has pollutant deposition mechanisms in addition to removal mechanisms associated with them. As an example, unconnected sources, which may include rooftops draining to pervious areas or bare ground and landscaped areas, are affected by regional air pollutant deposition (from point source emissions or from fugitive dust) and other sources that would affect all surfaces. Pollutant losses from these unconnected sources are caused by wind removal and rain runoff washoff, which flows directly to the drainage system or to adjacent areas. The drainage system may include curbs and gutters, where there is limited deposition, and catch basins and grass swales, which may remove substantial participates that are transported in the drainage system. Directly connected impervious areas include paved surfaces that drain directly to the drainage system. These source areas are also affected by regional pollutant deposition, in addition to wind removal and controlled removal processes, such as street cleaning. Onsite storage is also important on paved surfaces because of the large amount of participate pollutants that are not washed off, blown off, or removed by direct cleaning (2, 4, 6).

Figure 3 shows how SLAMM proceeds through the major calculations. There is a double set of nested loops in the analyses where runoff volume and suspended solids (particulate residue) are calculated for each source area and then for each rain. These calculations consider the effects of each source area control, in addition to the runoff pattern between areas. Suspended solids washoff and runoff volume from each individual area for each rain are summed for the entire drainage system. The effects of the drainage system controls (catch basins or grass swales, for example) are then calculated. Finally, the effects of the outfall controls are calculated.

SLAMM uses the water volume and suspended solids concentrations at the outfall to calculate the other pollutant concentrations and loadings. SLAMM keeps track of the portion of the total outfall suspended solids loading and runoff volume that originated from each source area. The suspended solids fractions are then used to develop weighted loading factors associated with each pollutant. In a similar manner, dissolved pollutant concentrations and loadings are calculated based on the

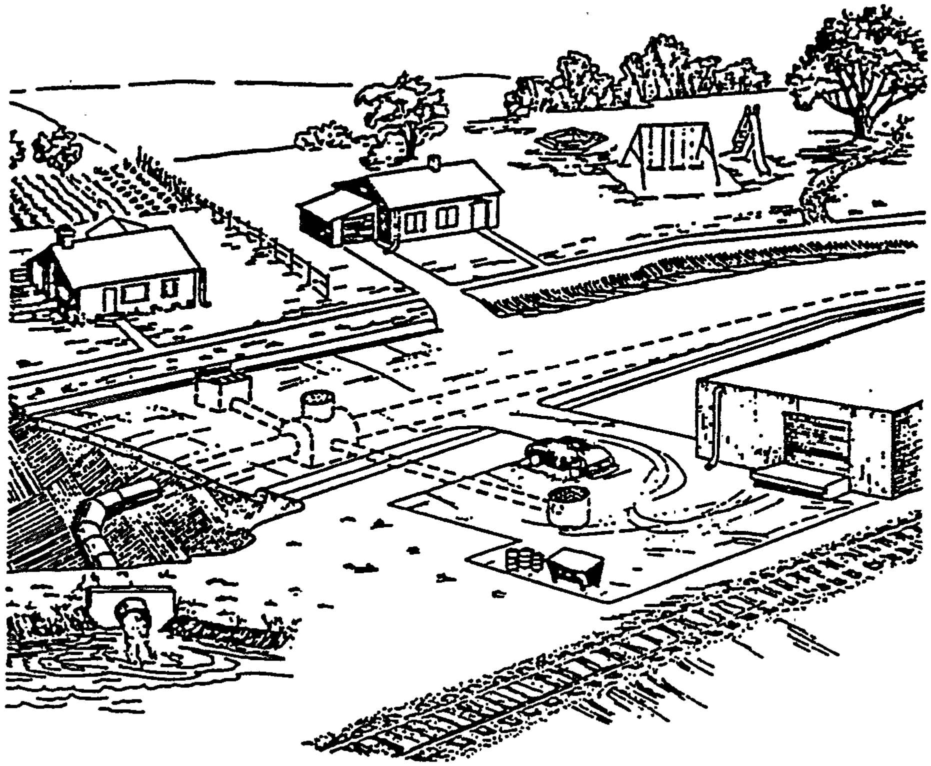

Figure 1. Urban runoff source areas and drainage alternatives (9).

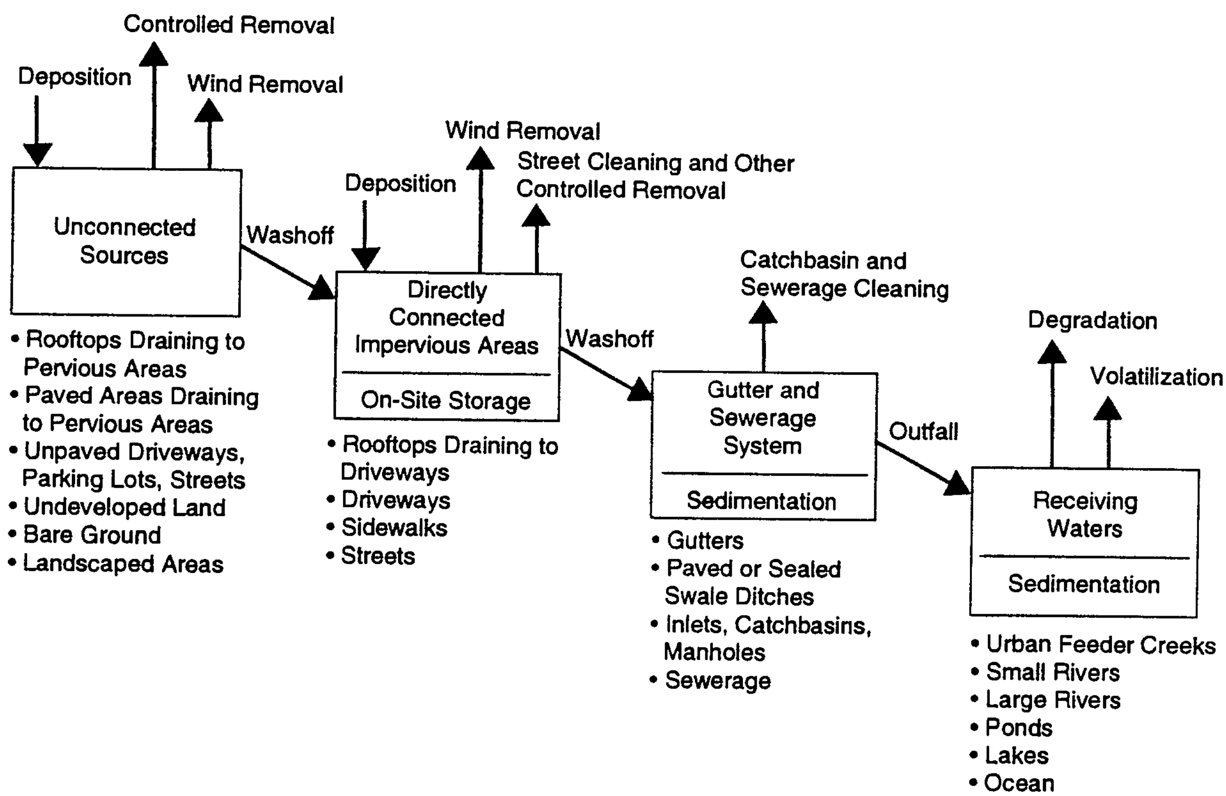

Figure 2. Pollutant deposition and removal at source areas (9).

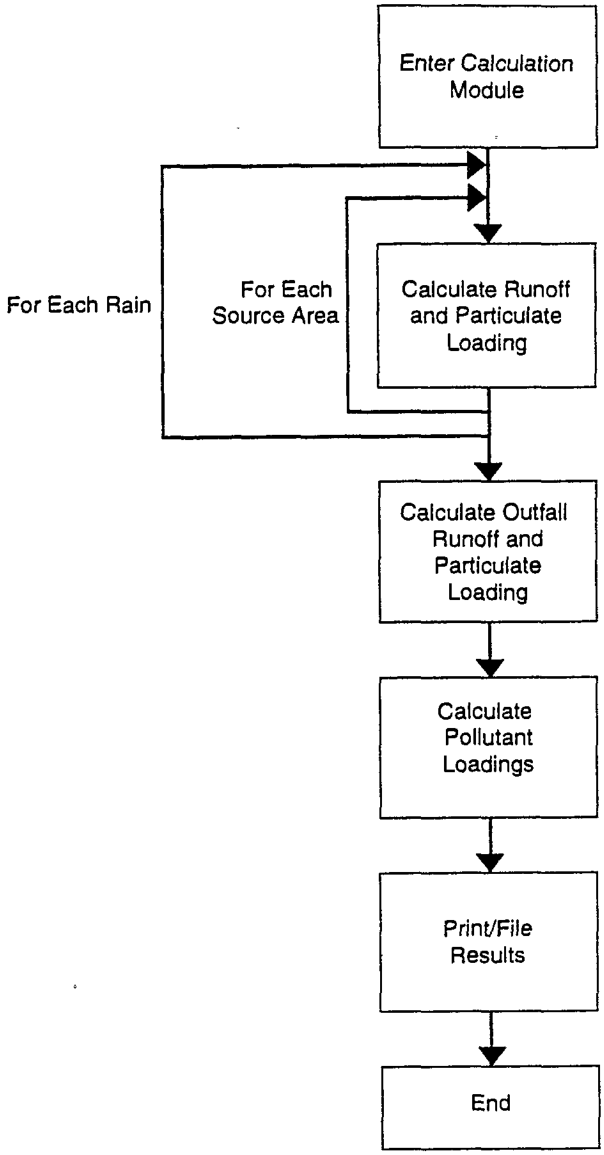

Figure 3. SLAMM calculation flow chart.

percentage of water volume that originates from each of the source areas within the drainage system.

SLAMM predicts urban runoff discharge parameters (total storm runoff flow volume, flow-weighted pollutant concentrations, and total storm pollutant yields) for many individual storms and for the complete study period. It has built-in Monte Carlo sampling procedures to consider many of the uncertainties common in model input values. This enables the model output to be expressed in probabilistic terms that represent the likely range of results expected.

Unique Aspects of SLAMM

SLAMM is unique in many aspects. One of the most important aspects is its ability to consider many stormwater controls (affecting source areas, drainage systems, and outfalls) together, for a long series of rains. Another is its ability to accurately describe a drainage area in sufficient detail for water quality investigations without requiring a great deal of superfluous information that field studies have shown to be of little value in accurately predicting discharge results. SLAMM also applies stochastic analysis procedures to represent actual uncertainty in model input parameters to better predict the actual range of outfall conditions (especially pollutant concentrations). The main reason SLAMM was developed, however, was because of problem areas in many existing urban runoff models. The following paragraphs briefly describe small storm hydrology and particulate washoff, the most significant of these problem areas.

Small Storm Hydrology

One of the major problems with conventional stormwater models concerns runoff volume estimates associated with small storms. Figures 4 and 5 show the importance of common small storms when considering total annual pollutant discharges. Figure 4 shows the accumulative rain count and the associated accumulative runoff volume for a medium density residential area in Milwaukee, Wisconsin, based on 1983 monitored data (11). This figure shows that the median rain, by count, was about 0.3 in., while the rain associated with the median runoff quantity is about 0.75 in. Therefore, more than half of the runoff from this common medium density residential area was associated with rain events that were smaller that 0.75 in. The 1983 rains (which were monitored during the Milwaukee NURP project) included several very large storms, which are also shown on Figure 4. These

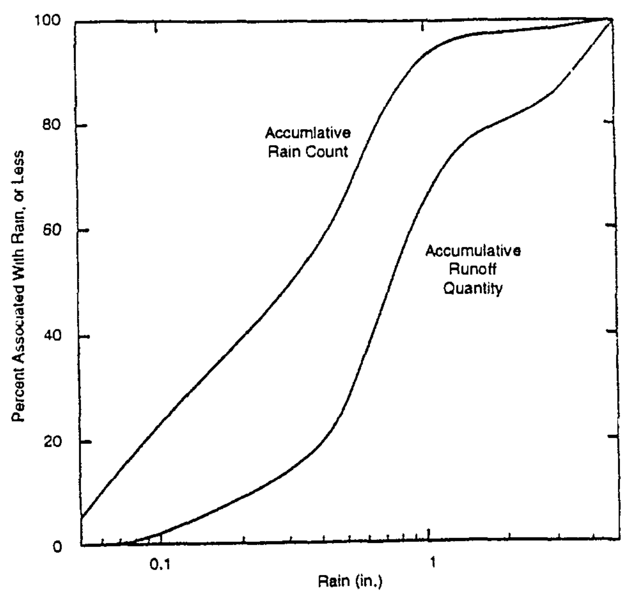

Figure 4. Milwaukee rain and runoff distributions (medium-density residential area).

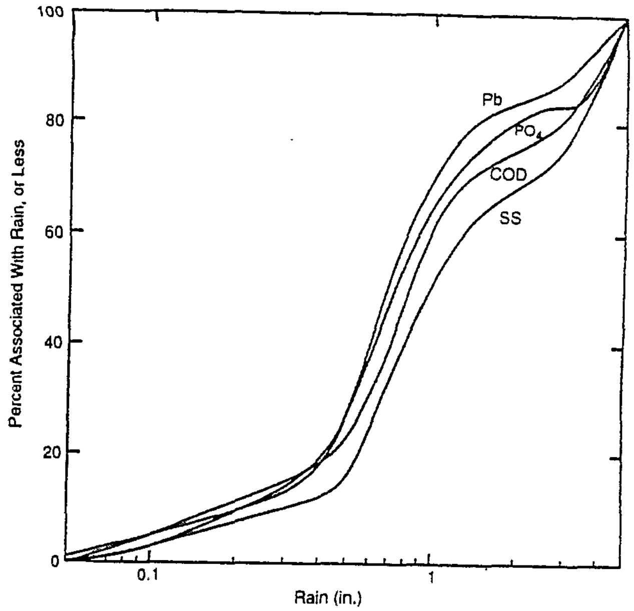

Figure 5. Milwaukee pollutant discharge distributions (medium-density residential area).

large storms (3 to 5 in. in depth) distort Figure 4 because, on average, the Milwaukee area only can expect one 3.5-in. storm every 5 years. If these large rains did not occur in most years, then the significance of the small rains would be even greater.

Figure 5 shows the accumulative loadings of different pollutants (suspended solids, chemical oxygen demand, phosphates, and lead) monitored during 1983 in Milwaukee at the same site as the rain and runoff data shown in Figure 4 (11). When Figure 5 is compared with Figure 4, runoff and discharge distributions appear very similar. This is a simple way of indicating that no significant trends of stormwater concentrations were observed for different size events. Substantial variations in pollutant concentrations were observed, but these were random and not related to storm size. Similar conclusions were noted when all of the NURP data were evaluated (5). Therefore, accurately knowing the runoff volume is very important when studying pollutant discharges. By better understanding the significance and runoff generation potential of these small rains, runoff problems will be better understood.

Figure 6 illustrates the concept of variable contributing areas as applied to urban watersheds. This figure indicates the relative significance of three major source areas (street surfaces, other impervious surfaces, and pervious surfaces) in an urban area. The individual flow rates associated with each of these source areas increase until their time of concentrations are met. The flow rate then remains constant for each source area until the rain event ends. When the rain stops, runoff recession curves occur, draining the individual source areas. The three component hydrographs are then added together to form the complete hydrograph for the

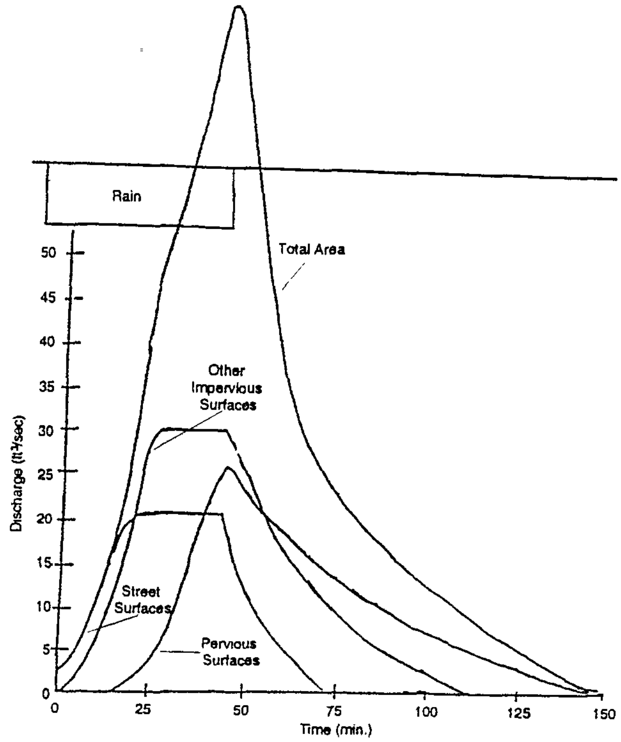

Figure 6. Variable contributing areas in urban watersheds.

area. Calculating the percentage of the total hydrograph associated with each individual source area enables estimates of the relative importance of each source area to be quantified. The relative pollutant discharges from each area can then be calculated from the runoff pollutant strengths associated with each area.

When the time of concentration and the rain duration are equal for an area, the maximum runoff rate for that rain intensity is reached (12). The time of concentration occurs when the complete drainage area is contributing runoff to the point of concern. If the rain duration exceeds the time of concentration, then the maximum runoff rate is maintained until the rain ends. When the rain ends, the runoff rate decreases according to a recession curve for that surface. The example shown in Figure 6 is for a rain duration greater than the times of concentrations for the street surfaces and other impervious areas, but shorter than the time of concentration for the pervious areas. Similar runoff quantities originated from each of the three source areas for this example. If the same rain intensity occurs but lasts for twice the duration (a less frequent storm), the runoff rates for the street surfaces and other impervious surfaces will be the same until the end of the rain, when their recession curves would begin. The pervious surface contribution would increase substantially, however, because its time of concentration may be exceeded by the longer rain duration. If the same rain intensity occurs but only for half of the original duration, the street surfaces time of concentration is barely met, and the other impervious surfaces would not have reached their time of concentration. In this last example, the pervious surfaces would barely begin to cause runoff. In this last case, the street surfaces are the dominant source of runoff water. By knowing the relative contributions of water and pollutants from each source area, it is possible to evaluate potential source area runoff controls for different rains.

Figure 7 shows monitored rainfall-runoff results from one of a series of tests conducted to investigate runoff losses associated with common small rains on pavement (13). This figure indicates that initial abstractions (detention storage plus evaporation losses) for this pavement totaled about 1 mm, while the total rainfall losses were about 6 mm. These maximum losses occurred after about 20 mm of rain. For a relatively small rain of about 7 mm, almost one-half of the rain falling on this pavement did not contribute to runoff. During smaller storms, the majority of the rainfall did not contribute to runoff. These rainfall losses for pavement are substantially greater than commonly considered in stormwater models. Most stormwater models use rainfall-runoff relationships that have been developed and used for many years for drainage design. Drainage design is concerned with rain depths of at least several inches. When these same procedures are used to estimate the runoff associated with common small storms (which are the most important in water quality investigations), the runoff predictions can be highly inaccurate. As an example, Figure 8 is a plot of

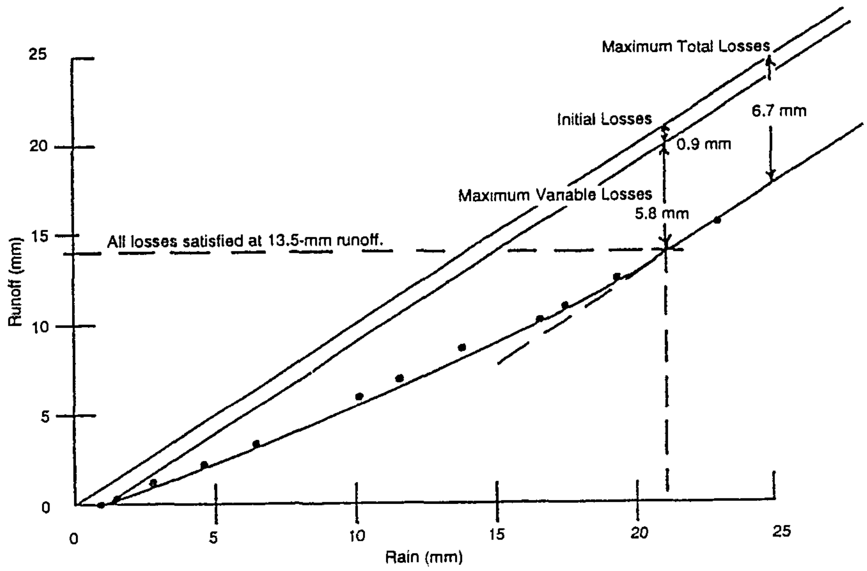

Figure 7. Rainfall-Runoff plot (example for high-intensity rains, clean and rough streets) (13).

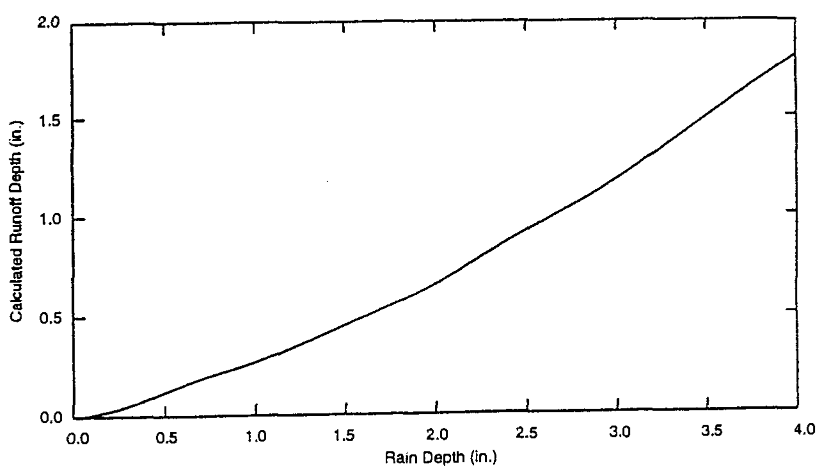

Figure 8. Rainfall-Runoff plot (medium-density area with clayey soils).

the observed runoff for different rain depths in Milwaukee during the 1983 NURP investigations. It was noted previously that several storms were monitored during this period that were very large. The volumetric runoff coefficient (the ratio of runoff to rain depth) observed varies for each rain depth. This ratio can be about 0.1 for storms of about 0.5 in. but may approach 0.4 for a moderate size storm of 2.5 in. or greater which is typically associated with drainage events. The NURP study (5), however, recommended the use of constant (average) volumetric runoff coefficients for the stormwater permit process. Therefore, the runoff volumes of common small storms would most likely be overpredicted.

Figure 9 shows the calculated SCS (14) CNs associated with different storms at a medium density residential site in Milwaukee. This figure shows that the CN values vary dramatically for the different rain depths that actually occurred at this site. The CN values approach the CN values that would be selected for this type of site only for rains greater than several inches in depth. The CN values are substantially greater for the smaller common storms, especially for rains less than the 1-in. minimum rain criteria given by SCS (14) for the use of this procedure. These results are similar to those obtained at many other sites. In almost all cases, the CN values for storms of less than 0.5 in. are 90 or greater. Therefore, the smaller storms contribute much more runoff than would typically be assumed if using SCS procedures. The CN method was initially developed, and is most appropriate, for use in the design of drainage systems associated with storms of much greater size than those of interest in stormwater quality investigations.

SLAMM makes runoff predictions using the small storm hydrology methods developed by Pitt (13). Figure 10

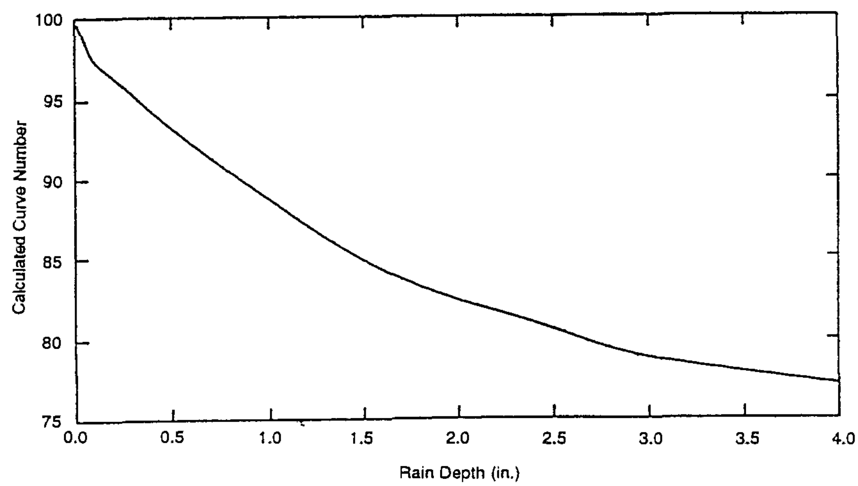

Figure 9. Curve number changes for different rain depths (medium-density area with clayey soils).

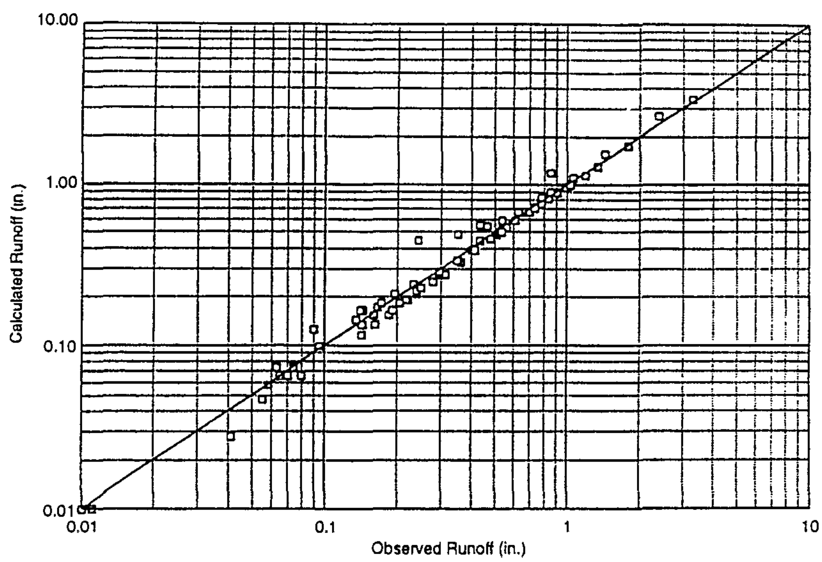

Figure 10. Commercial shopping center runoff verification.

shows the verification of the small storm hydrology method used in SLAMM for storms from a commercial area in Milwaukee. This figure shows that the calculated runoff for many storms over a wide range of conditions was very close to the actual observed runoff. Figure 11 shows a similar plot of the predicted versus observed runoff for a Milwaukee medium density residential area. These two sites were substantially different from each other in the amount of impervious surfaces and in the way these areas were connected to the drainage system. Similar satisfactory comparisons using these small storm hydrology models for a wide range of rain events have been made for other locations, including Portland, Oregon (15), and Toronto, Canada (8).

Particulate Washoff

Another unique feature of SLAMM is its use of a washoff model to predict the losses of suspended solids from different surfaces. Figure 12 is a plot of the suspended solids concentrations for different rain depths for sheetflow runoff from paved surfaces during controlled tests in Toronto (13). This figure shows local "first-flush" effects, with a trend of decreasing suspended solids concentration with increasing rain depth. During the smallest rains, these concentrations are shown to be about several hundred milligrams per liter, and as high as 4,000 mg/L. The suspended solids concentrations during the largest events (about 1 in. in depth) decreased

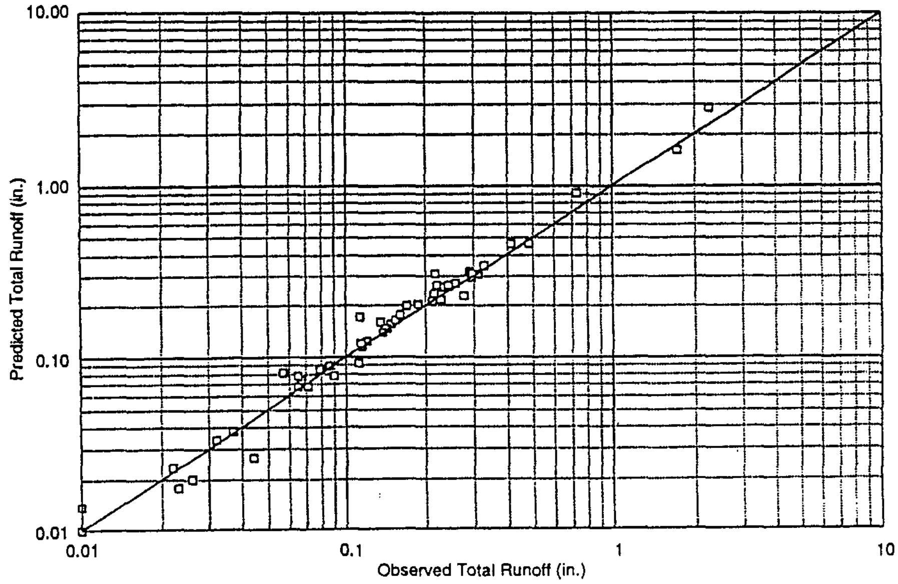

Figure 11. Medium-density residential area runoff verification.

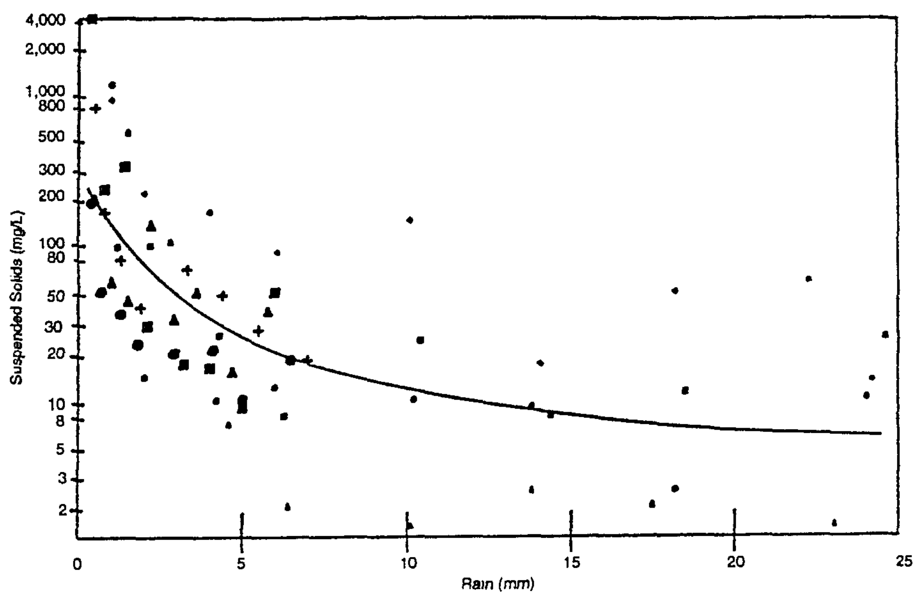

Figure 12. Pavement "first-flush" suspended solids concentrations (13).

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dramatically to about 10 mg/L. These data were obtained during controlled small storm hydrology and particulate washoff tests using carefully controlled and constant rain intensities. A first flush of pollutants, as seen in this figure, is likely only to occur for relatively small homogeneous surfaces subjected to relatively constant rain intensities. First flushes at storm drain outfalls may not be commonly observed because of the routing of many different individual first-flush flows that are mixed. Because the highest concentrations associated with these individual flows reach the outfall at different times, these individual first flushes are mixed and lost. More significantly, later times during a rain may have much higher periods of peak rain intensities, resulting in peak washoff late in a storm. Intermittent periods of high rain intensities later in rains likely cause localized periods of high runoff pollutant concentrations that may occur long after the beginning of the rain. Therefore, first-flush situations are most likely to occur for homogeneous drainage areas (such as for large paved areas or roofs) during relatively constant rain intensities.

SLAMM calculates suspended solids washoff based on individual first-flush (exponential) plots for each surface. These plots are derived from observations during rains and during controlled tests (8). The use of individual surface washoff plots has been verified using runoff observations from large and complex drainages (13). Figures 13 through 15 show washoff plots for total solids, suspended solids (>0.45 µm), and dissolved solids (<0.45 µm) during an example controlled street surface washoff test (13). These plots indicate the accumulative gram per square meter washoff as a function of rain

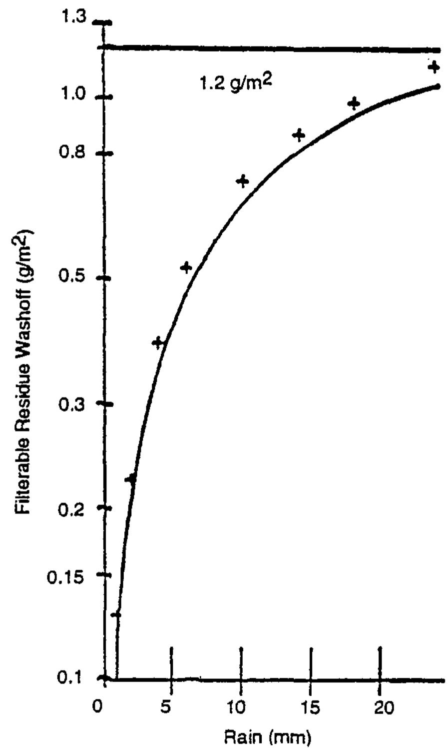

Figure 14. Dissolved solids washoff test results (13).

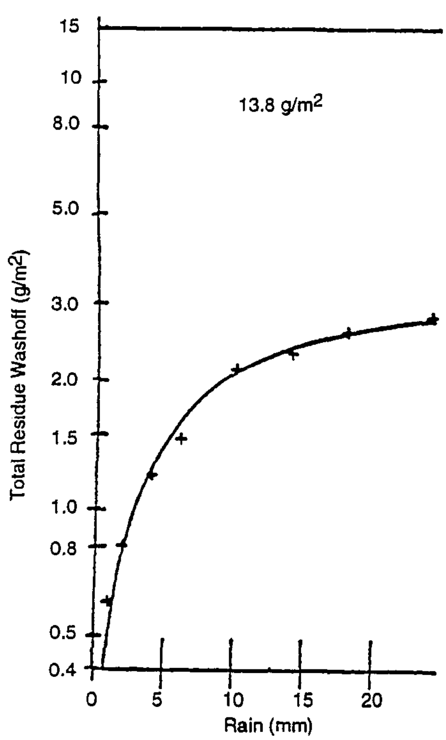

Figure 13. Total solids washoff test results (13).

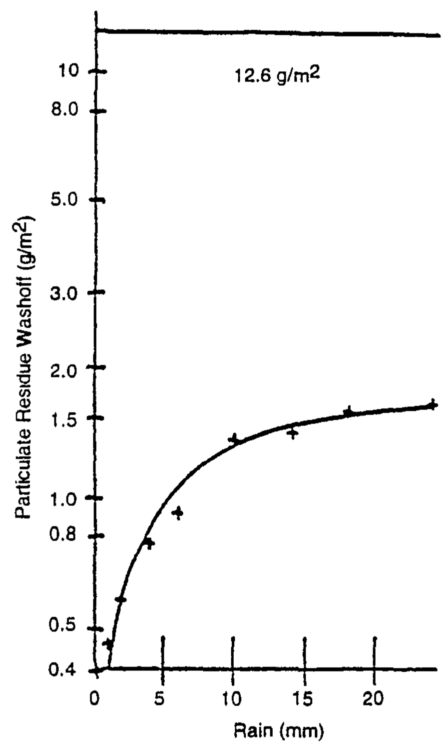

Figure 15. Suspended solids washoff test results (13).

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depth. Also shown on these figures are the total street dirt loadings. As an example, Figure 13 shows that 13.8 g/m^2 of total solids were on the street surfaces before the controlled rain event. After about 15 mm of rain fell on the test sites, almost 90 percent of the particulates that would wash off (about 3 g/m^2) did, similar to the rain depth needed for "complete" washoff as reported by earlier studies by Sartor and Boyd (16). The total quantity of material that could possibly wash off (about 3 g/m^2), however, is a small fraction of the total loading that was on the street (13.8 g/m^2). If the relationship between total available loading and total loading of particulates is not considered (as in many stormwater models), then the predicted washoff would be greatly in error.

Figure 14 is similar to Figure 13 but shows the smallest particle sizes ("dissolved solids," < 0.45 μm) as a function of washoff. Here, the total loading of the filterable solids on the streets was only about 1 g/m^2, and almost all of these small particles were available for washoff during these rains. Figure 15 shows the washoff of largest particles ("suspended solids," > 0.45 μm) on the street. Here, the street loading was 12.6 g/m^2, with only about 1.8 g/m^2 available for washoff. The predicted washoff of suspended solids could be in error by 700 percent if the total loading on the street was assumed to be removable by rains. SLAMM uses test results from Pitt (13) that measured the washoff and street dirt loading availability relationships for many street surfaces, rain intensities, and street dirt loadings to more accurately predict the amount of washoff.

Another common problem with stormwater models is the use of incorrect particulate accumulation rates for different surfaces. Figure 16 shows an example of the accumulation and deposition of street surface particulates for two residential areas monitored in San Jose, California (2). The two areas were very similar in land use but the street textures were quite different. The good condition asphalt streets were quite smooth, while the oil and screens overlaid streets were very rough. Immediately after intensive street cleaning, the rough streets still had substantial particulate loadings, while the smooth streets had substantially less. The accumulation of debris on the streets also increased the street dirt loadings over time.

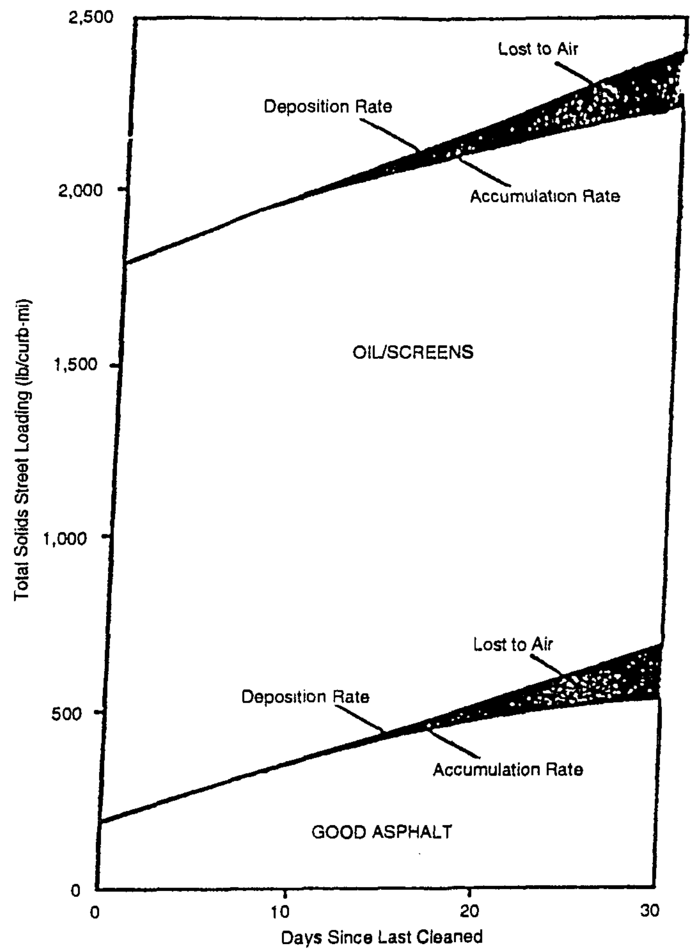

Figure 16. Deposition and accumulation rates of street dirt (13).

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The accumulation rates were very similar for these two different streets having the same land uses. The loadings on the streets at any given time, however, were quite different because of the greatly different initial loading values (permanent storage loadings). If infrequent street dirt loading observations are made, the true shape of the accumulation rate curve may not be accurately known. As an example, the early Sartor and Boyd (16) test results that have been used in many stormwater models assumed that the initial loading values after rains were close to zero, instead of the actual substantial initial loadings. The accumulation rates were calculated by using the slope between each individual loading value and the origin (zero time and zero loading), rather than between loadings from adjacent sampling times, which can easily result in accumulation rates many times greater than actually occurred.

The street dirt deposition rates were found to be only a function of the land uses, but the street dirt loadings were a function of the land use and street texture. The accumulation rates slowly decreased as a function of time and eventually became zero, with the loading remaining constant after a period of about 1 month of either no street cleaning or no rains. Figure 16 shows that the deposition and accumulation rates on the streets were about the same until about 1 or 2 weeks after a rain. If the streets were not cleaned for longer periods, then the accumulation rate decreased because of fugitive dust losses of street dirt to surrounding areas by winds or vehicle turbulence. In most areas of the United States (having rains at least every week or two), the actual accumulation of material on street surfaces is likely constant, with little fugitive dust losses (2).

SLAMM includes a large number of street dirt accumulation and deposition rate relationships that have been obtained for many monitoring sites throughout the United States and Canada. The accumulation rates are a function of the land uses, while the initial loadings on the streets are a function of street texture. The decreasing accumulation rate is also a function of the time after a street cleaning or large rain event.

Monte Carlo Simulation of Pollutants Strengths Associated With Runoff From Various Urban Source Areas

Initial versions of SLAMM only used average concentration factors for different land-use areas and source areas. This was satisfactory for predicting the event mean concentrations (EMC, as used by NURP [5]) for an extended period and for calculating the unit area loadings for different land uses. Figure 17 is a plot of the event mean concentrations at a Toronto test site (8). The observed concentrations are compared with the SLAMM predicted concentrations for a long-term simulation. All of the predicted EMC values are close to the observed EMC values. To predict the probability distributions of the concentrations, however, it was necessary to include probability information for the concentrations found in the different source areas. Statistical analyses of concentration data (attempting to relate concentration trends to rain depths and season, for example) from these different source areas have not been able to explain all of the observed variations in concentration. The statistical analyses also indicate that pollutant concentration values from individual source areas are distributed log normally. Therefore, log-normally distributed random concentration values are used in SLAMM

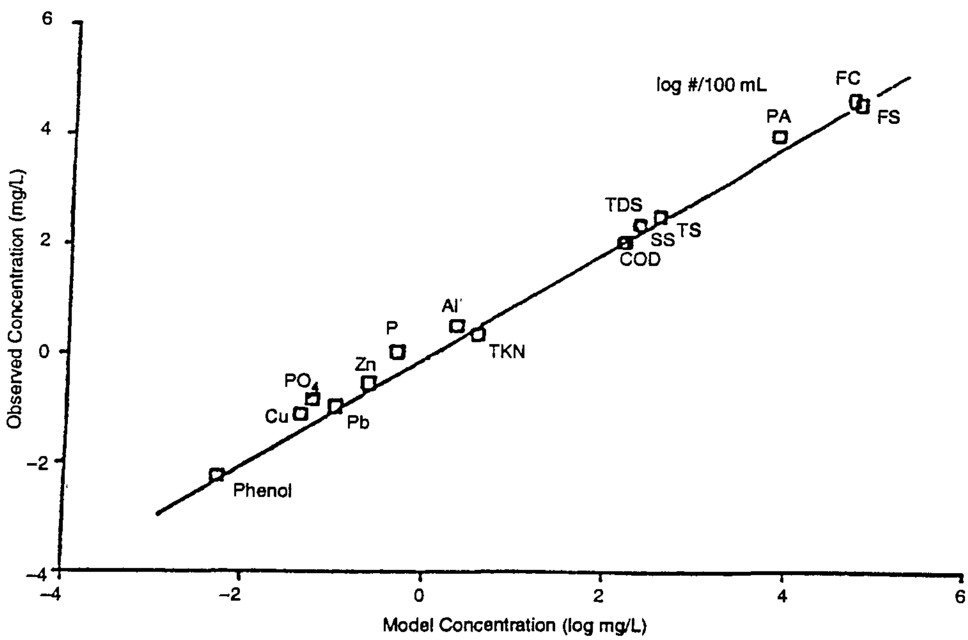

Figure 17. Observed and modeled pollutant concentrations (Toronto industrial site) (8).

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for these different areas. The results are predictions for concentration distributions at the outfall. This can provide estimates of criteria violations for different stormwater pollutants at an outfall for long, continuous simulations.

An Example Analysis Using SLAMM To Identify the Sources of Pollutants and To Evaluate Different Control Programs

Table 2 is a field sheet that has been developed to assist users of SLAMM to describe test watershed areas. This sheet is used to evaluate stormwater control retrofit practices in existing developed areas, and to examine how different new development standards effect runoff conditions. Much of the information on the sheet is not actually required to operate SLAMM but is very important when considering additional control programs, such as public education and good housekeeping practices, that are not quantified by SLAMM. The most important information shown on this sheet is the land use, the type of the gutter or drainage system, and the method of drainage from roofs and large paved areas to the drainage system. The efficiency of drainage in an area, specifically if roof runoff or parking runoff drains across grass surfaces, can be very important when determining the amount of water and pollutants that enter the outfall system. Similarly, the presence of grass swales in an area may substantially reduce the amount of pollutants and water discharged. This information is therefore required to use SLAMM.

The areas of the different surfaces in each land use are also very important for SLAMM. Figure 18 is an example showing the areas of different surfaces for a medium density residential area in Milwaukee. As shown in this

Table 2. Study Area Descriptions

Location: **Site number:**
Date: **Time:**
Photo numbers: **Roll number:**

Land-use and industrial activity:					
Residential:	Low	Medium	High-density single family		
	Multiple family				
	Trailer parks				
	High-rise apartments				
Income level:	Low	Medium	High		
Age of development:	<1930	'30-'50	'51-'70	'71-'80	New
Institutional:	School	Hospital	Other (type):		
Commercial:	Strip	Shopping center	Downtown	Hotel	Offices
Industrial:	Light	Medium	Heavy (manufacturing)	Describe:	
Open space:	Undeveloped	Park	Golf	Cemetery	
Other:	Freeway	Utility ROW	Railroad ROW	Other:	
Maintenance of building:	Excellent	Moderate	Poor		
Heights of buildings:	1	2	3	4+ stories	
Roof drains:	Underground	Gutter	Impervious	Pervious	
Roof types:	Flat	Comp. shingle	Wood shingle	Other:	
Sediment source nearby?	No	Yes (describe):			
Treated wood near street?	No	Telephone poles	Fence	Other:	
Landscaping near road:					
Quantity:	None	Some	Much		
Type:	Deciduous	Evergreen	Lawn		
Maintenance:	Excessive	Adequate	Poor		
Leaves on street:	None	Some	Much		
Topography:					
Street slope:	Flat (<2%)	Medium (2-5%)	Steep (>5%)		
Land slope:	Flat (<2%)	Medium (2-5%)	Steep (>5%)		
Traffic speed:	<25 mph	25–40 mph	>40 mph		

Table 2. Study Area Descriptions (continued)

Traffic density:	Light	Moderate	Heavy	
Parking density:	None	Light	Moderate	Heavy
Width of street:				
Number of parking lanes:				
Number of driving lanes:				
Condition of street:	Good	Fair	Poor	
Texture of street:	Smooth	Intermediate	Rough	
Pavement material:	Asphalt	Concrete	Unpaved	
Driveways:	Paved	Unpaved		
Condition:	Good	Fair	Poor	
Texture:	Smooth	Intermediate	Rough	
Gutter material:	Grass swale	Lined ditch	Concrete	Asphalt
Condition:	Good	Fair	Poor	
Street/Gutter interface:	Smooth	Fair	Uneven	
Litter loadings near street:	Clean	Fair	Dirty	
Parking/Storage areas (describe):				
Condition of pavement:	Good	Fair	Poor	
Texture of pavement:	Smooth	Intermediate	Rough	Unpaved
Other paved areas, such as alleys and playgrounds (describe):				
Condition of pavement:	Good	Fair	Poor	
Texture of pavement:	Smooth	Intermediate	Rough	Unpaved

Notes:

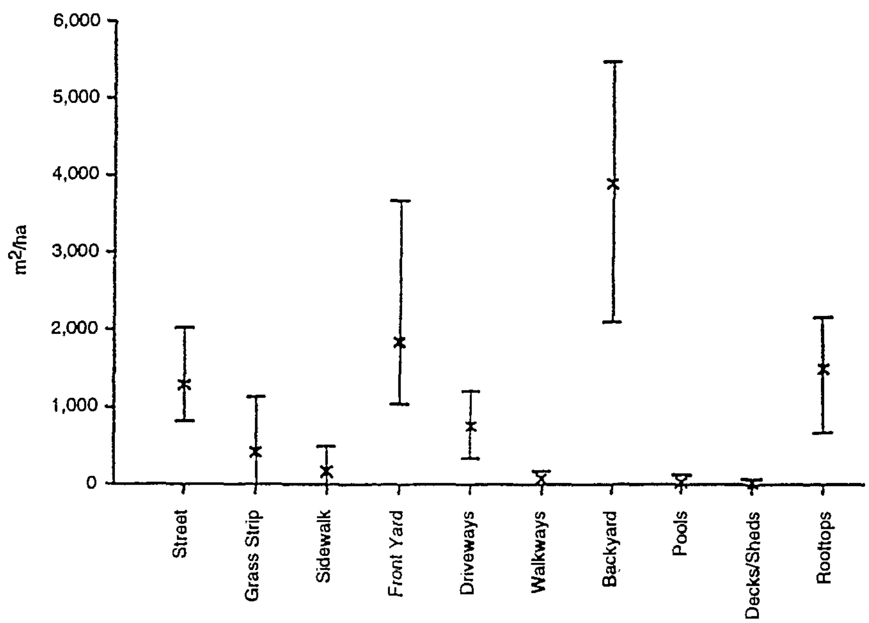

Figure 18. Source areas: Milwaukee medium-density residential areas (without alleys).

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example, streets make up between 10 and 20 percent of the total area, while landscaped areas can make up about half of the drainage area. The variation of these different surfaces can be very large within a designated area. The analysis of many candidate areas may therefore be necessary to understand how effective or consistent the model results may be for a general land-use classification.

Control practices evaluated by SLAMM include infiltration trenches, seepage pits, disconnections of directly connected roofs and paved areas, percolation ponds, street cleaning, porous pavements, catchbasin cleaning, grass swales, and wet detention ponds. These devices can be used singly or in combination, at source areas or at outfalls, or, in the case of grass swales and catchbasins, within the drainage system. In addition, SLAMM provides a great deal of flexibility in describing the sizes and other design aspects for these different practices.

One of the first problems in evaluating an urban area for stormwater controls is the need to understand where the pollutants of concern are originating under different rain conditions. Figures 19 through 22 are examples for a typical medium density residential area showing the percentage of different pollutants originating from different major sources, as a function of rain depth. As an example, Figure 19 shows the areas where water is originating. For storms of up to about 0.1 in. in depth, street surfaces contribute about one-half to the total runoff to the outfall. This contribution decreased to about 20 percent for storms greater than about 0.25 in. in depth. This decrease in the significance of streets as a source of water is associated with an increase in water contributions from landscaped areas (which make up more than 75 percent of the area and have clayey soils). Similarly, the significance of runoff from driveways and roofs also starts off relatively high and then decreases with increasing storm depth. Figures 20 and 21 are similar plots for suspended solids and lead. These show that streets contribute almost all of these pollutants for the smallest storms up to about 0.1 in. The contributions from landscaped areas then become dominant. Figure 22 shows that the contributions of phosphates are more evenly distributed between streets, driveways, and rooftops for the small storms, but the contributions from landscaped areas completely dominate for storms greater than about 0.25 in. in depth.

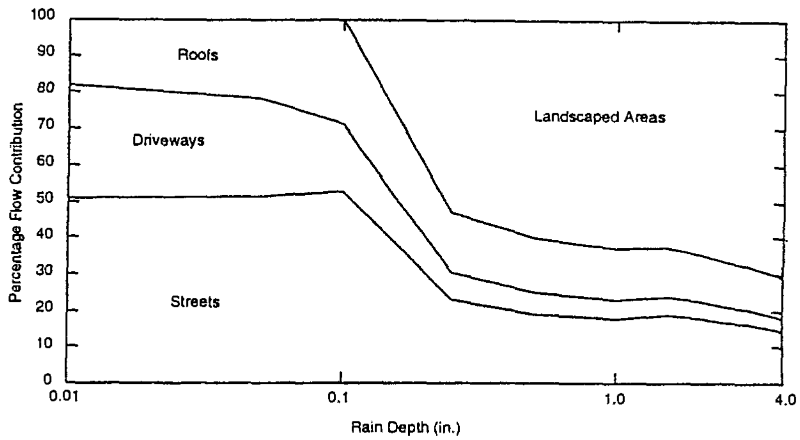

Figure 19. Flow sources for example medium-density residential area having clayey soils.

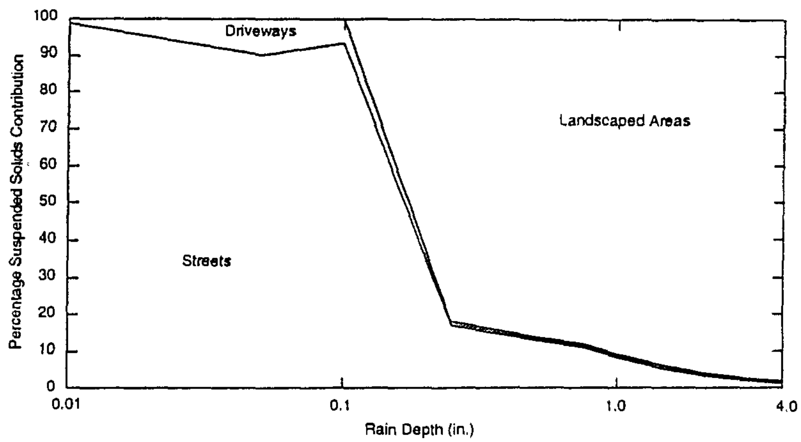

Figure 20. Suspended solids sources for example medium-density residential area.

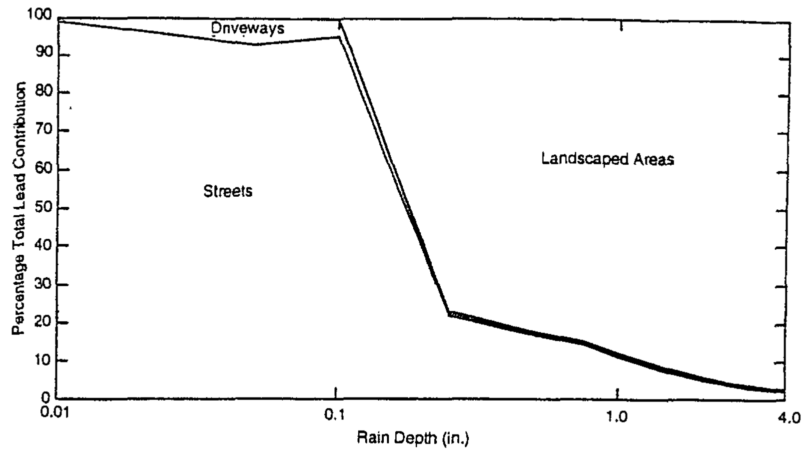

Figure 21. Total lead sources for example medium-density residential area.

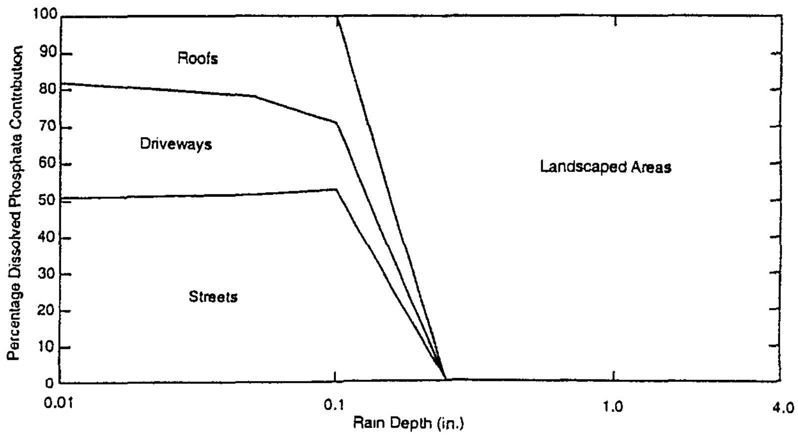

Figure 22. Dissolved phosphate sources for example medium-density residential area.

Obviously, the specific contributions from different areas and for different pollutants vary dramatically, depending on the characteristics of development for the area and the source controls used. Again, a major use of SLAMM is to better understand the role of different sources of pollutants. As an example, to control suspended solids, street cleaning (or any other method to reduce the washoff of particulates from streets) may be very effective for the smallest storms but would have very little benefit for storms greater than about 0.25 in. in depth. Erosion control from landscaped surfaces, however, may be effective over a wider range of storms.

The following list shows the different control programs that were investigated in this hypothetical medium density residential area having clayey soils:

- Base level (as built in 1961 to 1980, with no additional controls).
- Catchbasin cleaning.
- Street cleaning.
- Grass swales.
- Roof disconnections.
- Wet detention pond.
- Catchbasin and street cleaning combined.
- Roof disconnections and grass swales combined.
- All of the controls combined.

This residential area, which was based on actual Birmingham, Alabama, field observations for homes built between 1961 to 1980, has no controls. The use of catchbasin cleaning and street cleaning in the area was evaluated. Grass swale use was also evaluated, but swales are an unlikely retrofit option and would only be appropriate for newly developing areas. It is possible, however, to disconnect some of the roof drainages and divert the roof runoff away from the drainage system and onto grass surfaces for infiltration in existing developments. In addition, wet detention ponds can be retrofitted in different areas and at outfalls. Besides those controls examined individually, catchbasin and street cleaning controls combined were also evaluated, in addition to the combination of disconnecting some of the rooftops and the use of grass swales. Finally, the prospect of using all of the controls together was examined.

The following list shows a general description of this hypothetical area:

- All curb and gutter drainage (in fair condition).
- 70 percent of roofs draining to landscaped areas.
- 50 percent of driveways draining to lawns.
- 90 percent of streets of intermediate texture (remaining are rough).
- No street cleaning.
- No catchbasins.

About one-half of the driveways currently drain to landscaped areas, while the other half drain directly to the pavement or the drainage system. Almost all of the streets are of intermediate texture, and about 10 percent are rough textured. There currently is no street cleaning or catchbasin cleaning.

The level of catchbasin use that was investigated for this site included 950 ft^3 of total sump volume per 100 acres (typical for this land use), with a cost of about $50 per catchbasin cleaning. Typically, catch basins in this area could be cleaned about twice a year for a total annual cost of about $85 per acre of the watershed.

Street cleaning could also be used, with a monthly cleaning effort of about $30 per year per watershed acre. Light parking and no parking restrictions during cleaning are assumed, and the cleaning cost is estimated to be $80 per curb mile.

Grass swale drainage was also investigated. Assuming that swales could be used throughout the area, there could be 350 ft of swales per acre (typical for this land use), with swales 3.5 ft wide. Because of the clayey soil conditions, an average infiltration rate of about 0.5 in./hr was used in this analysis based on many different double-ring infiltrometer tests of typical soil conditions. Swales cost much less than conventional curb and gutter systems but require increased maintenance. Again, the use of grass swales is appropriate for new development but not for retrofitting in this area.

Roof disconnections could also be used as a control measure by directing all roof drains to landscaped areas. The objective would be to direct all the roof drains to landscaped areas. Because 70 percent of the roofs already drain to the landscaped areas, only 30 percent could be further disconnected, at a cost of about $125 per household. The estimated total annual cost would be about $10 per watershed acre.

An outfall wet detention pond suitable for 100 acres of this medium density residential area would have a wet pond surface of 0.5 percent of drainage area for approximately 90 percent suspended solids control. It would need 3 ft of dead storage and live storage equal to runoff from 1.25-in. rain. A 90-degree V notch weir and a 5-ft wide emergency spillway could be used. No seepage or evaporation was assumed. The total annual cost was estimated to be about $130 per watershed acre.

Table 3 summarizes the SLAMM results for runoff volume, suspended solids, filterable phosphate, and total lead for 100 acres of this medium density residential area. The only control practices evaluated that would reduce runoff volume are the grass swales and roof disconnections. All of the other control practices evaluated do not infiltrate stormwater. Table 3 also shows the total annual average volumetric runoff coefficient (Rv) for these different options. The base level of control has an annual flow-weighted Rv of about 0.3, while the use of swales would reduce the Rv to about 0.1. Only a small reduction of Rv (less than 10 percent) would be associated with complete roof disconnections compared with the existing situation because of the large amount of roof disconnections that already occur. The suspended solids analyses shows that catchbasin cleaning alone could result in about 14 percent suspended solids reductions. Street cleaning would have very little benefit, while the use of grass swales would reduce the suspended solids discharges by about 60 percent. Grass swales would have minimal effect on the reduction of suspended solids concentrations at the outfall. (They are primarily an infiltration device, having very little filtering benefits.) Wet detention ponds would remove about 90 percent of the mass and concentrations of suspended solids. Similar observations can be made for filterable phosphates and lead.

Figures 23 through 26 show the maximum percentage reductions in runoff volume and pollutants, along with associated unit removal costs. As an example, Figure 23 shows that roof disconnections would have a very small potential maximum benefit for runoff volume reduction, at a very high unit cost compared with other practices. The use of grass swales could have about a 60-percent reduction at minimal cost. The use of roof disconnection plus swales would slightly increase the maximum benefit to about 65 percent, at a small unit cost. Obviously, the use of roof disconnections alone, or all controlled practices combined, is very inefficient for this example. For suspended solids control, catchbasin cleaning and street cleaning would have minimal benefit at high cost, while the use of grass swales would produce a substantial benefit at very small cost. If additional control is necessary, however, the use of wet detention ponds may be necessary at a higher cost. If close to a 95-percent reduction of suspended solids was required, then all of the controls investigated could be used together, but at substantial cost.

Table 3. SLAMM Predicted Runoff and Pollutant Discharge Conditions for Example[a]

Birmingham 1976 rains (112 rains, 55 in. total, 0.01-3.384 in. each)	Runoff Volume			Suspended Solids		Filterable Phosphate		Total Lead	
	Annual ft^3/acre	Flow-wtg Rv	CN Range	Flow-wtg mg/L	Annual lb/acre	Flow-wtg µg/L	Annual lb/acre	Flow-wtg µg/L	Annual lb/acre
Base (no controls)	59,800	0.3	77-100	385	1,430	157	0.58	543	2.0
Catchbasin cleaning:	59,800	0.3	77-100	331	1,230	157	0.58	468	1.7
Reduction (lb or ft^3)	0				200		0		0.29
Reduction (%)	0			14	14	0	0	14	14
Cost ($/lb or $/$ft^3$)	NA				0.43		NA		293
($85/acre/yr)									
Street cleaning:	59,800	0.3	77-100	385	1,430	157	0.58	543	2.0
Reduction (lb or ft^3)	0				0		0		0.01
Reduction (%)	0			0	0	0	0	0	0.49
Cost ($/lb or $/$ft^3$)	NA				NA		NA		3,000
($30/acre/yr)									
Grass swales:	23,300	0.12	63-100	380	554	151	0.22	513	0.75
Reduction (lb or ft^3)	36,500				876		0.36		1.28
Reduction (%)	61			1	61	4	62	6	63
Cost ($/lb or $/$ft^3$)	Minimal				Minimal		Minimal		Minimal
($minimal/acre/yr)									
Roof disconnections:	56,000	0.28	76-100	410	1,430	156	0.55	443	1.6
Reduction (lb or ft^3)	3,800				0		0.03		0.48
Reduction (%)	6			-6	0	1	5	18	24
Cost ($/lb or $/$ft^3$)	0				NA		333		21
($10/acre/yr)									
Wet detention pond:	59,800	0.3	77-100	49	185	157	0.58	69	0.26
Reduction (lb or ft^3)	0				1,250		0		1.8
Reduction (%)	0			87	87	0	0	87	87
Cost ($/lb or $/$ft^3$)	NA				0.10		NA		73
($130/acre/yr)									
CB and street cleaning:	59,800	0.3	77-100	331	1,230	157	0.58	468	1.7
Reduction (lb or ft^3)	0				200		0		0.29
Reduction (%)	0			14	14	0	0	14	14
Cost ($/lb or $/$ft^3$)	NA				0.58		NA		397
($115/acre/yr)									
Roof dis. and swales:	20,900	0.1	63-100	403	526	139	0.18	352	0.46
Reduction (lb or ft^3)	38,900				904		0.40		1.6
Reduction (%)	65			-5	63	11	69	35	77
Cost ($/lb or $/$ft^3$)	0.00026				0.01		25		6.4
($10/acre/yr)									
All above controls:	20,900	0.1	63-100	42	55	139	0.18	36	0.05
Reduction (lb or ft^3)	38,900				1,375		0.40		1.98
Reduction (%)	65			89	96	11	69	93	97
Cost ($/lb or $/$ft^3$)	0.0066				0.19		638		129
($255/acre/yr)									

[a]Medium-density residential area, developed in 1961-1980, with clayey soils (curbs and gutters); new development controls (not retrofit).

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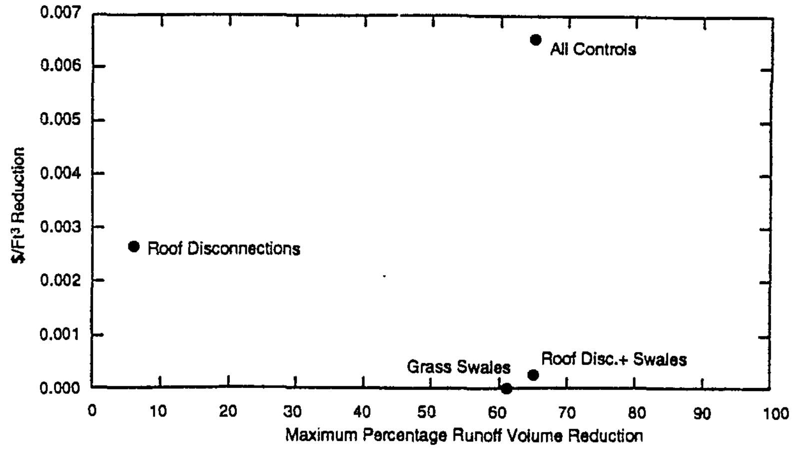

Figure 23. Cost-effectiveness data for runoff volume reduction benefits.

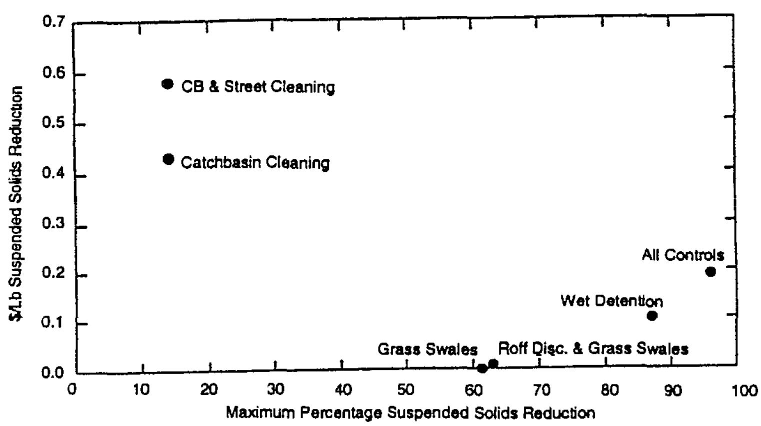

Figure 24. Cost-effectiveness data for suspended solids reduction benefits.

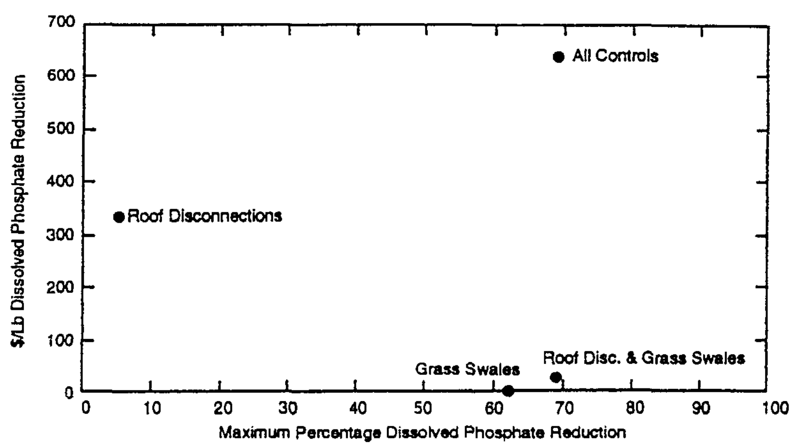

Figure 25. Cost-effectiveness data for dissolved phosphate reduction benefits.

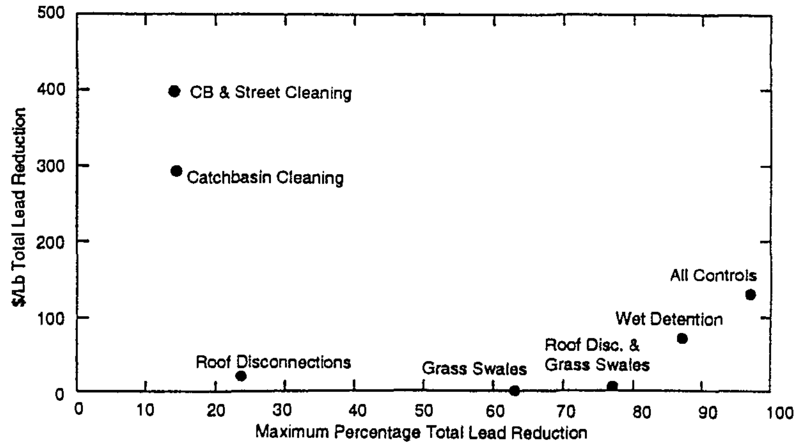

Figure 26. Cost-effectiveness data for total lead reduction benefits.

Conclusions

This paper has shown how SLAMM can be used to estimate the relative contributions of different pollutants from different areas within a complex watershed. SLAMM can also be used to examine the cost effectiveness of different individual control programs, or combinations of control programs, that could be located at source areas or at the outfalls.

SLAMM is unique compared with most stormwater models. Specifically, the use of small storm hydrology to predict the contributions of runoff from different source areas and the use of particulate washoff algorithms have greatly enhanced the accuracy of SLAMM. In addition, SLAMM requires a minimum amount of information to describe the area under consideration and engineering design parameters for different control practices. SLAMM is a very useful tool in guiding planners and watershed managers in devising control strategies. It has also been used to quantify and justify the benefits associated with stormwater controls for newly developing areas.

References

1. Ontario Ministry of the Environment. 1986. Humber River Water Quality Management Plan, Toronto Area Watershed Management Strategy. Toronto, Ontario.
2. U.S. EPA. 1979. Demonstration of nonpoint pollution abatement through improved street cleaning practices. EPA/600/2-79/161. Cincinnati, OH (August).
3. U.S. EPA. 1982. Sources of urban runoff pollution and its effects on an urban creek. EPA/600/S2-82/090. Cincinnati, OH (December).
4. Pitt, R. 1984. Characterization, sources, and control of urban runoff by street and sewerage cleaning. Contract No. R-80597012. U.S. Environmental Protection Agency, Office of Research and Development, Cincinnati, OH.
5. U.S. EPA. 1983. Final report for the Nationwide Urban Runoff Program. Washington, DC (December).
6. Pitt, R., and G. Shawley. 1982. A demonstration of nonpoint source pollution management on Castro Valley Creek. Alameda County Flood Control and Water Conservation District, Hayward, CA, for the Nationwide Urban Runoff Program, U.S. Environmental Protection Agency, Water Planning Division, Washington, DC (June).
7. Pitt, R., and P. Bissonnette. 1984. Bellevue Urban Runoff Program, summary report. Storm and Surface Water Utility, Bellevue, Washington (November).
8. Pitt, R., and J. McLean. 1986. Toronto Area Watershed Management Strategy Study—Humber River Pilot Watershed Project. Ontario Ministry of the Environment, Toronto, Ontario (June).
9. Pitt, R. 1986. Runoff controls in Wisconsin's priority watersheds. In: Urbonas, B., and L.A. Roesner, eds. Proceedings of the Conference on Urban Runoff Quality—Impact and quality enhancement technology. New York, NY: American Society of Civil Engineering (June).
10. Pitt, R. 1983. Effects of urban runoff on aquatic biota. In: Hoffman, D., ed. Handbook of ecotoxicology. Lewis Publishers.
11. Bannerman, R., K. Baun, M. Bohn, P.E. Hughes, and D.A. Graczyk. 1983. Evaluation of urban nonpoint source pollution management in Milwaukee County, Wisconsin, Vol. I. Grant No. P005432-01-5. NTIS PB 84-114164. Prepared for the U.S. Environmental Protection Agency, Water Planning Division (November).
12. McCuen, R.H. 1989. Hydrologic analysis and design. Englewood Cliffs, NJ: Prentice Hall.
13. Pitt, R. 1987. Small storm flow and particulate washoff contributions to outfall discharges. Ph.D. dissertation. Department of Civil and Environmental Engineering, University of Wisconsin—Madison (November).
14. U.S. Soil Conservation Service. 1986. Urban hydrology for small watersheds. U.S. Department of Agriculture Tech. Release No. 55—revised (June).
15. Sutherland, R. 1993. Portland stormwater quality using SIMPTM. Draft report. OTAK, Inc., Lake Oswego, OR.
16. Sartor, J.D., and G.B. Boyd. 1972. Water pollution aspects of street surface contaminants. Report No. EPA-R2-72-081. Prepared for the U.S. Environmental Protection Agency (November).

R0015872

Combining GIS and Modeling Tools in the Development of a Stormwater Management Program

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Abstract

A geographic information system (GIS) based Watershed Simulation Model (GWSM) was developed for stormwater pollution control in Prince George's County, Maryland, using the Stormwater Management Model (SWMM 4.2), ARC/INFO (6.1), and data postprocessors. The GWSM was designed to perform planning level assessments of water quality concentrations and loadings for 12 water quality parameters in 41 primary watersheds within the county. The model combines continuous watershed modeling and the spatial analysis capabilities of a GIS in a single, integrated system operating on a Sun Sparc 2 workstation. The user selects a watershed to determine daily, monthly, seasonal, or annual stormwater pollutant loadings using the SWMM output. Additional routines analyze stormwater control structures and user-defined subbasins. GWSM output is saved for watershed comparisons using both graphical and tabular formats.

GWSM allows county water resources planners to perform analyses in the following areas:

- *Prioritize problem watersheds:* Identify where impacts are most severe based on pollutant-specific data. Both temporal and spatial problems and trends are identified.
- *Integration with water quality databases:* Data from national databases, including STORET, WATSTORE, and Reachfile III streams, are used in characterizing the water resources of the study area.
- *Alternative land use assessment:* Water quality impacts and trends, based on land use changes or future master planning scenarios, can be evaluated.
- *Screening solutions/microscale analysis:* Management assessment tools provide planning level screening of controls designed to cost-effectively manage the pollutants of concern. This allows determination of which flows and loads need to be controlled. Smaller, 100- to 400-acre drainage basins can also be evaluated with alternative land uses and management practices.

Introduction

The National Pollutant Discharge Elimination System (NPDES) municipal stormwater permit regulations resulting from the Clean Water Act Reauthorization of 1987 require large counties and municipalities to develop comprehensive stormwater management programs. For complex urban fringe areas such as Prince George's County, Maryland, prioritizing stormwater problems and developing cost-effective management techniques is a primary objective if program resources are to be efficiently allocated. The geographic information system (GIS) based Watershed Simulation Model (GWSM) was designed to support the development and implementation of the county's stormwater management program. GWSM enables planning assessment at the watershed level through estimation of pollutant loads and flows for current land use conditions and future buildout scenarios, with or without structural controls. At the small basin level, alternative stormwater control scenarios can be evaluated for user-defined areas.

Existing Watershed Models

A variety of models are available for simulating water quantity and quality on a watershed scale (1). These range from relatively simple empirical models that predict annual or storm loads to deterministic models that yield flow and pollutant loads for a variety of flow conditions.

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Simple models, such as the U.S. Environmental Protection Agency (EPA) Screening Procedures (2) model and the Simple Method (3), commonly aggregate the physical parameters for an entire watershed and calculate loads on an annual or seasonal time step. Although this reduces the amount of input data and time required to apply the model, it does not allow for an examination of the variations between storm events or water quality problems occurring over a wide range of hydrologic conditions.

Complex models, such as SWMM (4) and the Hydrologic Simulation Program-Fortran (HSPF) (5), simulate hydrologic processes that generate runoff and pollutant loads in a continuous manner rather than relying on simplified rates of change (1). This class of model can use time series climatic data for continuous simulation over several years, enabling analysis of not only annual loads and flows but also of single events or a series of storms.

Previous Studies

GIS is increasingly used for watershed assessment in support of various water resources programs (6). A review of available literature shows that the use of GIS in conjunction with hydrologic models comprises a major part of the current activities. The use of GIS for hydrologic modeling can be divided into two general approaches: 1) performing watershed modeling analyses directly within a GIS package using empirical or lumped models and 2) processing input data for use with a separate or partially linked watershed model.

Empirical modeling within a GIS environment includes an approach using the modified Universal Soil Loss Equation (USLE) for evaluating silvicultural activities and control programs in Montana (7). Tim et al. (8) coupled empirical simulation modeling with a GIS to identify critical areas of nonpoint source pollution in Virginia. On the other hand, linked GIS and hydrologic modeling approaches include a study by Ross and Tara (9) using a GIS to perform spatial data referencing and data processing while traditional hydrologic codes performed the calculations for time-dependent surface- and ground-water simulations. Terstriep and Lee (10) developed AUTO_QI, a GIS-based interface for watershed delineation and input data formatting to the Q-ILLUDAS model.

Modeling Approach: The Prince George's County GIS-Based Watershed Simulation Model

The GWSM developed for the Prince George's County stormwater program combines results from a watershed model with GIS analytic routines. Figure 1 illustrates this modular modeling approach. The GWSM uses a continuous simulation model to generate single land-use water quality and quantity time series data. ARC/INFO,

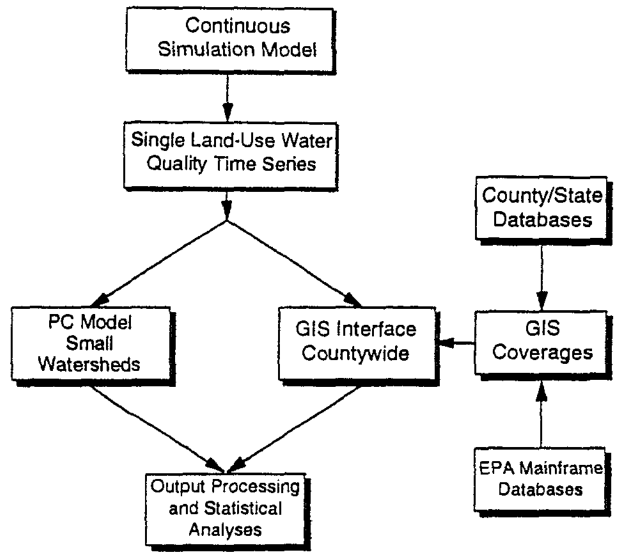

Figure 1. Watershed modeling approach.

combining GIS coverages from various databases, is used to select a watershed and determine its physical characteristics, including drainage area and land-use distribution. The single land-use time series, along with the land-use and drainage area files, are processed by a series of Fortran routines to determine watershed loads and summary statistics (Figure 1). Results can be interactively displayed for watershed comparisons and management assessment. As with AUTO_QI (10), the GWSM modeling approach uses the GIS to furnish data for use with a continuous simulation model. Unlike other approaches, however, GWSM uses preprocessed output from a watershed model to calculate storm flows and pollutant loads for the study watershed.

Although SWMM was used for this application of GWSM, results from other continuous simulation models can also be included in the model. This modular approach enables increased simulation accuracy as calibrated models become available. Further, several models can be used within a single application, combining the strengths of each. For instance, SWMM could be used for urban areas, while HSPF could be applied to agricultural lands within a single study area.

Input Data Requirements

GWSM requires both ARC/INFO vector coverages and continuous simulation model output for each land-use type modeled. Coverages include watershed boundaries and current land-use files. Input data for SWMM include parameters for the rainfall, temperature, and runoff blocks for each of the nine homogenous land-use basins.

A Case Study: Collington Branch Watershed

Water resource managers face multiple questions on how best to manage stormwater on a regional, watershed, and subbasin scale. In Prince George's County, an area covering over 480 square miles, there are 41 watersheds of varying size and land-use distribution. The proximity of the county to the fast-growing metropolitan Washington, DC, area makes stormwater management a complex and pressing problem.

An assessment of the predominantly forested and agricultural Collington Branch watershed, covering approximately 14,820 acres and draining to the Western Branch and to the Patuxent River, was performed as a demonstration of the GWSM. Figure 2 is the watershed selection screen from the GWSM, including the land-use distribution for the Collington Branch watershed. This case study demonstrates how the GWSM can be applied using a three-step approach: 1) identify and target problem watersheds, 2) identify pollutant sources and characterize pollutants, and 3) conceptually identify control measures and evaluate future land-use changes.

Watershed Problem Identification and Targeting

Often, the first questions that water resource managers ask are, How can problem watersheds be identified, and how do watersheds compare with each other in terms of pollutant loads and flows? GWSM enables the rapid analysis of the relative contributions of each watershed to the total load, performing a complete assessment and interpretation of the data within 10 minutes. The results

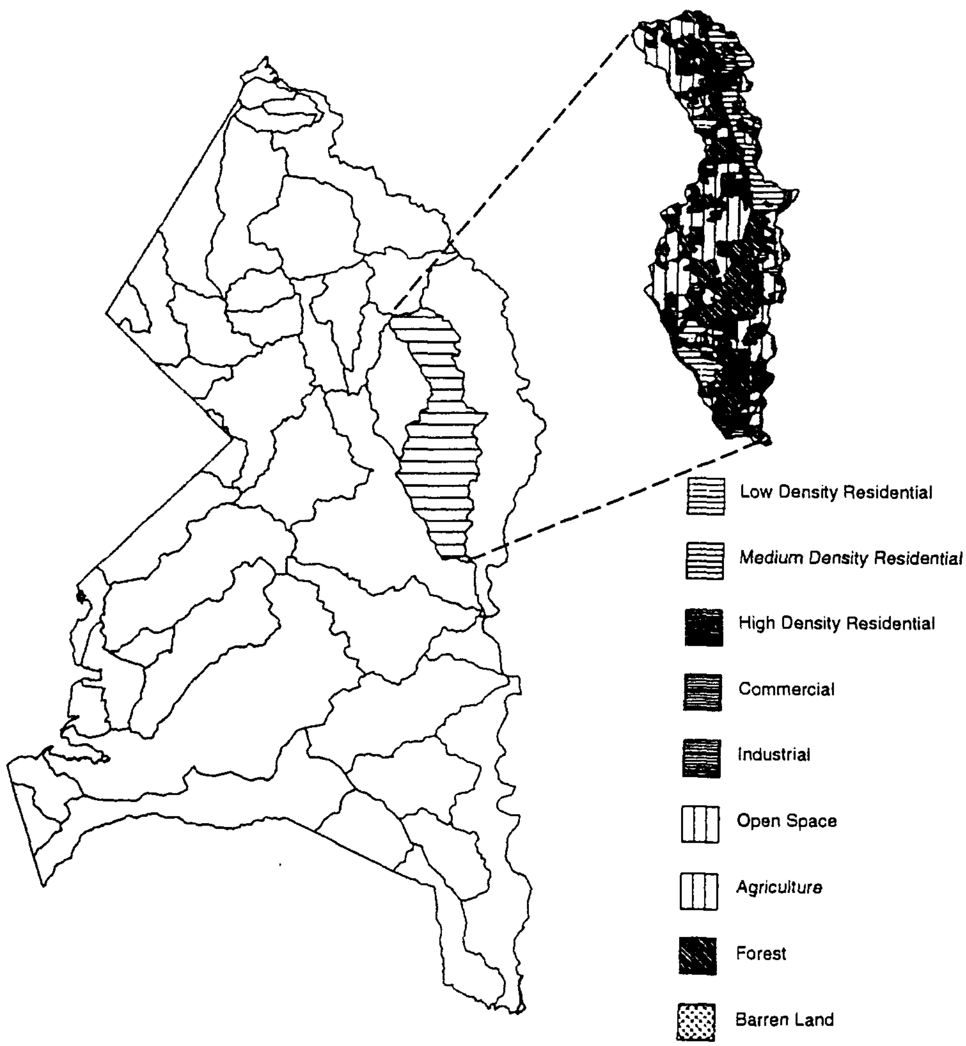

Figure 2. Watershed selection screen for the Collington Branch watershed, including land-use distribution.

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include estimates of annual, mean monthly, and monthly loads for the watershed for 12 parameters. Each constituent may be viewed either as a percentage of the total load or in actual units (pounds or cubic feet). Figure 3 presents the graphical display from GWSM showing the total nitrogen load for the Collington Branch, illustrating the changes in loads due to climatic variability.

A comparison between two watersheds is easily performed to assess load and flow estimates and review results graphically. Multiple applications provide a rapid assessment of all the major watersheds in the county. This phase of the GWSM analysis provides information to answer the questions, Which are the likely water quality impacts, and how significant are they compared to other watersheds?

Identify Pollutant Sources and Characterize Pollutant of Concern

Once problem watersheds are identified and targeted for further analysis, the water quality problems must be clearly defined. What are the sources of the pollutants of concern? An analysis of the pollutant contribution by land use is included in GWSM, calculating constituent load by land use for each of the 12 parameters. Figure 4 shows total nitrogen contributions for each land use in the Collington Branch, indicating that agricultural areas are the primary source. This provides important information for targeting control programs throughout the watershed. Characterizing the pollutant loads is an important issue for developing management programs. The following questions are answered at this phase: What pollutants are of primary concern? What are their sources and spatial and temporal characteristics? How do their loads vary seasonally and annually? What are the temporal variations between pollutants? To answer these questions, GWSM provides graphical displays of mean monthly, mean annual, and annual pollutant loads for each pollutant.

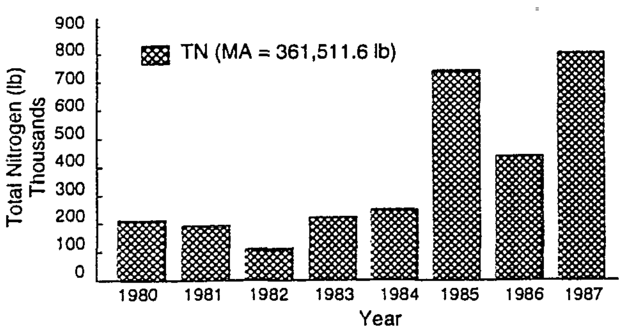

Figure 3. Annual summary of total nitrogen load, Collington Branch watershed, illustrating changes in loads due to climatic variability.

Management Screening

In this phase, implementing the most cost-effective controls is addressed. To address control measures, the relationship between storm size, runoff volume, and pollutant load must be assessed. For example, what storm sizes contribute the largest pollutant loads, and which storm size should be targeted? The analytic routines in GWSM provide graphical answers to these questions. Figure 5 presents lead loads by storm size, indicating that targeting only a percentage of runoff will control over half of the total load. Figure 6 illustrates the rainfall/runoff characteristics of the watershed, with the majority of storms generating less than 0.05 in. of runoff. These estimates will vary by watershed and type of pollutant, but GWSM allows rapid analysis of each pollutant and multiple watersheds.

Management evaluation is done at both watershed- and site-specific levels. Over an entire watershed, what is the optimal control level for structural water quality facilities? GWSM includes a stormwater pond routine that calculates the pollutant mitigating effects of different

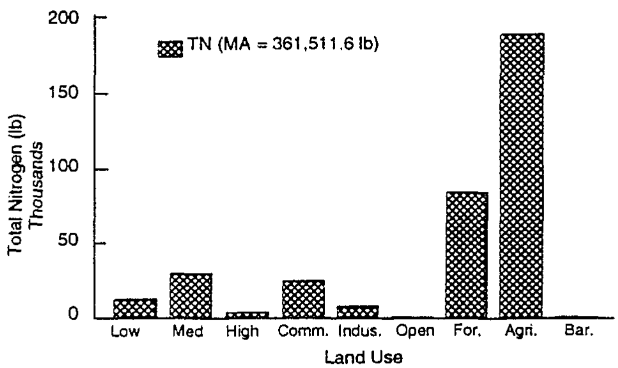

Figure 4. Total nitrogen load by land use, Collington Branch watershed.

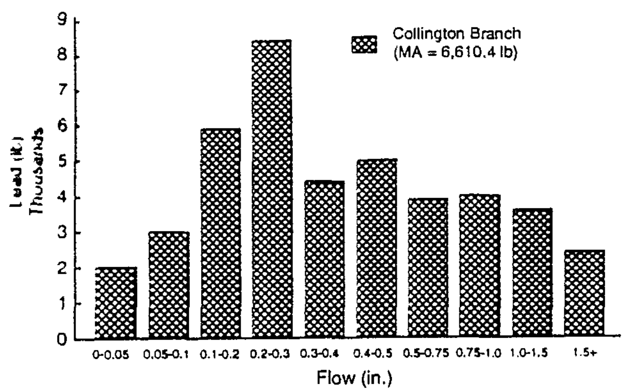

Figure 5. Lead distribution by storm size, Collington Branch watershed.

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control levels and retention times. At a site-specific level, such as a proposed new subdivision, similar structures can also be evaluated to allow optimal design criteria to be selected. Figure 7 illustrates the phosphorus contribution for a simulated residential subdivision, and the pollutant reduction from a stormwater pond designed to control for 0.3 in. of runoff. As seen in Figure 7, the mean annual phosphorus load was reduced from 453 to 277 lb by the simulated structure.

Managers must address how future changes will affect water quality. On the watershed level, what will be the impact of urbanization on flow and pollutants loads? At the subbasin level, how will proposed projects change the runoff characteristics? Both land use scenarios can be evaluated in GWSM. On the watershed scale, the current land use can be interactively changed with a "point-and-click" menu. At the subbasin level, a user-defined basin may be modeled, with the land-use distribution entered into a pulldown menu. At both watershed and subbasin levels, once a land-use scenario is selected, GWSM calculates the anticipated pollution loads. The results can then be compared with preexisting conditions. The following questions are answered during the final phase of GWSM: How do pollutant loads relate to rainfall and runoff distribution and intensity?

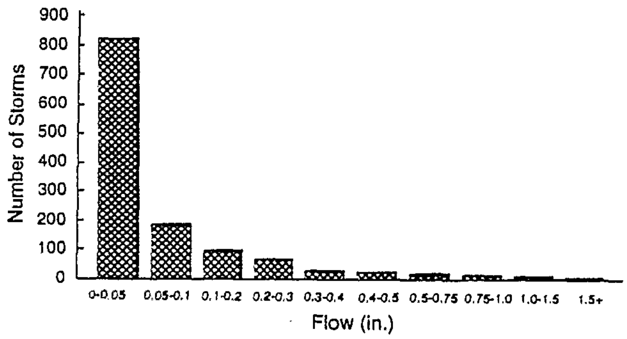

Figure 6. Flow (frequency) distribution by storm size, Collington Branch watershed.

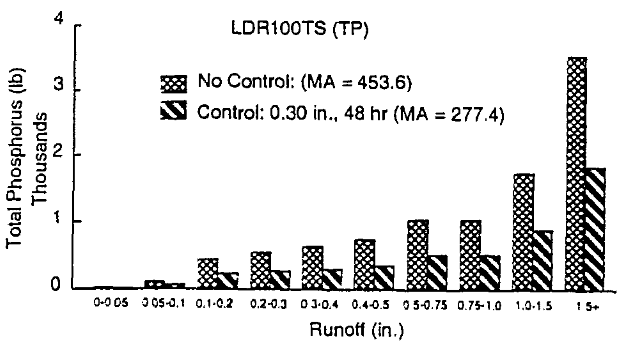

Figure 7. Phosphorus contribution for a simulated residential subdivision with a stormwater pond designed to control for 0.3 in. of runoff.

What is the optimal control level for structural practices? What are the likely impacts of future land-use changes on water quality?

Stormwater Management: Future Model Applications

The NPDES stormwater permit regulations have created new challenges and opportunities for state, county, and city water resource programs. Water resource managers are faced with often conflicting stormwater management objectives and forced to make decisions that weigh the costs and benefits of each. For instance, water quality and flood control objectives do not always coincide. The design and management of regional stormwater ponds will vary depending on whether water quantity control or water quality control is the primary objective.

To address the complex array of stormwater issues, more sophisticated analytical tools and techniques are needed. Watershed models that effectively evaluate alternative scenarios and allow for optimization routines for differing management objectives are in demand. Integrating environmental data, such as wetland areas, bioassessment information, structural and nonstructural best management practice (BMP) optimization, and permit and monitoring information will be required in a user-friendly GIS package.

As the NPDES stormwater regulations are implemented at the county and local level, unique management programs will develop according to specific water quality and resource availability issues. As these programs take shape, GIS and GIS-based models and information management systems are likely to play larger roles in assessing problems and crafting solutions.

Conclusions

The GWSM enabled the rapid assessment of Prince George's County's stormwater problem areas and the evaluation of control measures. GWSM was developed to support the development of the county's stormwater management program. The model incorporates the strengths of continuous simulation modeling with the spatial analysis techniques of GIS in an integrated system. Together, the GIS and data processing routines allow for further analysis and interpretation of time series data from the SWMM model. Combining continuous time series data with georeferenced watershed/land-use data allows for the further analysis and interpretation of the results. As additional data from monitoring both homogenous land-use basins and in-stream locations becomes available from the long-term monitoring program developed as part of the NPDES Part 2 permit, the accuracy of the model will increase.

As technologies for developing and evaluating stormwater programs increase in sophistication, the questions asked of water resource managers are likely to become more difficult. The GWSM will continue to develop to incorporate more functions designed to assist managers to make the best, most informed decisions.

Acknowledgments

The authors thank the Prince George's County Watershed Protection Branch for its support of the model development; Prince George's County Park and Planning for watershed delineation coverages; and the Maryland Department of Planning for 1990 land-use coverages of Prince George's County.

References

1. U.S. EPA. 1992. Compendium of watershed-scale models for TMDL development. EPA/841/R-92/002. Washington, DC.
2. U.S. EPA. 1985. Water quality assessment: A screening procedure for toxic and conventional pollutants in surface and groundwater, Part 1. EPA/600/6-85/002a. Athens, GA.
3. Schueler, T. 1987. Controlling urban runoff: A practical manual for planning and designing urban BMPs. Washington, DC: Metropolitan Washington Council of Governments.
4. Huber, W.C., and R.E. Dickinson. 1988. Storm water management model, Version 4: User's manual. EPA/600/3-88/001a (NTIS PB-88-236641/AS). Athens, GA.
5. Barnwell, T.O., and R. Johanson. 1981. HSPF: A comprehensive package for simulation of water hydrology and water quality. In: Nonpoint pollution control: Tools and techniques for the future. Rockville, MD: Interstate Commission on the Potomac River Basin.
6. DeVantier, B.A., and A.D. Feldman. 1993. Review of GIS applications in hydrologic modeling. J. Water Resour. Plan. Mgmt. 119(2):246-261.
7. James, D.E., and M.J. Hewitt, III. 1992. To save a river. GeoInfo Systems, November/December. pp. 37-49.
8. Tim, U.S., S. Mostaghimi, and V.O. Shanholz. 1992. Identification of critical nonpoint pollution source areas using geographic information systems and water quality modeling. Water Resour. Bull. 28(5):877-887.
9. Ross, M.A., and P.D. Tara. 1993. Integrated hydrologic modeling with geographic information systems. J. Water Resour. Plan. Mgmnt. 119(2):129-140.
10. Terstriep, M., and M.T. Lee. 1990. ARC/INFO GIS interface for Q_ILLUDAS stormwater quantity/quality model. Proceedings of the Remote Sensing and GIS Applications to Nonpoint Source Planning Meeting, Chicago, IL (October).

Watershed Screening and Targeting Tool (WSTT)

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Abstract

Screening-level tools allow managers to understand, evaluate, and compare the water quality problems of watersheds so that they can be prioritized. The Watershed Screening and Targeting Tool (WSTT) makes it easier for watershed managers in federal, state, and local agencies to conduct these evaluations by providing access to the necessary data and information and facilitating the assessment itself. This prototype has been developed as a cooperative project for the U.S. Environmental Protection Agency (EPA) Region 4 and the Office of Wetlands, Oceans, and Watersheds in support of the Total Maximum Daily Load (TMDL) program.

The WSTT is an interactive, user-friendly, two-step evaluation and targeting process. The first step allows for preliminary screening based on multiple criteria. Each criterion can be compared with a default or user-defined reference value. Data from EPA mainframe databases allow the user to compare reference values with land-use and water quality observations from watersheds under consideration. The second level of targeting, comparative analysis, allows for a more detailed examination of watersheds. In addition, this analysis permits the user to include subjective weights and additional data to the targeting procedure. The algorithms for this targeting system are based on a hierarchical structure of objectives and criteria, where a set of up to seven criteria can be used to describe the comparison objectives. Although the analysis objectives are project specific, the procedures are developed to use either user-specified data or information from provided databases. Weights can be entered to give greater or lesser value to particular criteria. This paper presents examples of the application of these techniques to sample watersheds in Alabama.

Introduction

Targeting of watersheds is used to allocate increasingly scarce water management resources for data collection, modeling studies, and management assessment, design, and construction. Water resource managers can use screening-level evaluations to help assess, compare, and prioritize the water quality problems of watersheds within their jurisdictions. The Watershed Screening and Targeting Tool (WSTT) makes it easier for watershed managers in federal, state, and local agencies to conduct these evaluations by providing easy access to the necessary data and facilitating targeting assessments. A prototype of WSTT has been developed that allows access to data for Alabama and Georgia. WSTT operates on a personal computer (286+) in a DOS environment.

WSTT provides an interactive, user-friendly, two-step evaluation and targeting process (Figure 1). The first allows for preliminary screening based on multiple criteria. Each criterion can be compared with a default or user-defined reference value. Data from U.S. Environmental Protection Agency (EPA) mainframe databases allow the user to compare reference values with land-use and water quality observations from watersheds under consideration. The second level of targeting, comparative analysis, allows for a more detailed examination of watersheds. In addition, this analysis permits the user to include subjective weights and additional data in the targeting procedure. The algorithms for this targeting system are based on a hierarchical structure of objectives and criteria, where a set of up to seven criteria can be used to describe the comparison objectives. Although the analysis objectives are project specific, the procedures are developed to use either user-specified data or information from provided databases. Weights can be entered to give greater or lesser value to particular criteria.

Watershed prioritization and targeting involve a multistep decision-making process using both technical criteria and subjective judgement. The use of formal targeting procedures throughout this process can assist in structuring the problem while taking into account all pertinent and site-specific concerns.

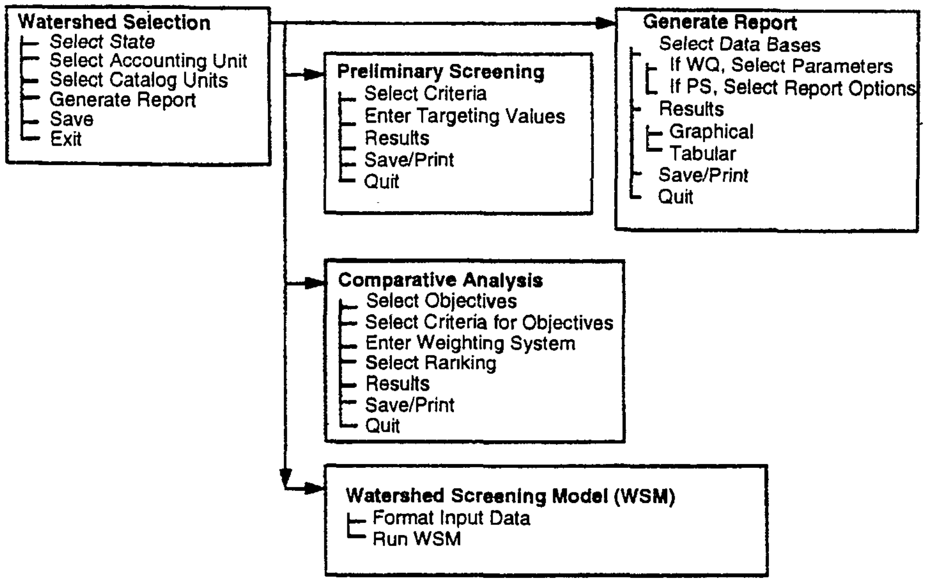

Figure 1. Schematic of WSTT components.

Multicriteria analysis techniques can aid in processing available information in a more structured framework, leading to a rational prioritization of watersheds. These procedures can be used in the Total Maximum Daily Load (TMDL) process to identify data sources, retrieve relevant water quality and watershed data, and analyze these data within a structured framework to determine which watersheds require management. The advantages of structured decision-making techniques—especially when dealing with numerous watersheds where the ranking in order of priority is not obvious *a priori*—include analysis directed toward the selection of pertinent decision criteria and identification of potential candidate watersheds; credibility of the selection process by the use of demonstrated and valid decision-making techniques; reductions in the cost and time for data collection and processing through a multiphase screening process; iterative evaluation of watersheds; and increased understanding of the various tradeoffs.

For the incorporation of targeting criteria and the generation of reports, WSTT is distributed with and relies on data that were selectively downloaded from EPA's mainframe computer. The databases that it uses include an accounting unit/catalog unit (CU) summary table, land use (U.S. Department of Agriculture Natural Resource Inventory summary of acres per land-use category), water quality (EPA STORET ambient water quality data summarized by CU for 50 parameters), reference levels (based on EPA water quality criteria), water supplies (number, flow, location, and type), point sources (number, flow, location, and type), and water bodies (number and size). These data, always available to the public, have traditionally been difficult to access without familiarity with EPA's mainframe. Through WSTT, these data are readily accessible. Using these databases, WSTT can generate reports, in table or graph form, on land use, water quality, water supplies, impoundments, and point source facilities in each of the selected areas.

The data that are distributed with WSTT can also be used to prepare preliminary data input files for a watershed screening model (WSM) which, for this prototype version, can be run for CUs within Georgia and Alabama. The watershed screening methodology permits simple watershed assessments that predict daily runoff, streamflow, erosion, sediment load, and nutrient washoff. The WSM relies on observed precipitation and temperature data from local meteorologic stations, municipal point source load estimations from pollutant concentrations in the literature, and nonpoint source loading functions for selected land uses based on literature values. Users can readily modify or revise the input data to reflect site-specific conditions. Output data from the model simulations can be used to augment information provided by the other databases.

Review of Potential Targeting Procedures

Most multicriteria decision techniques with potential application to the prioritization and targeting process can be grouped into three categories:

- *Sequential elimination:* Techniques to eliminate watersheds that do not show any need for controls.
- *Dominance theory:* Techniques to eliminate inferior or dominated watersheds that demonstrate a need for

pollution control but do not present a character of relative urgency.

- *Ranking procedures:* Techniques to prioritize remaining watersheds.

Sequential Elimination

The first group of analytical procedures target nonpriority watersheds or the nonfeasible set of watersheds. These procedures are typically referred to as sequential elimination techniques. Each watershed is compared with a hypothetical watershed using an amalgamation of standards and criteria. Watersheds that are better than the hypothetical watershed form the nonfeasible set and can be eliminated from further analysis. These techniques provide a preliminary filtering system to ensure the legitimate acceptability of the remaining set of watersheds. Sequential elimination techniques do not differentiate on the basis of relative importance, only on the ability to satisfy a condition of preset limits. Four relevant sequential elimination techniques, available for application in the prioritization process, include the conjunctive approach, the disjunctive approach, the lexicographic approach, and the compensatory approach (1).

The conjunctive approach screens out watersheds by establishing minimum cutoff levels for each discriminating criteria. Depending on the type of criterion and its method of measurement, the constraint or "cutoff level" is defined as either a categorical exclusionary or inclusionary limit. The application of a conjunctive scheme relates the decision criteria and their constraint with the logical "and" so that all constraints must be satisfied for a watershed to be eliminated from further consideration. Evaluation scales do not have to be homogeneous across criteria and can include logical, numeric, or natural scales. Because decision criteria and the set of watersheds are independent, each watershed is compared individually with a hypothetical set of constraints rather than with other watersheds. In general, decision criteria in the conjunctive approach should be carefully selected to focus on criteria with a strict regulatory requirement and technical constraints that cannot be relaxed or are not subject to tradeoffs.

The disjunctive approach is similar to the conjunctive scheme, but it requires that only one criterion be satisfied for a watershed to be eliminated from further consideration. Because this process is characterized by the logical relation "or," problem formulation must be defined in terms of the level of substitutions among the selected decision criteria.

Lexicographic screening differs from the previous techniques in that the value of each criterion is compared across watersheds (2). The criteria are first ordered in terms of their relative importance, and watersheds are then screened, starting with the most important criteria. Watersheds that pass this preliminary test are screened with the next highest ranked criteria until either all criteria are evaluated or the number of watersheds selected for further analysis is sufficiently reduced.

Compensatory analysis is a more elaborate form of conjunctive and disjunctive screening and deals primarily with preferential constraints where the cutoff levels are set by the objectives rather than by the criteria themselves (3). The analysis develops constraints on selected objectives that are represented in the decision problem by a group of two or more criteria. For each identified objective, the corresponding criteria are combined into a discriminating model expressing the degree to which each criterion achieves the objective. The discrimination process can be inclusionary, exclusionary, or both, depending on the screening model.

Dominance Theory

The second group of analytical tools with potential for application in the watershed prioritization and targeting process consist of techniques developed from the dominance approach. This approach serves to identify poorer watersheds rather than rank them completely. In this case, when the first watershed that has criterion values at least as poor as those of a second, as well as one or more values that are poorer, the first watershed will be selected for further analysis rather than the second. The first watershed is said to dominate the second. These techniques add some capability of determining which watersheds are worse than others beyond the simple comparisons offered by the sequential elimination schemes. Although several techniques have been developed based on this decision rule, their application to discrete decision space, such as watershed targeting applications, may not be effective in eliminating many watersheds. Among these techniques are the noninferior curve technique, the indifference map technique, and fuzzy outranking approaches.

The noninferior curve technique uses the distribution of the feasible set of watersheds within the decision space to identify inferior and noninferior sets (4). The curve defines the level of tradeoff between decision criteria where any incremental improvement in one criterion results in a balanced incremental decrease in other criteria. Application of this technique may require excessive computational time and professional training for interpretation of the results (5).

The indifference map technique relies on the representation of the preference structure to determine the family of indifference curves (6). An indifference curve represents points in the decision space for which the preference is equivalent among all criteria. This approach can be used in combination with the noninferior curve technique. Theoretically, if the one indifference curve tangent to the noninferior curve can be located, then watersheds lying farthest from the point of tangency form the set with the highest priority for controls.

Outranking techniques analyze sets of watersheds to derive binary relationships on the set rather than a function from this set to the real numbers, as in the case of the classical theory of decision analysis. This binary relationship also differs from classical decision analysis in the sense that it does not necessarily require a strict transitivity condition (7, 8). Outranking procedures can be used to select one and only one watershed, a set of acceptable watersheds, or a cluster of watersheds in an ordered sequence of indifference classes ranging from best to worst.

Ranking Procedures

The third group of analytical decision techniques ranks the set of watersheds under consideration. Several algorithms with potential application to discrete situations include utility theory, compromise programming and displaced ideal techniques, cooperative game theory, and the analytic hierarchy process.

Decision techniques developed based on the theory of utilities assign a utility function to each decision criterion, then compute the expected utility for each watershed using either an additive or multiplicative model (9). Watersheds that maximize the expected utilities may be eliminated from further analysis, and those with low ranking values form the set to be considered. The difficulties associated with application of the utility models reside in the development of representative utility functions for each criterion and the insurance that all criteria satisfy both preference and utility independence axioms. A utility function refers to a mapping of the values in the range of natural criteria scale to a bounded cardinal-worth scale reflecting the preference structures associated with that criteria as perceived by the decision-maker(s).

Compromise programming techniques have been applied extensively to water resources projects. These techniques attempt to identify watersheds that approach an ideal case (10), assuming that the watershed located the closest to the ideal watershed in the decision space can be eliminated from further consideration. The computation algorithms rank watersheds based on the normalized distance between each watershed and this ideal point. This approach can also be applied to identify watersheds that are the closest to an anti-ideal point using a similar minimization scheme.

Cooperative game theory is a representation of a conflict situation based on the general concepts of rational behavior. Optimization of a set is sought by well-informed decision-makers with conflicting objectives who are aware of their preference structure. The objective of each participant in the game is to identify solutions that are high on the preference scale. A generic algorithm based on this theory for an n-person game was developed by Harsanyi (11). This algorithm was generalized for a regional ground-water pollution problem (12) and for the analysis of wastewater management alternatives (13).

The analytic hierarchy process was developed in an effort to expand the classical decision models to include subjective analysis of multilevel or hierarchical systems (14, 15). The process consists of decomposing the decision problem into smaller subproblems, analyzing each subproblem individually, and then recomposing the results to reach a complete ranking of the set of watersheds considered. It relies strongly on the structuring of the decision problem into an intuitively logical hierarchy of objectives and criteria. The hierarchical structures express the factual relationships between the decision elements (objectives, criteria, and alternatives). This decision process parallels the principles of analytical thinking (16): constructing hierarchies, establishing priorities, and logical consistency.

Targeting Techniques in WSTT

The review of decision analysis techniques, briefly described above, provided the background for the development of the targeting tools used in the WSTT. The development of decision-making techniques for watershed prioritization and targeting was based on the following:

- Ability to perform a multicriteria analysis.
- Applicability to discrete situations with a limited number of watersheds.
- Applicability to selecting the worst watersheds rather than the preferred conditions, as is the case in most decision situations for TMDLs or watershed management.
- Flexibility of problem structuring, data processing, and the ability to decompose the problem into smaller and more homogeneous components.
- Stability of the final ranking using simple scaling procedures.
- Ease of interpreting the rankings.
- Ability to perform sensitivity analysis and consistency testing of the value judgment.

These considerations led to the development of a two-step targeting approach consisting of both a preliminary screening and a formal comparative analysis. A test watershed is used for illustrating examples of the two types of screening techniques (Figure 2).

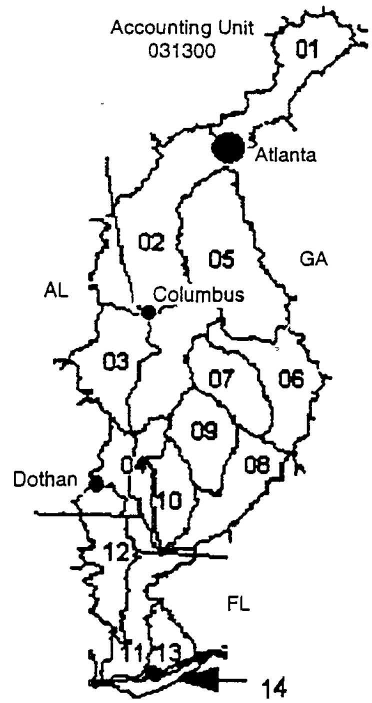

Figure 2. Watersheds selected for preliminary screening.

Preliminary Screening Analysis

The screening level analysis of watersheds at a regional or accounting unit scale is designed to help users understand what the water quality conditions are in each watershed and how the factors governing quality vary from one watershed to the next. The advantage of this procedure is its ability to operate under the WSTT environment, using automatically retrieved values for the desired decision criteria, and iteratively screen out watersheds that do not represent a significant water quality problem.

The screening algorithm used in WSTT consists of a sequential elimination scheme adapted from the conjunctive approach described in the previous section. The objective of this process is to identify watersheds that do not represent a significant water quality problem and consequently reduce the set of watersheds to a workable number. The significance of the water quality problem is, however, indirectly introduced into the analysis through the selection of screening criteria indicative of the problem under consideration and the magnitude of each criterion cutoff level. Figure 3 illustrates this process using a single water quality criterion, and Figure 4 presents the case of a two-criteria screening. Based on the sample cutoff limit shown in Figure 3, six watersheds (1, 2, 3, 4, 5, and 13) would be selected for further analysis. In Figure 4, two criteria are examined. In this case, both acres of urban land and BOD_5 concentrations are selected for examination. Values outside the upper limits for either of the two criteria would be selected for

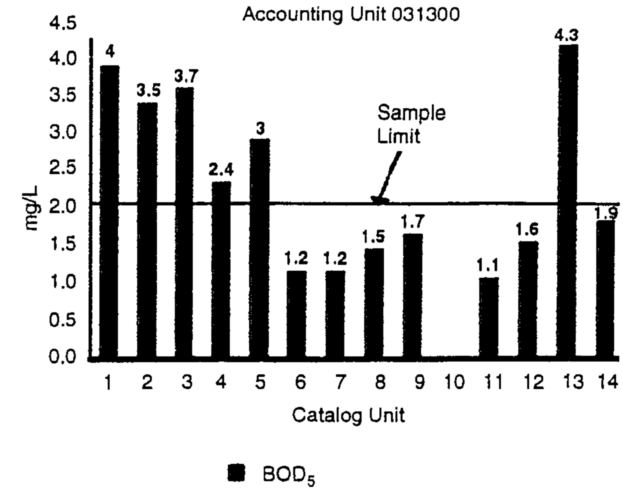

Figure 3. Preliminary screening example with one criterion.

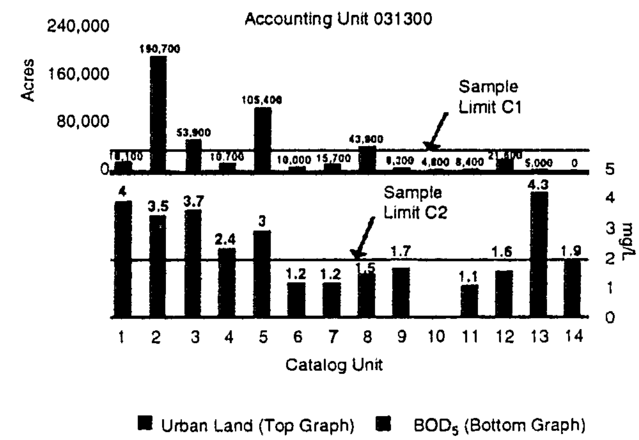

Figure 4. Preliminary screening example with two criteria.

further examination. In this case, seven watersheds (1, 2, 3, 4, 5, 8, and 13) would be selected. The user can select the cutoff limits in an iterative fashion to examine the differences between the watersheds. Multiple criteria can be selected for evaluation, depending on data availability and watershed characteristics. This provides a quick and easy approach for preliminary evaluation of the differences between the watersheds selected for examination.

For a multidimensional problem, each criterion is defined in terms of a cutoff limit representing a vector of threshold values. Depending on the type of criterion and its measurement scale, each value in this vector may either represent an upper or a lower limit. Examples of criteria with an upper limit are water quality parameters for which the cutoff limit represents a concentration that should not be exceeded. On the other hand, criteria with a lower limit include those with ascending scales in which the higher values are better, such as in the case of dissolved oxygen concentration.

The watershed screening level analysis in WSTT allows users to retrieve screening criteria and their values automatically from available, preprocessed databases. When the criteria represent water quality parameters, watershed rating with respect to each criterion can be expressed in terms of a mean value, a median, or a quartile. Multiple databases can be accessed sequentially. Access to the water quality and land-use databases is enabled at the present time. Cutoff limits are user specified and can be modified in an iterative scheme by either relaxing the criteria's cutoff limit and consequently decreasing the set of selected watersheds or by making them more stringent. Watersheds eliminated during this screening level analysis can still be considered in the comparative analysis phase. The output of this algorithm generates a list of watersheds that do not satisfy the criteria's cutoff levels. For these watersheds, the corresponding input data (payoff-matrix) can be accessed through the reporting option of the WSTT. Watersheds that satisfied all user-specified constraints are also tabulated. As noted earlier, the screening analysis does not take into consideration the relative differences in the exceedence of the observations beyond the upper limit. For examination of the relative importance and actual ranking of the watersheds, the comparative analysis technique is used.

Comparative Analysis in WSTT

The objective of the comparative analysis is to provide a system that captures both the importance of the selection objectives and that of the criteria describing these objectives. Comparative analysis can provide a complete ordering of watersheds. The process requires that the targeting problem be formulated in terms of a decision situation and that judgement values be incorporated into each phase of analysis. At this level of analysis, additional measurable and subjective criteria are usually incorporated into the analysis; therefore, the algorithm provides a logical scaling system to evaluate the importance of these objectives on a common basis. The algorithm also incorporates a mathematical framework to amalgamate the value judgement and the watershed observations with respect to each criterion or objective in terms of a ranking index.

Four subroutines incorporated in the development of the comparative analysis algorithm in the WSTT are described below.

Structuring of the Targeting Problem

The formulation of watershed prioritization problems in WSTT consists of a multilevel hierarchical structuring of the selection objectives, the decision criteria, and the alternative watersheds. This formulation separates the selection problem into several smaller and homogeneous subproblems which can be easily compared. Figure 5 illustrates a generic representation of a clustered hierarchy in which the project is decomposed into a set of simple and smaller subprojects. Each subproject can be analyzed separately, and the results can be reintegrated to obtained an overall ranking of the watersheds.

Value Judgment

The decision-maker's value judgment is introduced in terms of the importance weight coefficients of the objectives and criteria. The derivation of criterion importance weights proceeds according to the hierarchical structure of the decision problem, starting from the higher level objectives. This routine takes the decision-maker through a series of paired comparisons cluster by cluster in the order shown by the roman numerals in Figure 5. For each paired comparison between two criteria, the decision-maker defines which criterion of the pair is more important and determines the magnitude of the importance using the integer ratio scale presented in Table 1. The magnitude of importance is not the desired importance weight but rather a measure of a pairwise ratio defined as follows:

$$a_{ij} = \frac{W_i}{W_j} \qquad \text{(Eq. 1)}$$

where a represents the ratio of importance weight W of criterion i over that of criterion j.

The use of the ratio scale defined in Table 1 generates a square, positive, and reciprocal matrix in which the importance weight coefficients consist of the entries of the eigenvector corresponding to the maximum eigenvalue of the this matrix. The characteristics of the resulting comparison matrix are summarized as follows:

$$a_{ij} = \frac{1}{a_{ji}} \qquad \text{(Eq. 2)}$$

for all i and j;

$$a_{ii} = 1 \qquad \text{(Eq. 3)}$$

for all i=1 to n where n is the number of criteria; and

$$a_{ik} = a_{ij} + a_{ik} \qquad \text{(Eq. 4)}$$

The rationale for determining the eigenvector corresponding to the maximum eigenvalue as the importance weight coefficient vector derives naturally from the type of scale used in the pairwise comparisons and the as-

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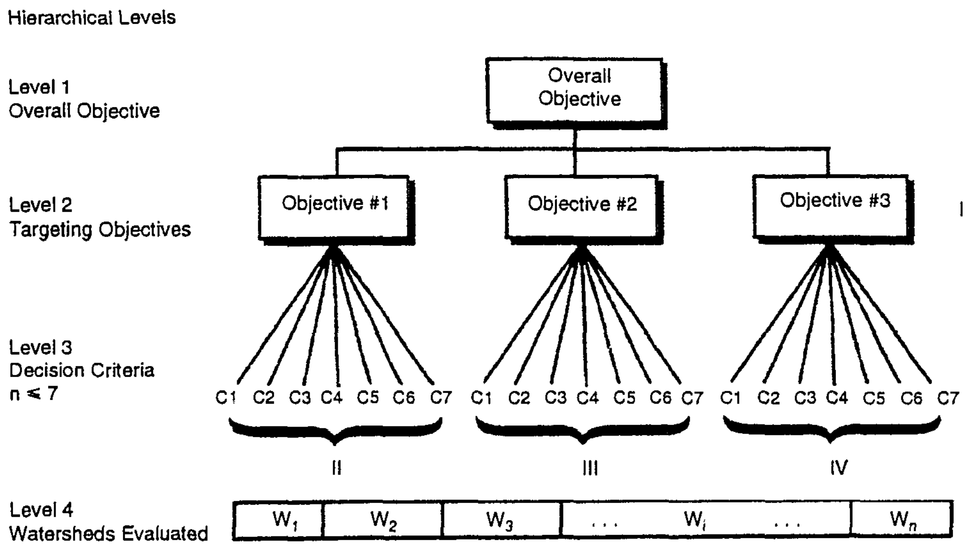

Figure 5. Generic representation of the watershed targeting problem in WSTT.

Table 1. Evaluation Scale Developed by Saaty (14) for Use in the Analytic Hierarchy Process

Intensity of Importance	Definition	Explanation
1	Equal importance	Two activities contribute equally to the objective.
3	Weak importance of one over another	Experience and judgment slightly favor one activity over another.
5	Essential of strong importance	Experience and judgment strongly favor one activity over another.
7	Demonstrated importance	An activity is strongly favored, and its dominance is demonstrated in practice.
9	Absolute importance	The evidence favoring one activity over another is of the highest possible order of affirmation.
2, 4, 6, 8	Intermediate values between the two adjacent judgments	Compromise is needed.
Reciprocal of above nonzero	If activity i has one of the above nonzero numbers assigned to it when compared with activity j, then j has the reciprocal value when compared with i.	
Rational	Ratio arising from the scale	Consistency is forced by obtaining n numerical values to span the matrix.

sociated matrix theory used in solving nonlinear systems, expressed in matrix form as

$$A \cdot W = n \cdot W, \quad \text{(Eq. 5)}$$

where A is the comparison matrix with n entries, n is the number of criteria, and W is the vector of importance weight coefficients. The solution of the above eigenvalue problem for each cluster in the order shown in Figure 5 provides a partial weight coefficient for each criterion. The overall weight can be derived by multiplying the partial weight of the dominant objective by that of the criteria:

$$W_i = W_p\,(objective) \cdot W_p(criteria_i). \quad \text{(Eq. 6)}$$

Consistency of the Preference Structure

When dealing with large numbers of objectives and criteria, the preference structure tends to lose its transitive character. As intransitive comparisons are introduced, the resulting matrices become less consistent, and the importance weight coefficients may not represent the true preference structure.

For a perfectly consistent positive reciprocal matrix, the maximum eigenvalue should equal the order of the matrix. This suggests that the remaining eigenvalues are equal to zero. As small inconsistencies are introduced into the matrix because of intransitive judgements, they lead to very small perturbations in the original set of eigenvalues. This represents the fundamental theory of consistency measurement in positive reciprocal matrices (14). The more the maximum eigenvalue deviates from that of a consistent matrix, the less consistent the pairwise comparisons are. A consistency index developed by Saaty (14) was introduced into the targeting subprogram in WSTT to indicate the degree of consistency at the end of each series of pairwise comparisons. A consistency index of 0.0 indicates a perfect consistency, and a value of 1.0 indicates a fully inconsistent matrix. Because of the use of an integer scale in addition to the nonlinearity of certain subjective judgments, a slight nonconsistency in developing importance weight coefficients is common. In fact, a fully consistent comparison is not required to reach the desired accuracy. Analysis of the sensitivity of eigenvalue solution shows that matrices with a consistency ratio of up to 0.1 are acceptable (17).

Ranking of Watersheds

The hierarchic representation of the watershed targeting process is a logical structure for integrating the decision elements into a single problem and deriving the selection priorities defined in terms of objectives, criteria, and their respective weight coefficients. To derive the overall ranking of the watersheds, a simplified form of the additive utility model is used. This model is described in much of the relevant literature as the best known of the multiattribute utility functions because of its relevance to a wide range of decision problems, its stability in ranking alternatives, and its simplicity of application. This model is also used in most index calculations. Its generic expression when applied to a hierarchic problem takes the following form:

$$U_i = \sum_{j=1}^{N} W_j \cdot \sum_{k=1}^{M} W_k \cdot V_k, \qquad \text{(Eq. 7)}$$

where

W = weight coefficient
N = number of objectives
M = number of criteria under each objective
U = ranking of watershed i
V = measurable value of lower level criteria

This model uses normalized values of the criteria in an ascending scale, meaning that the higher values are better. The ranking is therefore performed on a descending scale so that watersheds with the lowest scores are identified as the priority watersheds.

The results of a sample application are shown in Table 2 below. For illustration purposes, a comparative analysis was applied, using WSTT, to six watersheds in Alabama. Three criteria were selected for examination—BOD5, ammonia, and iron—based on the 85th percentile of all data available on STORET since 1980. The values used for the comparative analysis are shown first. Three types of weights are shown: equal weights and two variable options. The final section of Table 2 shows how the changes in weights affect the resulting ranking of the watersheds. The ability to adjust weights and test a variety of user- and system-provided criteria allows for a wide range of flexibility in the assessment of watershed ranks. Users can thereby incorporate best professional judgement and local knowledge into the targeting procedure in a systematic fashion.

Table 2. Description of Comparative Analysis Application

Values Used for Comparative Analysis (Payoff Matrix)

Catalog Unit	Criterion 1 BOD_5 (mg/L)	Criterion 2 NH_4 as N (mg/L)	Criterion 3 Fe (µg/L)
0313001	4.0	0.27	1,100
0313002	3.5	0.62	1,600
0313003	3.7	0.30	315
0313004	2.4	0.14	680
0313005	3.0	0.66	2,900
0313013	4.3	0.16	370

Calculated Importance Weight Coefficients

Criteria	Equal	Variable 1	Variable 2
1 (BOD_5)	0.333	0.122	0.637
2 (NH_4 as N)	0.333	0.648	0.258
3 (Fe)	0.333	0.230	0.105

Final Watershed Ranking

Catalog Unit	Equal	Variable 1	Variable 2
0313001	3	3	3
0313002	4	2	1
0313003	5	4	5
0313004	6	6	6
0313005	1	1	4
0313013	4	5	2

Application of the comparative analysis requires users to evaluate which criteria are relevant and significant to the local watershed conditions. Often, application will be constrained by the availability of water quality sampling information or other data. Consideration should also be given to possible dependence between two criteria selected. Criteria should be independent for accurate assessment of watershed ranking.

Conclusions

The WSTT program and associated databases provide watershed managers with the tools to effectively target and assess watersheds on a broad scale. The two levels of targeting tools included with the WSTT allow for a range of targeting applications—from simple to sophisticated—depending on project needs. The incorporation of the comparative targeting tool provides the valuable addition of subjective judgement and user-defined parameters to the decision-making structure. This powerful algorithm allows managers to refine decision-making criteria and evaluate multiple and often conflicting objectives. The incorporation of targeting tools and databases into a user-friendly PC environment can make these powerful techniques convenient and accessible to a wide range of water resources professionals.

Acknowledgments

The authors would like to thank Jim Greenfield, EPA Region 4, and Donald Brady, Chief, Watershed Management Section, EPA Office of Wetlands, Oceans, and Watersheds, for their guidance and input into the development of WSTT. Sigrid Popowich and John Craig of Tetra Tech, Inc., provided significant input into both the design of WSTT and the preparation of the databases. Software design and development was performed by Randy French of Isoceles Software, Inc.

References

1. Lahlou, M., and L.W. Canter. 1993. Alternatives evaluation and selection in environmental remediation projects. Environmental Impact Assessment Review. In press.
2. MacCrimmon, K.R. 1973. An overview of objective decision making. In: Cochrane, J.L., and M. Zeleny, eds. Multiple criteria decision-making. Columbia, SC: University of South Carolina Press. pp. 18-44.
3. Keeney, R.L. 1980. Siting energy facilities. New York, NY: Academic Press.
4. Church, R.L., and J.L. Cohon. 1976. Multiobjective location analysis of regional energy facility siting problems. BNL-50567. Upton, NY: Brookhaven National Laboratory.
5. Hobbs, B.F., and A.H. Voelker. 1978. Analytical multiobjective decision-making techniques and power plant siting: A survey and critique. ORNL-5288. Oak Ridge, TN: Oak Ridge National Laboratory (February).
6. MacCrimmon, K.R., and M. Toda. 1969. The experimental determination of indifference curves. Review of Economic Studies 36(2):433-450.
7. Vincke, P.H. 1986. Analysis of multicriteria decision aid in Europe. Eur. J. Research 25(2):160-168.
8. Roy, B. 1976. Partial preference analysis and decision-aid: The fuzzy outranking relation concept. Paris, France: SEMA.
9. Keeney, R.L., and H. Raiffa. 1976. Decisions with multiple objectives: Preferences and value tradeoffs. New York, NY: Wiley and Sons.
10. Zeleny, M. 1982. Multiple criteria decision-making. New York, NY: McGraw-Hill.
11. Harsanyi, J.C. 1977. Rational behavior and bargaining equilibrium in games and social situations. London, England: Cambridge University Press.
12. Szidarovsky, F., L. Duckstein, and I. Bogardi. 1984. Multiobjective management of mining underwater hazard by game theory. Eur. J. Operational Research 15(2):251-258.
13. Tecle, A., M. Fogel, and L. Duckstein. 1988. Multicriteria selection of wastewater management alternatives. J. Water Resources Planning and Management 114(4):383-713.
14. Saaty, T.L. 1977. A scaling method for priorities in hierarchical structures. J. Math. Psychol. 15(3):234-381.
15. Saaty, T.L. 1980. The analytic hierarchy process. New York, NY: McGraw-Hill.
16. Saaty, T.L. 1982. Decision-making for leaders. Belmont, CA: Van Nostrand Reinhold.

Hydrocarbon Hotspots in the Urban Landscape

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Abstract

This paper reports on a monitoring study that compared hydrocarbon, polycyclic aromatic hydrocarbons (PAHs) and trace metal levels in stormwater runoff captured within standard oilgrit separators (OGSs) serving five automotive-related land uses in the Maryland Piedmont. Composite priority pollutant scans and trace metal samples were collected from the pools and the trapped sediments of 17 OGSs serving gas stations, convenience commercial, commuter parking lots, streets, and residential townhouse parking lots. Previous studies indicated that OGSs were not effective in trapping sediments over the long term, based on sediment accumulation rates over time. Oily sediments, however, were retained over a short term, making the OGS sites useful sampling ports to characterize differences in hydrocarbon and toxic levels in small, automotive-related land uses.

Gas stations had significantly higher hydrocarbon, total organic carbon, and metal levels than all other sites in both the water column and the sediments. Convenience commercial and commuter parking lots had moderate levels of contamination, with the lowest levels recorded for streets and residential townhouse parking lots. Mean hydrocarbon concentrations of 22 mg/L and 18,155 mg/kg were recorded for the water column and the sediments at gas station OGS sites. The priority pollutant scan identified 37 potentially toxic compounds in the sediments and 19 in the pools of gas station OGS sites. This can be compared with non-gas-station sites, which had 29 and 7 toxics in the sediment and water column, respectively. Some of the gas station priority pollutants included naphthalene, phenanthrene, pyrene, toluene, xylene, chrysene, benzene, phenols, acetone, and numerous trace metals.

The source of these pollutants appears to be spillage or leakage of oil, gas, antifreeze, lubricating fluids, cleaning agents, and other automotive-related compounds. The study suggests that numerous "hotspots" exist in the urban landscape that generate significant hydrocarbon and PAH loadings, particularly where vehicles are fueled, serviced, and parked for extended periods. Preliminary computations suggest a possible link between these hotspots and sediment PAH contamination of a local estuary.

Introduction

Over the past decade, nearly one thousand oil grit separators (OGSs) have been installed in the metropolitan Washington area to treat urban stormwater runoff from small drainage areas. These structures consist of two precast chambers connected to the storm drain system (Figure 1). The first chamber is termed the grit chamber and is used to trap coarse sediments. The second chamber, termed the oil chamber, is used to temporarily trap oil and grease borne in urban runoff so that they may ultimately adsorb to suspended sediments and settle to the bottom of the chamber.

Most OGSs control runoff from highly impervious sites of an acre or less and have a storage volume of 0.06 to 0.12 in. of runoff, depending on the local design. As such, OGSs were never expected to achieve high rates of pollutant removal (1). Rather, they are intended to control hydrocarbons, floatables, and coarse sediments from small parking lots that cannot normally be served by other, more effective best management practices.

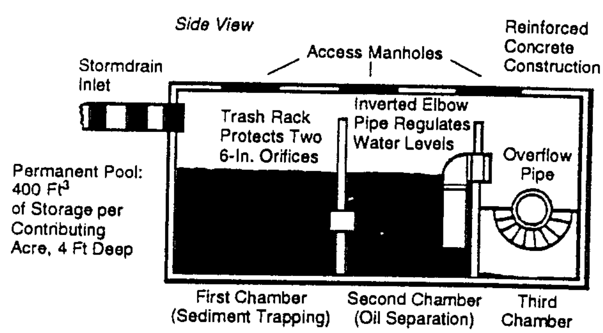

Figure 1. Schematic diagram of an OGS (1).

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From a monitoring standpoint, OGSs are interesting in that they act as a very useful and standardized sampling port to extract runoff samples from very small areas of differing automotive land use. It was hypothesized that hydrocarbon and trace metal levels might be greater at sites where vehicles were parked, serviced, or fueled. These potential "hotspots" had never been systematically monitored in the metropolitan Washington area before.

Methods

A two-tiered monitoring strategy was employed to test the effectiveness of OGS systems and to detect hydrocarbon hotspots. In the first tier of sampling, 110 OGS systems were surveyed to determine their general characteristics in the field. Each structure was sampled for the mass and particle size distribution of trapped sediments, land use, age, maintenance history, secchi depth, and other engineering parameters (2).

The emphasis on the second tier of sampling was to characterize the range of pool and sediment quality found within OGS and related systems. Nineteen of the Tier 1 sites were selected for additional detailed sampling of the quality of pool water and trapped sediments. The sites were grouped into five land-use categories: townhouse parking lots, streets, all-day parking lots, gas stations, and convenience store parking lots. Sediment and pool samples were collected from each chamber and were subsequently analyzed for nutrients, soluble and extractable metals, total organic carbon (TOC), and total hydrocarbons.

In addition, six priority pollutant scans were conducted based on composite sediment and pool water samples from gas station sites, non-gas-station sites, and all five land-use sites combined. The samples were analyzed for the presence of 128 compounds outlined in the U.S. Environmental Protection Agency's (EPA's) priority pollutant list. A complete description of the sampling and analytical protocol is contained in Schueler and Shepp (3).

Results

Retention of Sediments in OGS

The field surveys indicated that OGS systems had poor retention characteristics. The average wet volume of trapped sediments in 110 OGSs was 11.2 ft^3, with an average sediment depth of only 2 in. If OGS systems were highly retentive, the mass of trapped sediments would be expected to increase with age. No such relationship was evident, however, in the 110 OGSs surveyed (Figure 2), suggesting that frequent scour and resuspension occur.

Monthly sampling of sediment depths in individual OGS systems revealed sharp fluctuations in depth over time (Figure 3), with up to a 50-percent decrease in sediment depths recorded in a single month. Dye tests indicated pool residence times of less than 30 min during storms. Consequently, it is thought that the mass of trapped sediments contained within an OGS at any given point represents only a temporary accumulation of pollutants.

General Characteristics of OGS Systems

Trapped sediments within OGSs were coarse-grained, highly organic, oily in appearance, and interlaced with litter and debris. Sediments were also quite soupy; only 45 percent total mass of sediment existed as dry weight. The proportion of volatile suspended solids, a measure of the general organic content of the sediments, averaged 15 percent of total mass.

OGS pools frequently had a thin oil sheen or surface scum, and oil stains were present on the chamber walls. Despite the sheen, the pool water was relatively transparent, with an average secchi depth of 14 to 22 in. Floatable trash was present in low to moderate quantities.

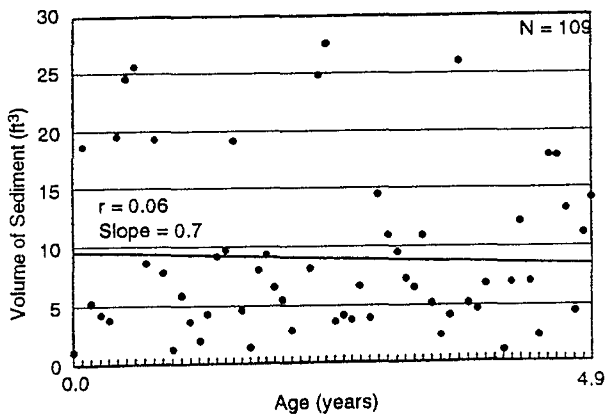

Figure 2. Relationship of OGS age and volume of trapped sediments (2).

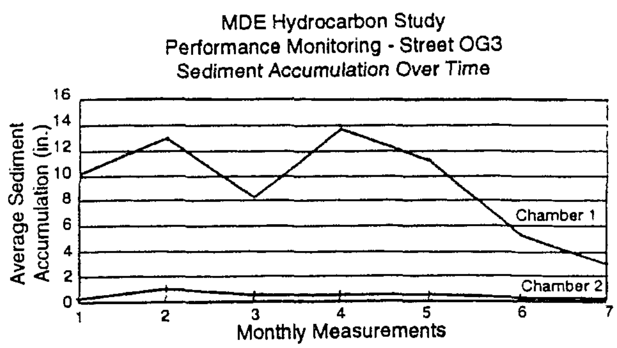

Figure 3. Monthly change in depth in OGS (1).

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Table 1. Characterization of Pollutant Concentrations in the OGS Water Column: Effect of Land-Use Condition (Mean Values)

Sampled Parameter	All-Day Parking (N = 8)	Convenience Commercial (N = 6)	Gas Stations (N = 7)	Streets (N = 6)	Townhouse/ Garden Apartments (N = 6)
OP (mg/L)	0.23	0.16	0.11	ND	0.11
TP (mg/L)	0.30	0.50	0.53	0.06	0.19
NH_3-N (mg/L)	0.20	1.58	0.11	0.19	0.20
TKN (mg/L)	1.18	4.94	2.5	0.84	1.00
OX-N (mg/L)	0.65	0.01	0.21	0.92	0.17
TOC (mg/L)	20.60	26.80	95.51	9.91	15.75
Hydrocarbons (mg/L)	15.40	10.93	21.97	2.86	2.38
TSS (mg/L)	4.74	5.70	—	9.60	7.07
ECD (µg/L)	6.45	7.92[a]	15.29[a]	ND	ND
SCD (µg/L)	3.40[a]	ND	6.34[a]	ND	10.34[a]
ECR (µg/L)	5.37	13.85	17.63[a]	5.52[a]	ND
SCR (µg/L)	ND	ND	6.40[a]	ND	4.79[a]
ECU (µg/L)	11.61	22.11	112.63	9.50[a]	3.62
SCU (µg/L)	8.22[a]	ND	25.64	ND	2.40
EPB (µg/L)	13.42	28.87	162.38	8.23	ND
SPB (µg/L)	8.10[a]	ND	26.90[a]	ND	ND
EZN (µg/L)	190.00	201.00	554.00	92.00	NA
SZN (µg/L)	106.70	43.70	471.00	69.00	59.00

[a]Mean is for all observations in which the indicated parameter was actually detected.
ND = not detected; NA = not applicable.

OP = ortho phosphate phosphorus
TP = total phosphorus
NH3-N = ammonia nitrogen
TKN = total Kjeldahl nitrogen
OX-N = oxidized nitrogen
TOC = total organic carbon
Hydrocarbons = total hydrocarbons
TSS = total suspended solids
ECD = extractable cadmium
SCD = soluble cadmium
ECR = extractable chromium
SCR = soluble chromium
ECU = extractable copper
SCU = soluble copper
EPB = extractable lead
SPB = soluble lead
EZN = extractable zinc
SZN = soluble zinc

The influence of contributing land use on the quality of OGS pool water is evident in Table 1. In general, the concentration of conventional pollutants such as nutrients and suspended solids was similar to many other reported urban stormwater runoff datasets (1). The pool water concentrations of total hydrocarbons, TOC, and soluble and extractable trace metals, however, were much higher. In particular, the average concentration of total hydrocarbons exceeded 10 mg/L in three of the five land uses studied. Analysis of variance indicated that gas station OGS sites had significantly greater pool water hydrocarbon, TOC, zinc, copper, lead, and cadmium levels that any other OGS sites.

The influence of contributing site land use was even more pronounced when sediment quality was analyzed (Table 2). OGS sediments were all heavily enriched with hydrocarbons, TOC, nutrients, and metals. The gas station OGS sites had significantly higher hydrocarbon, TOC, phosphorus, and metals concentrations compared with the other four land uses. Convenience commercial and all-day parking sites generally had higher levels than streets and townhouse parking lots.

Effects of Automotive Land Use

Previous priority pollutant scans of stormwater runoff and pond sediments from primarily residential land uses in the metropolitan Washington area had failed to detect the presence of polycyclic aromatic hydrocarbons (PAHs) (4). Numerous PAHs and other compounds on EPA's priority pollutant list, however, were detected in the automotive-influenced sites of the OGS study (Tables 3 and 4).

Table 2. Characterization of the Quality of Trapped Sediments in OGS: Effect of Land Use

Parameter (mg/kg)	All-Day Parking (N = 8)	Convenience Commercial (N = 6)	Gas Stations (N = 7)	Streets (N = 6)	Townhouse/ Garden Apartments (N = 6)
TKN	1,951.0	5,528.0	3,102.0	1,719.0	1,760.0
TP	466.0	1,020.0	1,056.0	365.0	266.7
TOC	37,915.0	55,617.0	98,071.0	33,025.0	32,392.0
HC	7,114.0	7,003.0	18,155.0	3,482.0	894.0
Cadmium	13.2	17.1	35.6	13.6	13.5
Chromium	258.0	233.0	350.0	291.0	323.0
Copper	186.0	326.0	788.0	173.0	162.0
Lead	309.0	677.0	1,183.0	544.0	180.0
Zinc	1,580.0	4025.0	6,785.0	1,800.0	878.0

TKN = total Kjeldahl nitrogen, TP = total phosphorus, TOC = total organic carbon, HC = total hydrocarbons. All metals are extractable.

A total of 19 priority pollutants were detected in pool water at the gas station OGS sites, compared with seven detected at non-gas-station sites, most of which were metals. Thirteen volatile and semivolatile priority pollutant compounds were detected in pool water at the gas station OGS sites. Semivolatile compounds included phenols, naphthalene, and plasticizers, whereas the volatile compounds included acetone, benzene, toluene, xylene, and ethyl benzene. Most, if not all, of these compounds are linked to gasoline and its derivatives, lubricants, and cleaning agents customarily found at gas stations (5).

An even greater number of priority pollutants, 26, were detected in the trapped sediments of gas station OGS sites. An additional 11 priority pollutants were indicated but were below analytical detection limits. Metals and PAHs dominated the list of confirmed priority pollutants. PAHs found at the highest concentrations in the sediment included 2-methylnapthalene, naphthalene, phenanthrene, fluoranthene, pyrone, and christen. Three of these PAHs have been listed as toxics of concern by the EPA Chesapeake Bay Program (5). Most of these PAHs are strongly associated with gasoline and its byproducts. The gas station OGS sites had the highest sediment metals levels, particularly for cadmium, copper, chromium, lead, and zinc.

Only nine PAHs were recorded at the non-gas-station OGS sites, and in nearly all cases the concentration in the sediments was lower. Interestingly, the only pesticides detected in the sampling were discovered at the more residential non-gas-station sites.

Discussion

The monitoring study has several interesting implications for urban stormwater runoff and its effective control, which are discussed below.

Hydrocarbon Hotspots in the Urban Landscape

The results suggest that hotspots of possible hydrocarbon and metal loading do exist in the urban landscape, and that these are likely to occur where vehicles are fueled, stored, or serviced. In this study, gas stations and, to a somewhat lesser degree, frequently used parking lots clearly exhibited greater hydrocarbon and metal loading potential than more residential sites. Future monitoring may reveal other potential hotspots such as bus depots, loading bays, highway rest areas, and vehicle maintenance operations.

The traditional management approach for urban runoff quality has been to specify a uniform treatment standard for all impervious areas across the urban landscape (e.g., the first half inch of runoff). Based on the results of this study, a more effective strategy might be to supplement uniform standards with more stringent treatment requirements when a possible hydrocarbon hotspot may be involved.

Only nine PAHs were recorded at the non-gas-station OGS sites, and in nearly all cases the concentration in the sediments was lower. Interestingly, the only pesticides detected in the sampling were discovered at the more residential non-gas-station sites.

Possible Link to Estuarine Sediment Contamination

The bottom sediments of most of the nation's urban estuaries are frequently contaminated with hydrocarbons, PAHs, and metals. The sources of the ubiquitous and pervasive contamination may include air deposition, fuel spills, leaking underground storage tanks, leachate from landfills or industrial sites, industrial discharges, and waste oil dumping, among others. This study suggests

Table 3. Priority Pollutants Detected in Composite Scans of OGS Sediments

Compound (µg/kg)	Gas	Nongas	All Site
Semivolatile Organics			
Napthalene	9,000	—	S
2-Methylnapthalene	24,000	S	S
Acenapthene	1,800	—	—
Fluorene	3,200	—	—
Phenathrene	11,500	1,800	S
Fluoranthene	3,400	2,000	20,000
Pyrene	5,800	2,300	26,000
Butylbenzylpthalate	3,400	S	S
Chrysene	2,200	1,200	S
bis (2-Ethylhexyl) pthalate	44,000	13,000	220,000
Di-n-octyle pthalate	2,900	S	S
Benzo (b) flouranthene	1,400	S	S
Indeno (123-cd) pyrene	1,400	S	S
Benzo (g,h,i) perylene	1,900	S	S
Di-n-butyl pthalate	S	1,800	S
Volatile Organics			
Toluene	6,800	2,300	7,500
Ethylbenzene	S	3,100	—
Total xylenes	6,900	13,000	—
Methylene chloride	S	S	—
Pesticides and PCBs			
Aldrin	—	29	950
4,4-DDT	—	29	—
Metals			
Antimony (mg/kg)	5.1	—	—
Arsenic	4.1	2.6	6.2
Beryllium	0.3	0.5	1.6
Cadmium	6.5	0.8	7.2
Chromium	123	37	91.3
Copper	126	36	132
Lead	493	46	145
Nickel	50	50	95
Silver	—	—	2
Zinc	953	261	1,650
Cyanide and Phenols			
Phenol	25.6	8.0	76.2
Cyanide	—	—	—

S = detected but at concentrations under the detection limit

— = not present

Table 4. Priority Pollutants Detected in Composite Scans Within the OGS Water Column

Compound (µg/kg)	Gas	Nongas	All Site
Semivolatile Organics			
Benzyl alcohol	10	—	—
2-Methylphenol	22	—	—
3,4-Methylphenol	32	—	—
2,4-Dimethylphenol	16	—	—
Napthalene	100	—	—
2-Methylnapthalene	43	—	—
bis (2-Ethylhexyl) pthalate	14	—	—
Chrysene	—	—	12
Volatile Organics			
Acetone	57	13	46
2-Butanone	16	—	—
Benzene	18	—	—
Toluene	140	5	—
Ethylbenzene	41	—	—
Total xylenes	230	—	—
Pesticides and PCBs	—	—	—
Metals			
Antimony	—	—	—
Arsenic	1.0	1.0	—
Beryllium	—	1.2	—
Cadmium	—	—	8
Chromium	5	6.2	5
Copper	72	8.3	15
Lead	48	3.3	5
Nickel	—	—	—
Silver	—	—	—
Zinc	373	65	132
Cyanide and Phenols			
Cyanide	—	—	—
Phenol	86	10	24

that the washoff of leaked fuels and fluids from vehicles may also be a key source of sediment contamination.

The significance of runoff from hydrocarbon hotspots in sediment contamination may be great. For example, 12 out of 13 PAHs present in the sediments of the tidal Anacostia estuary were also present in the trapped sediments of gas station OGS sites. On average, the concentration in OGS sediments was seven times greater than that recorded in the tidal estuary. Of even greater interest is the finding that the relative composition of PAHs in both the river and OGS sediments was quite similar (3). While the possible link between runoff from hydrocarbon hotspots and estuarine sediment contamination remains suggestive rather than conclusive at this point, the subject merits further monitoring and analysis.

Opportunities for Pollution Prevention at Hotspots

Because leakage, spills, and improper handling and disposal of automotive products appear to be the key source of many of the pollutants observed at hydrocarbon hotspots, an effective control strategy involves the use of pollution prevention practices. For small vehicle maintenance operations, these may include techniques to run a dry shop, reduce run-on across work areas, use less toxic cleaning agents, control small spills, store automotive products in enclosures, and, perhaps most importantly, train employees to reduce washoff of automotive products from the site (6).

Implications for OGS Cleanout and Disposal

The original purpose of the study was to establish the characteristics of trapped sediments and pool water within OGS sites to determine the most appropriate and safe disposal method. Based on preliminary data, OGS residuals do not quite meet criteria to be considered hazardous for landfilling (7). Many local landfills, however, may set more stringent criteria and will not accept OGS sediments unless they are fully dewatered. Introduction of OGS residuals into the sanitary system appears also to be prohibited due to utility pretreatment requirements.

Regular cleanout of OGS systems appears to be quite rare. For example, none of the 110 OGS systems surveyed in the field appeared to have been maintained in the last year (2). Given the poor retention characteristics of existing OGS designs, a minimum frequency of quarterly cleanouts would seem warranted to ensure that the trapped residuals are removed before they are resuspended. The cost to cleanout an OGS system and safely dispose of the trapped sediments, however, could exceed $400 per site visit. The need for frequent and costly cleanouts, coupled with the ambiguities regarding the possible toxicity of trapped sediments, raises serious concerns about the effectiveness of the current generation of OGS systems.

Outlook for Improvements in OGS Design and Performance

The study indicates that the current generation of OGS systems does not retain trapped pollutants and therefore must be maintained at an unrealistically high frequency. Clearly, the retention characteristics of OGS must be sharply increased if they are to become a credible urban best management practice.

Several design improvements have the possibility of increasing the retention of pollutants. These include designing the OGS to be fully off-line, so that larger runoff events bypass the OGS and reduce the frequency of sediment resuspension; providing larger treatment volumes; using sorptive media, fabrics, or pads within chambers; and modifying the geometry of each chamber to reduce turbulence in the vicinity of trapped sediments. Until the improved retention of these design modifications is confirmed in the field, however, it may not be advisable to use OGS systems on a widespread basis.

Given the possible importance of hydrocarbon hotspots in the urban landscape and the apparent inadequacy of the current generation of onsite best management practices to control them effectively, it is strongly recommended that an intensive research and demonstration program be started to evaluate alternative small-site runoff treatment technologies.

Acknowledgments

The study was sponsored by the Maryland Department of the Environment under an EPA Chesapeake Bay Implementation grant. Sampling and laboratory analyses were conducted by the Occoquan Watershed Monitoring Laboratory.

References

1. Schueler, T. 1987. Controlling urban runoff: A practical manual for planning and designing urban best management practices. Metropolitan Washington Council of Governments.
2. Shepp, D., and D. Cole. 1992. A field survey of oil grit separators. Prepared for Maryland Department of the Environment, Washington Metropolitan Council of Governments.
3. Schueler, T., and D. Shepp. 1992. The quality of trapped sediments and pool water within oil grit separators in suburban Maryland. Prepared for Maryland Department of the Environment.
4. JTC, Inc. 1982. Washington area NURP priority pollutant scan Final report prepared for Washington Metropolitan NURP Project. Metropolitan Washington Council of Governments.
5. U.S. EPA. 1991. Chesapeake Bay toxics of concern list. Annapolis, MD: Chesapeake Bay Program.
6. Santa Clara Valley NPS Program. 1992. Best management practices for automotive related industries.
7. Jordan, B. 1993. Oil-grit separator residual: Potential toxicity and possible disposal methods. Washington, DC: Metropolitan Washington Council of Govemments, Department of Environmental Programs.

Additional Reading

1. Metropolitan Washington Council of Governments. 1983. Urban runoff in the Washington metropolitan area. Final NURP project report prepared for U.S. EPA.

Design Considerations for Structural Best Management Practices

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Abstract

Upon selection of the appropriate structural best management practice (BMP) to address an urban runoff management need, the design process begins. Successful BMP design does not consist merely of achieving required technical performance levels specified in a government regulation. To meet both the letter and spirit of the regulation and to help encourage the public participation vital to the future of urban runoff management, a responsible BMP designer must also acknowledge and address several other technical and nontechnical considerations.

This paper emphasizes the need for a strong theoretical understanding of standard design models and equations. It also recommends a technique for identifying and evaluating a structural BMP's inherent maintenance, safety, and aesthetic needs that may not be readily apparent when using more conventional design procedures. The paper also identifies the individuals and agencies that will interact with a structural BMP during its design and/or following its construction, and emphasizes the need to include their interests in the BMP design process.

Finally, in recognition of the nascent state of nationwide stormwater management, the paper encourages BMP designers to contribute to the continued development of the field by conducting their designs in an open and objective manner and by continually seeking new and better responses to the many stormwater management challenges we face.

Introduction

> design \di-zine\ vb 1: to conceive and plan out in the mind; 2: to devise for a specific function or end; 3: to conceive and draw the plans for (Merriam-Webster Dictionary)

This definition succinctly describes both the scope and sequence of activities typically undertaken by the designer of a structural best management practice (BMP). Having identified a stormwater management problem or need that can best be solved through the construction of a structural BMP, the designer then selects the most appropriate type of BMP, conceptualizes its function and operation, and determines the specific characteristics necessary for the BMP to achieve its desired performance. Having completed this, the designer must then transform these characteristics into a physical entity. This is done through the development of detailed construction plans and specifications, which are used to construct the BMP in the field.

Throughout the entire endeavor, the structural BMP designer must, of course, fulfill certain technical responsibilities if the BMP is to comply with the standards and requirements of the community's overall stormwater management program. To do so, the designer must be familiar with these program requirements as well as the technical data, equations, and analytic techniques commonly used to meet them. If stormwater management is to grow beyond its traditional concerns for stormwater quantity to address stormwater quality and nonpoint source (NPS) pollution, however, such technical compliance is not enough. Instead, the BMP designer must also recognize his or her unique responsibilities both to the success of the overall stormwater management program and to the people who will live, work, or travel past the structural BMP they are creating. Only by fulfilling these larger design responsibilities will stormwater management be able to achieve and sustain the public support and participation it needs to effectively address the complex problems that lie ahead of it. A description of each of these design responsibilities is presented below, along with recommendations for fulfilling each.

The Responsibilities of the BMP Designer

As noted above, the effective BMP designer must fulfill several levels of responsibility. First and foremost, the designer is responsible for complying with the technical requirements and standards of the overall stormwater management program of which the

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BMP will be a part. This typically includes achieving the required level and range of peak outflow control necessary to prevent or reduce downstream flooding as well as the detention times and pollutant removal rates necessary for stormwater quality enhancement. Additional technical requirements contained in the stormwater management program may include emergency discharge capacity to insure dam or embankment safety, as well as structural and geotechnical standards to achieve stability and strength. The BMP designer must be familiar with the specific technical requirements of the stormwater management program as well as the theoretical basis for and use of the various hydrologic, hydraulic, structural, and geotechnical analyses typically used to comply with them.

The responsible BMP designer should not only be familiar with the program's technical requirements but also understand the program's overall intent or goals, for the designer must recognize that the program's technical requirements are only the means through which we hope to achieve the program's goals or ends. As such, a structural BMP will contribute more towards those goals if its designer understands, for example, not just what detention time the BMP should have, but why it should have one, why it should be a certain duration, and what will happen if it does not. Such understanding also produces BMP designs that are better able to achieve satisfactory results over a much wider range of real-world conditions than the more limited conditions that are normally analyzed during the design process.

In addition, due to the inherent complexities of stormwater quality and nonpoint source (NPS) pollution, we have not been able in many instances to define the technical requirements of our stormwater management programs as well as we have been able to specify their goals. For example, it is considerably easier to select a goal of 80 percent removal of suspended solids from stormwater runoff than it is to specify the exact technical measures that must be implemented to do so. This disparity between means and ends can be overcome to a great degree by the responsible designer who, aware of the disparity, is willing and able to look behind and beyond the program's somewhat limited technical requirements and produce designs that do a better job of achieving the program's goals.

Another BMP design responsibility is based on the fact that the final product of the designer's efforts will be a real structure that must be constructed and maintained and that will occupy space in a real environment. As such, it is vital that the BMP be both simple and practical in terms of construction, materials, operation, maintenance, and safety. Such characteristics can only be achieved by a designer who is aware of their importance and can define them in physical terms. In addition, such vital characteristics cannot, at times, be achieved by strictly adhering to a stormwater management program's technical standards and may, in fact, require that they even be ignored or broken. Such instances demand the involvement of a responsible designer who will be able to achieve a more informed, effective balance between technical compliance and practicality than is achievable through strict compliance alone.

In the design of any structural BMP, cost must also be an important factor, and the responsible designer not only appreciates this fact but also can accurately and objectively determine both the benefits that a structural BMP provides and the costs of doing so. A true measure of a BMP's cost effectiveness can only be achieved by understanding, quantifying, and comparing both. To do so, the designer has a responsibility to fully understand both the cost of BMP construction, operation, and maintenance and the relative values or benefits to be gained from it. This requires, among other traits, a high degree of objectivity to ensure that the costs and benefits determined by the designer are based on reality and not the interests or desires of his or her client or supervisor, or a government regulator.

Finally, the responsible BMP designer understands the importance of professionalism and will always conduct the design process in an open, honest, and objective manner. In view of the nascent state of stormwater management nationwide, such tenets are particularly vital if we are to close the present gap between what we seek to gain from stormwater management and how we can best achieve it. Such conduct will also enable us to more quickly identify uncertainties, conflicts, and errors in our present understanding of stormwater runoff and NPS pollution and to develop more effective and efficient solutions.

BMP Design Considerations: Points To Ponder

From the above, it can be seen that the responsible BMP designer must not merely be concerned with the technical requirements of a stormwater management program but, instead, must strive to produce facilities that also achieve and even advance the program's goals and intentions. The structural BMPs that result from such an effort will become assets to the community that they serve and promote the public interest and involvement necessary for overall program success. The BMP must also be practical, safe, aesthetically pleasing, easy to build, and even easier to maintain. Faced with such a formidable list of requirements, the responsible designer must not only bring competent technical ability to the design process but also an informed, open attitude and even a sense of mission or purpose. To help promote such an attitude and more fully prepare the BMP designer for the job ahead, the following points regarding BMP design, construction, and operation are offered. The BMP designer should consider these points before undertaking a design effort.

Interested Parties

To produce a BMP design good enough to earn an "approved" stamp from a stormwater management program regulator (who is presumably interested in ensuring compliance with the program's regulations), a BMP designer must identify with those interests and make sure they are reflected on the construction drawings. To further ensure that the BMP will truly be an asset to the community and will make a positive statement about the value of stormwater management, the BMP designer must consider several interested parties.

The Client

Including the client on a list of parties having an interest in a BMP design should not come as a surprise; however, a review of what the client's interests really are just may be. Therefore, the responsible BMP designer will not automatically assume to know the client's interests (however obvious they may appear) but will instead fully discuss them with the client.

The prospect of such a discussion may then lead the designer to ask the following question: What should the client's interests be? Does the client have a misinformed or misguided attitude towards the goals of stormwater management? Is this attitude based on a lack of understanding or information? In such cases, the responsible designer can, through education (and a touch of diplomacy), both expand the client's understanding and improve his or her attitude towards stormwater management, thereby enhancing the designer's own chances of producing a positive BMP design.

The Regulator

Similar to the client, the regulator is also an obvious choice for an interested party list. Once again, the following questions may be raised: What are the regulator's interests, and what should they be? Because a regulator's review of a BMP design can sometimes stray from the program's technical standards into more subjective areas (due, in part, to a lack of such standards), it is often helpful to know what interests the regulator has stored up in those areas. Are those interests both in keeping with the goals of the stormwater management program and within the program's (and, therefore, the regulator's) jurisdiction?

For example, a regulator may have a strong interest in promoting proper land use as a means of achieving a program's goals. If regulating land use is beyond the program's scope or authority, however, then such interests have no rightful place in the regulator's review of the BMP design. Should such interests become part of the review, it is the designer's responsibility to point this fact out and redirect the review back to its proper direction. In doing so, all of the diplomatic skills the designer has developed from educating the client will prove invaluable.

Similar to the client, a BMP designer may also encounter a regulator who, through a lack of knowledge or an abundance of wrong information, either misunderstands the program's requirements or lacks the ability to fully ensure their compliance. Once again, the responsible BMP designer can, through education and a competent, comprehensive design, expand the regulator's understanding and ability so that the designer's intentions can be better understood.

The Constructor

As noted earlier, one of the key responsibilities of the structural BMP designer is to transform the BMP from concept to reality by preparing detailed plans and specifications of how it should be built. It is then up to the constructor to finish the project by actually building the BMP from these plans and specifications. Therefore, the responsible designer appreciates the efforts of the constructor and does not see his or her own efforts as an independent exercise, but rather as an integral part of a much larger process—a process that requires the constructor to complete.

As such, the responsible BMP designer recognizes and responds to the constructor's interests by producing a well thought-out design that can be constructed as easily and simply as possible. Because this may not always be possible, particularly when faced with complex performance requirements or difficult site conditions, the responsible designer also takes extra care to bring any difficult or unusual aspects of the design to the constructor's attention before the start of construction, even consulting with the constructor during the design phase to mutually devise the best construction technique, material, or sequence.

Under ideal circumstances, the BMP designer will also continue his or her involvement in the project throughout the construction phase and will work with the constructor to correct mistakes, address oversights, and develop revised designs as necessary to overcome problems that may be encountered in the field.

The Maintainer

Once construction of the BMP has been completed, the designer's involvement with the process (assuming it lasted through construction) normally ends. However, there are interested parties whose involvement with the BMP is just about to start and whose interests the designer must also consider. These are the maintenance personnel who will be responsible for mowing the grass, removing the sediment, clearing the debris, managing the habitats, and performing the necessary repairs at the BMP for the rest of its serviceable life. Similar to the constructor, the maintainer's actions will be governed by what the designer creates on paper. Because construction has been completed and the designer has moved on to other projects, however, it is considerably more difficult for the maintainer to have deficiencies or oversights in the design corrected.

As such, the designer must understand and address the interests of the maintainer before it is virtually too late. As described in more detail in later sections, this can be accomplished by designing a facility that, optimally, requires a minimal amount of maintenance that can be performed as easily as practicable.

The Resident

This interested party may also be the worker, commuter, shopper, student, or local government official who will interact with the structural BMP on a regular basis. This interaction may be physical (through the sense of touch, sight, hearing, or smell) or psychological (as anyone who has worried about children's safety or the value of his or her property will understand).

In any case, these are the people who have, perhaps, the strongest interest in seeing that a positive BMP design is achieved. These are also the people who will soon be asked to participate in the community's nonstructural stormwater management programs by changing some of their aesthetic values and even their lifestyles. Therefore, the person responsible for producing the BMP design must be aware of their interests and incorporate them into the design as well.

Operating Conditions

Just as a wide range of people have an interest in the BMP design, the BMP must operate under a wide range of conditions. Just as the BMP designer may fail to recognize the full range of interests, he or she often fails to consider all of the real-world conditions that the BMP will be subject to by focusing solely on those design conditions necessary for official program approval. This is unfortunate, because the design conditions that received all of the designer's attentions will, in reality, only occur during a small fraction of the BMP's existence. However, its performance during the remainder of its existence, while ignored by the designer, will largely determine the community's opinion of its value.

Therefore, it is important that the BMP designer be aware of all of the weather and other site conditions to which the BMP will be subjected.

Design Conditions

These are obviously the designer's first concern and, as noted above, are normally established by the community's stormwater management program. In the case of runoff quantity control, these conditions usually include either a single event or a range of relatively extreme storm events, the runoff from which must be stored and released at a predetermined rate. New Jersey's Stormwater Management Regulations, for example, require that the runoff from a proposed land development site for the 2-, 10-, and 100-year storm events be controlled so that the peak rate of site runoff after development for each storm does not exceed the peak rate that existed before development. The Somerset County, New Jersey, standards are stricter, requiring a peak rate after development that is actually less than existing to account for development-induced changes in runoff volume and overall hydrograph shape as well.

In the case of stormwater quality control, typical design conditions may include the temporary storage and slow release of the runoff from a much smaller, more frequent storm event to promote pollutant removal through sedimentation. For example, the New Jersey Stormwater Management Regulations require the temporary storage of runoff from a 1-year storm event, with release occurring over 18 to 36 hours depending on the character and intensity of the proposed development. The state of Delaware requires extended storage of the first inch of runoff from a proposed site, with release occurring over 24 hours.

Whatever exact design conditions the stormwater management program may specify, it is vital that the structural BMP function properly under them or the goals of the program cannot be met.

Extreme Conditions

In addition to the program's design conditions, which have been selected with the goal of runoff quantity and/or quality in mind, the responsible BMP designer must also recognize that more extreme storms may also occur. Therefore, due to the inherent dangers of storing runoff and the exceptionally large quantities of runoff that can be produced by these extreme events, it is vital that the BMP designer also address the goal of safety by ensuring that the BMP will also function properly under such extreme conditions. This will typically include the provision of an emergency spillway or other auxiliary outflow device that will safely convey the extreme event runoff that exceeds the capacity of the BMP's normal outflow structure. It will also include protection of critical portions of any embankment, dam, or discharge points that may be subject to scour or erosion from the high flow velocities generated by the storm event.

Dry Weather Conditions

While design and even extreme storm conditions can be expected to occur periodically, the most common operating condition at a structural BMP will be dry weather with various seasonal temperatures, winds, humidities, and periods of daylight. While dry weather may be the most prevalent operating condition, it is also the one that is most frequently overlooked by the BMP designer. As a result, how the BMP will look, smell, and even sound during the majority of its operating life is then left to chance. This can be particularly unfortunate for the BMP maintainer and, more critically, the resident, worker, or commuter who will interact most often with the BMP during dry weather conditions. Therefore, the responsible BMP designer will not only address extreme storm events but will also make sure that the BMP performs satisfactorily when it isn't raining at all.

Design Methodologies

Before starting the actual design process, the responsible designer will have an adequate understanding of the selected design methodologies. These methodologies can cover such aspects as rainfall-runoff computations, hydrograph routings, infiltration and ground-water movement, structural design, and geotechnical issues. In doing so, the designer's understanding should include the methodology's theoretical basis, assumptions, limitations, and applicability. In addition, the responsible designer will also have an understanding of both the accuracy needed to perform the design and the accuracy of the method he or she has selected to do it. From this, the responsible designer will neither waste time producing unneeded accuracy nor attempt to achieve a level of accuracy beyond the limits of the method. Finally, the responsible designer will understand the sensitivity of each of the method's input variables and will appropriately allocate his or her time and resources in developing each one.

Facility Type

The final point for the BMP designer to ponder before beginning the actual design process is the type of structural BMP to be used. Presently, a wide range of facilities are available for use, ranging from relatively simple vegetated filter strips and swales to large ponds and constructed wetlands. Selection of the appropriate BMP depends on several factors, including program requirements, BMP location, site conditions, maintenance needs, safety, cost, and performance characteristics.

Similar to BMP operating conditions, the BMP designer may often consider only a few of these factors, most notably program requirements (keep the regulator happy) and cost (keep the client happy, too), in making his or her selection. The responsible designer, however, will recognize the performance, needs, uncertainties, and risks inherent in each type of BMP and will then select (or help influence the selection of) the most appropriate type of BMP for the site. This process typically begins with the identification of the fundamental characteristics of each type of BMP, along with the project's physical, economic, social, and regulatory constraints. The process then becomes one of comparison and analysis, with the best match found by eliminating the worst.

For example, a site with porous soils, low ground-water table, and close proximity to residences may not be best suited for a wet pond or constructed wetland, while the active recreational needs of the residents may benefit from a dry, extended detention basin that can also serve as an athletic field. Although perfect matches rarely occur, comparisons and analyses such as this will help reduce the number of potential BMPs, improve the thoroughness and objectivity of the overall selection process, and ideally produce the optimal facility type. This process can even help identify inherent weaknesses in or problems with the selected type, which will enable the responsible BMP designer to devote additional time and effort towards correcting them during the design phase.

To undertake such a selection process obviously requires a designer who understands the fundamental characteristics and needs of each BMP and who can objectively assess all of the pertinent site constraints. Such a designer must also be willing and able to confront the differing opinions of other, less objective or informed parties (including the regulator and client) to ensure that the best BMP is selected. As noted throughout this paper, achieving an optimal BMP design is a complex and demanding process that must incorporate numerous interests and requirements. Starting the process with the wrong facility type, however, transforms a complex and demanding process into an impossible one.

BMP Design Considerations: A Checklist

Having completed the BMP selection process with honor, idealism, and design contract still intact, and armed with both the necessary technical and regulatory knowledge and economic and social sensitivity, the responsible BMP designer is ready to begin the actual design process. Presented below is a checklist of six key design considerations to help guide this effort. Ideally, these six items have or will become an integral part of the designer's thought process and will automatically be included in each design effort. These items can also serve as guidelines for those responsible for the review and approval of specific BMP designs as well as goals for those developing new stormwater management programs.

Safety

For several reasons, the safety of the structural BMP must be the primary concern of the designer. Due to its "structural" nature and, in many instances, the fact that it will impound water either permanently or temporarily, the structural BMP will inherently pose some degree of safety threat.

Those at risk include people living, working, or traveling downstream of the BMP whose safety and/or property will be jeopardized if the BMP were to fail and release stored runoff. Because this is a risk that has been created solely by the BMP, the designer must ensure that the probability of such a failure is acceptably small.

Also at risk at a structural BMP are maintenance personnel, inspectors, mosquito control personnel, and equipment operators, who must work in and around the facility. Typical hazards include deep water, excessively steep slopes, slippery or unstable footing, limited or unsafe access, and threats posed by insects and animals. As noted above, the responsible BMP designer understands the importance of facilitating BMP maintenance. Providing a safe working environment for the BMP maintainer is one important way to do it.

Finally, those living, working, attending school, or playing in the vicinity of a structural BMP may also be at risk, particularly if the BMP serves both as a stormwater management and recreational facility. Once again, such things as standing water, steep slopes, unstable footings, and insect and animal bites must be addressed by the designer to avoid creating a facility that is a detriment to the community it is intended to serve. Failure to do so will only alienate those members of the community who will be asked to play a vital role in future stormwater management efforts.

Performance

Having made a strong commitment to safety, the BMP designer must then consider facility performance. This normally includes achieving the necessary stormwater detention times, flow velocities, settling rates, peak flow attenuation, and/or ground-water recharge for the range of storm events to be managed. Again with a commitment to safety, the designer must also ensure that the BMP performs adequately under emergency conditions, most notably when the peak rate and/or volume of runoff flowing into the basin exceeds the discharge capacity of the BMP's principal outlet. This will require the inclusion of emergency or auxiliary outlets in the BMP to safely convey this excessive inflow through the BMP without jeopardizing its structural integrity.

In most instances, the performance standards that the BMP design must meet will be specified in the stormwater management program's regulations. Experience has shown, however, that these performance standards may, at times, be vague, contradictory, or even impossible to meet. For example, many BMP designers have been confronted with a requirement to reduce both the peak rate and total runoff volume from a developed (or developing) watershed to predeveloped levels. This has often lead to much head scratching, for the solution normally requires the use of an infiltration or recharge basin which, due to site constraints, may either be impractical or impossible. Faced with such circumstances, the responsible designer looks beyond the written regulations and investigates their origins and true intent with regulatory personnel. Direct inclusion of these individuals in the design process will also help ensure more positive overall results.

Constructability

Up until now, the designer's efforts to achieve adequate BMP safety and performance levels have been achieved only on paper or computer disk. Because the ultimate goal of the design process is to actually create a BMP, the BMP designer must also give careful consideration to how it is to be constructed. Achieving exceptional safety and performance characteristics in a BMP that cannot actually be built solves nothing and wastes much. Achieving required levels of safety and performance in a BMP that can be reconstructed with relative ease using readily available materials, equipment, and skills is commendable and not only solves a specific stormwater management problem, but also helps to advance the community's overall program. "Constructability" can be defined as a measure of the effort required to construct a structural BMP. A BMP that is highly "constructable" utilizes materials that are readily available, relatively inexpensive, and do not require special shipping or handling measures. They will be both durable and easily modified in the field to meet specific site conditions. Similarly, the construction techniques and equipment required to construct the BMP will also be relative simple, straightforward, and familiar to the people who will be performing and operating them.

It is important to note that the above description is not intended to discourage the use of new or innovative materials or construction techniques, nor to inhibit creativity in the BMP design process. In fact, innovation in design and construction is vital to the future growth of stormwater management. Instead, the above description of "constructability" is intended to remind designers that they must consider the construction aspects of the BMP in the design process and strike a balance between performance and safety requirements, constructability, and innovation for each design they undertake.

Maintenance

The same reminder stated above for constructability must also be said for BMP maintenance. Similar to construction, the degree of effort and expense required to adequately maintain a structural BMP will help determine the overall success of its design. A BMP with manageable maintenance needs can be expected to remain in reasonably good condition and has a stronger chance of becoming an asset to the surrounding community. On the other hand, a BMP with excessive maintenance needs is likely to be neglected and will quickly become a community liability. As such, BMP maintenance can directly effect the overall success of the community's stormwater management program.

The BMP designer can help determine a BMP's maintenance needs by considering several aspects of that maintenance in the design process. First, the BMP design should include the use of durable materials that are able to withstand the many and varied physical conditions that the BMP will experience over its lifetime. Secondly, suitable access to key BMP components and areas is vital if required maintenance levels are to be achieved. This will include provisions for walkways, staging and disposal areas, access hatches and gates, and safe, stable working areas. The frequency of maintenance has a large impact on both maintenance cost and quality, and it is the designer's responsibility to achieve an appropriate level. Finally, the BMP designer should always strive to minimize the overall amount of maintenance at the BMP and to make that amount as easy as practicable to perform.

Cost

Inclusion of a BMP's cost in a list of design considerations is not surprising. Once again, however, a review of the full costs associated with a structural BMP may yield a few surprises that may increase designers' understanding and encourage them to give BMP costs the full consideration they deserve.

The most obvious BMP cost is its construction. This can be estimated with reasonable accuracy and is the cost most directly borne by the designer's client. As such, designers most often focus on this cost during the design process to the exclusion of all others.

What other costs may be overlooked? One may be the designer's own fee, which is part of the overall BMP cost but which has probably been excluded from consideration because it has already been determined. The designer's fee, however, has a direct impact on the BMP design because it determines the effort and resources the designer uses to produce it. The level of effort expended during the BMP design can have a similarly direct effect on the effort and cost of both construction and maintenance. The greater cost of a more thorough BMP design can ultimately result in cost savings to the client during subsequent project stages. Therefore, while this is not a signal to BMP designers to raise their fees, it is meant to remind designers that their fee is part of the overall BMP cost and that it is their responsibility to determine what level of design effort and cost represents the best investment for both the client and the community.

Another portion of total BMP cost that is frequently overlooked is the cost associated with its maintenance. While this cost on an annual basis is usually a small percentage of the construction and even the design cost, it must be remembered that, unlike construction or design, maintenance costs are recurring and must be paid throughout the life of the BMP. Therefore, while a maintenance cost savings may appear to be insignificant on a per-operation basis and not worth the extra investment in design or construction required to achieve it, its value may be viewed quite differently when multiplied by the numerous times it will be realized. As such, an added investment in design to produce a trash rack that will require less frequent cleaning or an added investment during construction to reduce the frequency of repairs may quickly yield a positive return in the form of reduced maintenance costs. Similar conclusions can be reached for many other design and construction efforts, such as providing better access, using more durable materials, and selecting a BMP that best suits site conditions.

Community Acceptance

The final recommended design consideration once again involves those people who may have the greatest interest in the structural BMP. Not coincidentally, these are the same people who will have the greatest role in the various nonstructural programs intended to augment and even replace structural BMPs in the future. To protect those interests and encourage assumption of that role, it is up to the designer to help achieve a structural BMP that will be reviewed as a community asset rather than a liability.

As discussed above, this can be achieved by considering the aesthetic value of the BMP, preventing the creation of nuisances and safety threats, as well as achieving required performance levels. Through all three, stormwater management gains the understanding and credibility it requires within the community.

Suggested Design Review Techniques

Throughout this paper, the BMP designer has been encouraged to consider a wide range of interests, operating conditions, costs, and other responsibilities

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throughout the design process. Presented below are two recommended techniques to help accomplish it. They can either be used as review techniques following completion of a preliminary BMP design or, ideally, be incorporated into the overall design process and used continually throughout it.

Spend a Mental Year With the BMP

To use this technique, the BMP designer simply imagines conditions at the constructed BMP throughout a full year. This should not only include rainy and sunny weather, but also light rain showers (with little or no runoff), light and heavy snowfalls, and frozen ground conditions. Other site conditions may include late autumn, when trees have lost their leaves and the BMP has found them, and hot, dry weather or even drought, when the turf or other vegetation is stressed or even killed. Finally, the designer may wish to imagine what the BMP will be like at night.

As these conditions are visualized, the designer should also imagine how those conditions may effect not only the operation of the BMP itself but also the people that will interact with it. Can blowing snow completely fill the BMP, leading the unsuspecting pedestrian to think that the grade is level? Will the outlet structure's trash rack be particularly prone to clogging by fallen leaves, particularly from the trees the designer just specified for the BMP's bottom?

What about the ice that will form on the surface of a pond or constructed wetland? Can someone fall through? Could that someone be a child taking a shortcut home? How will people be warned not to? How will they be rescued if they do anyway? What about night conditions? Will the constructed wetland next to the office parking lot that is so attractive during summer lunch hours become a safety hazard to workers walking to their cars in the winter darkness? Or will that same summer sun and a lack of rainfall produce some of the wonderful aromas of anaerobic decomposition?

At first, it may be exasperating to realize that the possible site conditions and circumstances can be as numerous and varied as the number of possible BMP uses But then again, that is the point of the exercise. It is intended to help the designer consider and design for all conditions at the BMP, not just the 1- or 100-year storm event required by the regulations. In doing so, the BMP designer will not only meet the letter of the regulations but will raise the spirit of the entire stormwater management program.

Who, What, When, Where, and How?

The second recommended review technique a BMP designer may employ is to simply focus on one or more characteristics or functions of the BMP and then ask (and attempt to answer) the above questions. For example, let's consider BMP maintenance and then ask:

- Who will perform it? Does the BMP design require specialists, or will someone with general maintenance equipment and training be able to do the job?
- What needs to be maintained? Preparing a list of all the BMP components included in a design that will need attention sooner or later may prompt a revised design with a shorter list.
- When will maintenance need to be performed? Once a day? A week? A year? Remember, the recurring costs of BMP maintenance can be substantial. In addition, can maintenance only be performed during dry weather? If so, what happens during 2 or 3 weeks of wet, rainy weather? What happens when repairs need to be made or debris removed during a major storm event? In terms of effort and possible consequences, it is easier for the designer to find answers to these questions now than for maintenance or emergency personnel to scramble for them later.
- Where will maintenance need to be performed? Will the maintainer be able to get there? Once there, will he or she have a firm, safe place to stand and work? In addition, where will such material as sediment, debris, and trash removed from the BMP be disposed of? Before answering that question, do you know what is in it? Are there toxics or hazardous materials in the sediment or debris? If so, is the place you originally intended to use still suitable? Once again, it is easier to address these questions now then when the dump truck is loaded and the engine's running.
- How will maintenance be performed? The simple instruction to remove the sediment or harvest the vegetation can become rather complicated if no provisions have been made to allow equipment to get to the bottom or even into the site. "Mowing the grass" can become "risking your limbs" on long, steep slopes. How will you explain to your client why the BMP in which he or she has invested has become a liability to themselves and their community?

Similar exercises can be performed with constructors, inspectors, and residents as the object of inquiry. For example, where will the nearest residence be? How will the constructor build the emergency spillway? When will the inspector need to visit to check for mosquitos?

Similar to the "mental year" review technique, the questions raised in this technique are intended to make the designer more aware of all the possible impacts the BMP may have and, further, to encourage the designer to address those impacts now, during the design phase, rather than leave them for others to cope with later. Even if the designer cannot completely answer all of the questions, he or she will be able to advise the others of any unavoidable needs or problems that will be inherent in the BMP and allow them to adequately prepare.

Summary

Stormwater management must still be considered a relatively new endeavor, particularly on a nationwide basis. Despite its nascent state, it has been charged with the responsibility of addressing some very complex environmental problems. For stormwater management to grow to the level demanded by this charge, the designers of structural BMPs must be willing to assume a degree of responsibility for that growth. BMP designers can fulfill that responsibility by producing BMP designs that do not merely meet official regulations and standards, but help inspire new, better, and more comprehensive ones. BMP designers must also incorporate a wide range of interests into the BMP design, including those held by stormwater program regulators, BMP constructors and maintainers, and all those members of the community who will interact with the BMP over its lifetime. During the design process, BMP designers must not only consider the BMP's performance but also its cost, durability, ease of construction, and maintenance needs. Finally, BMP designers must always recognize the BMP's impacts both on the community around it and on the stormwater management program with which the community has entrusted them.

Targeting and Selection Methodology for Urban Best Management Practices

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Abstract

Selecting best management practices (BMPs) to implement as part of a stormwater management plan is quite difficult and controversial because of a variety of technical, regulatory, institutional, and financial factors and constraints. Specifically, the nature and sources of stormwater-borne pollutants and the water quality and ecological problems these pollutants cause are not well understood. The cost, effectiveness, and applicability of many BMPs are also not well understood, although several BMP manuals summarize existing information. The federal National Pollutant Discharge Elimination System (NPDES) stormwater regulations provide flexibility in selecting BMPs to control urban pollutants. EPA gives only general guidance on the types of BMP programs that are desirable and does not require the implementation of specific BMPs. Several other factors contribute to difficulties in selecting and implementing BMPs. In many cases, institutional jurisdictions do not correspond to watershed boundaries, and water management institutions' roles and responsibilities are fragmented for effectively dealing with the myriad nonpoint sources of pollution associated with stormwater drainage systems. Finally, the availability of funds, which are currently very limited, significantly determines BMP implementation.

This paper provides guidance on the selection of BMPs given this current environment and based on experience in developing stormwater management plans for areawide programs, individual municipalities, industries, developments, and government facilities. The paper describes the current tools available for BMP selection, a 10-step "model" selection process, and case studies for a large areawide municipal program and for an industrial facility.

Introduction

In October 1990, the U.S. Environmental Protection Agency (EPA) issued regulations requiring certain municipalities and industries to select and implement best management practices (BMPs) to control pollution associated with stormwater runoff and dry weather discharges into storm drain systems. Such BMPs would be selected and described in stormwater management plans and implemented in compliance with an NPDES permit. The specific regulatory language in Section 402(p) of the Clean Water Act is "Permits for discharges from municipal storm sewers shall require controls to reduce the discharge of pollutants to the maximum extent practicable . . . ." The maximum extent practicable (MEP) standard has a legal definition; however, considerable uncertainty exists in the regulated community about what constitutes technical compliance with the MEP standard.

Other existing and proposed regulations require BMP selection. Section 303 of the Clean Water Act requires that delegated states and EPA establish total maximum daily loads (TMDLs) for designated "water quality limited" water bodies. The TMDL process considers both point and nonpoint sources. For nonpoint sources, water quality management plans must be developed to meet load allocations for urban and other land uses. The 1990 Coastal Zone Act Reauthorization Amendments (CZARA) require the development of state nonpoint source control plans for the coastal zone using BMP guidance recently released by EPA and the National Oceanic and Atmospheric Administration (NOAA).

Finally, watershed planning is gaining favor as a way of meeting water quality goals for the nation's waters. The watershed planning approach requires examination of all land uses and activities in a watershed and development of BMPs to protect water quality. EPA is considering the watershed approach for the phase II portion of the NPDES program.

This paper describes our experience in selecting BMPs for clients complying with the NPDES stormwater regulations; the process would also be applicable to TMDL, coastal zone, and watershed planning. We discuss types of BMPs and sources of information on BMPs available for developing management plans. Based on our experience, we also describe the attributes of a good selection process and describe the steps involved in a "model" selection process. Because of numerous site-specific conditions that enter into any selection process, the actual process chosen must be adapted to each situation. To illustrate how such a process might be adapted to different circumstances, we describe two case studies, one for a large areawide municipal program and one for multiple federal facilities regulated as industrial dischargers.

Best Management Practices

Although BMPs may be organized in many ways, it is useful in the selection process to distinguish controls based on how they function. BMPs based on function are often considered as source controls, treatment controls, and hydraulic controls.

- *Source controls* are intended to prevent pollution in the first place (i.e., pollution prevention) or to intercept the pollutants before they enter the storm drainage system. Preventing pollution in the first place often involves behavior modification, which requires public information and education, an important source control BMP. Street sweeping and catch basin cleaning are examples of source controls that intercept pollutants before stormwater carries them into receiving waters.
- *Treatment-based controls* are controls that remove pollutants from stormwater, usually through some structural means such as a detention basin or grassy swale.
- *Hydraulic controls* are structural controls that reduce the volume of runoff (or otherwise alter the runoff hydrograph) or divert flows away from source areas. Examples of hydraulic controls are infiltration systems.

In general, the effectiveness of these types of controls are not well understood. The effectiveness of treatment and hydraulic controls generally can be measured through monitoring, and there is an increasing body of literature regarding the effectiveness of treatment and hydraulic controls under limited conditions. Federal, state, and local agencies have developed numerous BMP guidance manuals to help identify, select, and design BMPs. The following is a partial list of manuals, starting with design manuals that contain detailed control selection and design information.

- U.S. EPA. 1993. Handbook: Urban runoff pollution prevention and control planning. EPA/625/R-93/004.
- City of Austin Environmental Resource Management Division. 1991. Environmental criteria manual. Environmental and Conservation Services Department (February 19).
- Metropolitan Washington Council of Governments (MWCOG). 1987. Controlling urban runoff: A practical manual for planning and designing urban BMPs. Prepared for Washington Metropolitan Water Resources Board (July).
- State of Florida Department of Environmental Regulation. 1988. The Florida development manual: A guide to sound land and water management (June).
- State of Washington Department of Ecology. 1992. Stormwater management manual for the Puget Sound Basin (the technical manual) (February).
- Urban Drainage and Flood Control District. 1992. Urban storm drainage criteria manual. Denver, CO (September).
- Metropolitan Washington Council of Governments (MWCOG). 1992. Design of stormwater wetland systems. Prepared for the Nonpoint Source Subcommittee of the Regional Water Committee (October).

The following documents primarily discuss control effectiveness and do not contain control selection and design information:

- City of Austin Environmental Resource Management Division. 1990. Removal efficiencies of stormwater control structures. Environmental and Conservation Services Department (May).
- Metropolitan Washington Council of Governments (MWCOG). 1992. A current assessment of urban best management practices. Prepared for the U.S. Environmental Protection Agency (March).
- U.S. EPA. 1990. Urban targeting and BMP selection: An information and guidance manual for state nonpoint source program staff engineers and managers. Region 5, Water Division, Chicago, IL 60604 (November).
- Metropolitan Washington Council of Governments (MWCOG). 1992. Analysis of urban BMP performance and longevity.
- U.S. EPA. 1993. Guidance specifying management measures for sources of nonpoint pollution in coastal waters. EPA/840/B-92/002. Washington, DC (January). (Includes costs.)
- California State Stormwater Task Force. 1993. California BMP handbooks for municipal, construction, and industrial/commercial (April).

Finally, the following document addresses BMP costs:

- Southeastern Wisconsin Regional Planning Commission. 1991. Costs of urban nonpoint source water pollution control measures. June.

These manuals describe BMP function, requisite site conditions, existing performance information, and cost ranges. In general, these manuals are well written and provide a good starting point for developing an understanding of the advantages and disadvantages of many treatment-based controls. For some BMPs, there is limited information on effectiveness and cost; for these, pilot testing may be helpful under site-specific conditions.

Treatment-based controls are especially applicable in construction and new developments, where structural measures may be incorporated into the construction process and site design. The cost of constructing and maintaining treatment-based controls is a major concern to municipal and industrial dischargers.

In contrast to treatment-based controls, source control effectiveness in terms of water quality improvement cannot easily be measured, if at all. For example, the effect of a public education program on improving water quality cannot be determined, although some public education activities obviously are more effective than others. The effectiveness of street sweeping and catch basin cleaning on water quality requires careful and expensive paired catchment types of studies. Source controls are generally considered the most cost-effective long-term solution because they address the cause of the problem; thus, we see many programs focusing on source control measures.

Attributes of a Good Selection Process

The following sections describe some attributes of a good selection process.

Keep It Simple and Straightforward

BMP selection for nonpoint source controls is in its infancy compared with point source controls, for which treatment technologies and associated costs are well understood. Instead of traditional cost benefit analysis, nonpoint source BMP selection is more of an art and requires experience, sound judgement, and common sense. Though the process of selection may involve several steps, the process itself must be easily understandable and accepted by the various interest groups involved, including public agency staff and decision-makers, environmental groups, and regulatory personnel.

Document the Process

It is essential to carefully document the process by which BMPs were selected and the various assumptions and considerations made during the selection process. In other words, the process, even though it may be subjective in part, should not be "arbitrary and capricious." The selection process must be clear to reviewers in evaluating the adequacy of the process in meeting the intent of the regulations. Also if the process is clear, it can be improved or modified in the future as more information becomes available or policies change.

Be Comprehensive

The federal regulations require a comprehensive approach such that a broad range of controls are evaluated for various land uses and activities. The selection process must evaluate a comprehensive list of BMPs to address pollutants of concern and their sources.

Plan for Implementation

Human nature being what it is, effectively implementing many BMPs at once is difficult. The solution to this dilemma is to minimize the number of BMPs chosen, prioritize or phase their implementation, and/or group related BMPs into a few categories, sometimes called program elements.

Involve Affected Parties in the Process

A second element of human nature is adverseness to implementing someone else's plan. Therefore, BMPs are selected ideally by those who have to implement them (with guidance, of course). A second alternative is that the process heavily involves those who will implement the BMPs in a review and approval role. If neither of these approaches are followed, the plan is not likely to be well implemented.

Indeed, involvement of the affected parties in the selection process is probably more important to the success of the program than the exact nature of the process itself. Through this process, the parties become educated regarding problems, possible solutions, and the need for teamwork in implementing solutions.

Model of a Good Selection Process

There is no one correct selection process as the process must be tailored to local institutional, political, and regulatory conditions. Figure 1 is a schematic showing six steps in a BMP evaluation, selection, and planning process that are generally applicable. The following is a somewhat expanded discussion of BMP selection steps appropriate for most areawide municipal programs.

Step 1: Establish Program Goals and Objectives

The clients must agree on a compliance strategy from which will stem goals and objectives for the program. The strategy should address such issues as organization and administration, decision-making, coordination with other interest groups, and degree of proactiveness.

Step 2: Identify Receiving Waters, Problems, Pollutants, and Resources

The ultimate intent of the regulations is to protect and improve the water quality and ecology of receiving waters, and this goal should drive the BMP selection proc-

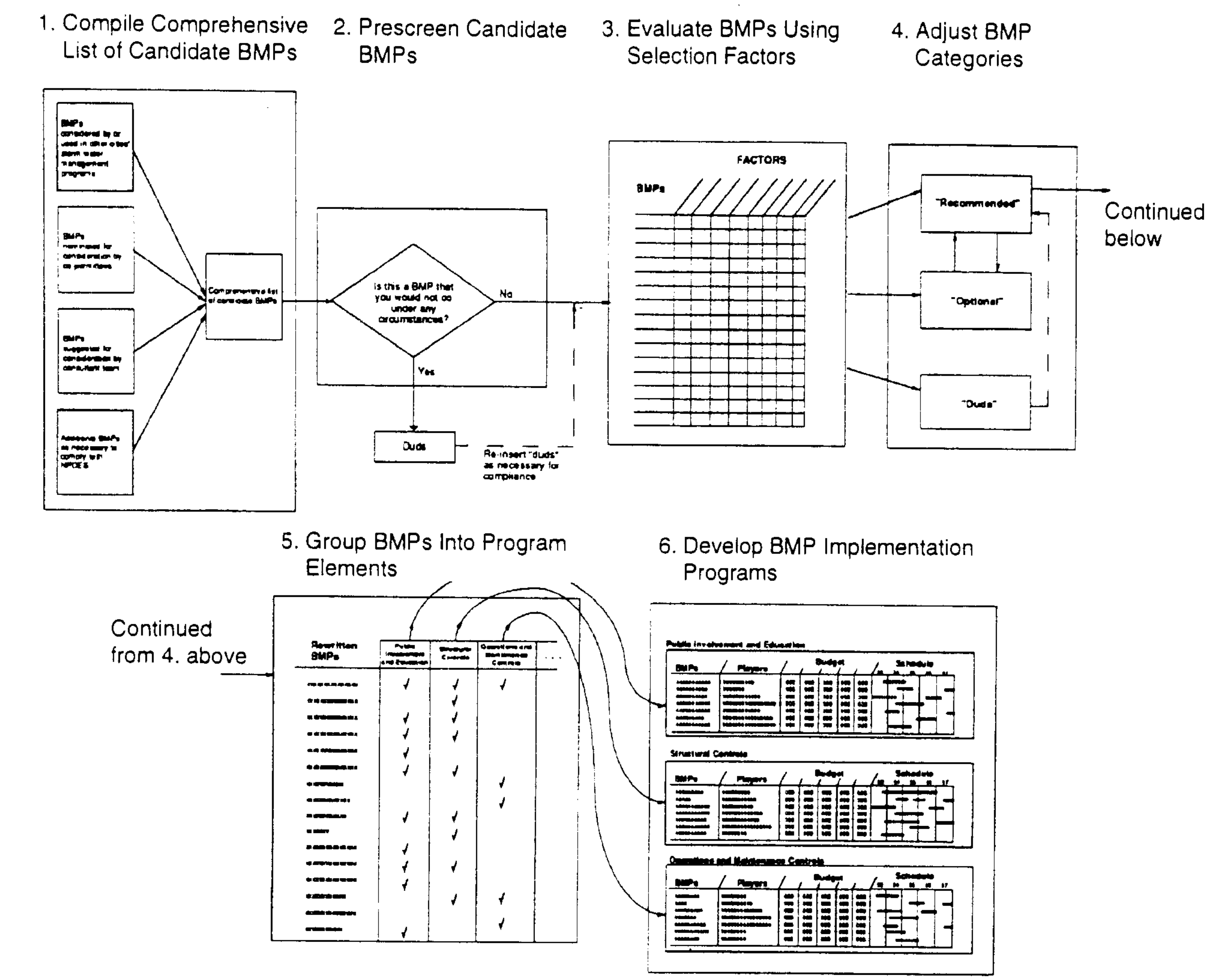

Figure 1. BMP evaluation, selection, and planning process.

ess to the extent possible. Ideally this step identifies water resources of particular value that are especially critical to protect, as well as impaired water bodies (e.g., 304(L) segments) that are currently not meeting water quality objectives appropriate for the beneficial uses. Where data are available, pollutants to be controlled should be identified. Without this step, much work and resources may be focused on activities that do not necessarily translate into an improved aquatic environment. Many programs find that a nontechnical one- or two-page "fact sheet" on receiving water problems, pollutants, sources, and management implications helps to develop support from taxpayers and decision-makers.

Step 3: Identify Sources and Pathways

Given the problems, the next step is to try to identify the important point and nonpoint sources of pollutants that are causing the problems. This is an essential step, because control of nonpoint sources only makes sense to the extent that it is a major source of the problem pollutant. For nonpoint sources, try to describe the pathway from source to receiving water, because this helps identify the BMPs that can most effectively intercept the pollutant along the pathway. For example, dumping waste oil into catchbasins can be mitigated by labeling storm drain inlets and/or requiring a monetary deposit at the point of purchase. It should also be pointed out that some sources may be quite difficult to control (e.g., natural erosion).

Step 4: Prioritize Sources (Areas) for Control

Targeting sources for BMP application is the next step. Focusing resources on selected areas is important, otherwise resources tend to be spread too thin to be effective. This is particularly important in municipal programs, where some early "successes" encourage the participation and financial support of local citizens.

A systematic targeting scheme using a ranking process based on stream size, beneficial uses, pollutant loads, and ease of implementation of the BMP is provided in U.S. EPA (1) and U.S. EPA (2). Use of these manuals might be appropriate after an areawide plan is developed; for example, a BMP might be to begin basin planning for selected basins within a city. The targeting manual (1) could be used to identify the basin and subbasins for BMP selection.

Step 5: Identify and Evaluate Existing BMPs

Compile a list of existing BMPs that are currently being conducted and organize them according the sources identified in Step 5. Identifying existing measures is often very difficult. Some municipalities do not know their system very well and are organized into departments in such a way that no one department is aware of what stormwater measures are currently being implemented. Carefully crafted questionnaires work quite well at developing information on existing practices that affect stormwater quality. Evaluate the effectiveness of these measures and improve or discontinue as appropriate.

This step also involves identifying existing environmental programs that are conducting activities that relate to stormwater pollution control and with whom cooperation should be sought. Examples include pretreatment programs, HAZMAT programs, solid waste control and recycling programs, and public information programs.

Step 6: Compile Candidate BMPs

Compile a comprehensive list of candidate BMPs that may be appropriate. This list should contain both source- and treatment-based controls and include such things as regulatory authority. Attach attributes to each BMP, including (if available) pollutant type controlled, cost, and effectiveness. (Recall that such information is generally not available for source controls.) Note dependencies or synergistic relationships between BMPs. For example, some BMPs may be more effective if or may require that another BMP is implemented before or at the same time.

Step 7: Develop Selection Criteria

In addition to the obvious criteria that the BMP address the problems and sources identified in Steps 2 and 5, developing a list of additional criteria that can be used to assist in the selection process is helpful. Such criteria include regulatory requirement compliance, effectiveness, reliability and sustainability, implementation and continuing costs, equitability, public and agency acceptability, risk and liability, environmental implications, and synergy with existing or other BMPs.

Step 8: Apply Criteria for Selection of Baseline Measures

Selection criteria may be applied in numerous ways. For example, applying different criteria in multiple screening "passes" is a common procedure. BMPs may be required to meet "critical criteria" such as obtain co-permittee acceptance, address the problem pollutants and sources, and meet regulatory requirements. Then, in a second "pass," those BMPs that met the critical criteria are further evaluated by applying additional criteria that would help to select preferred BMPs. Such criteria could include effectiveness, cost, and reliability. Often the second pass allows the municipality to help determine what is financially feasible. In the second pass, qualitative (e.g., high, medium, low) or simple quantitative (e.g., 1, 2, 3) scoring might be used to help rank preferred BMPs. Unequal weighting can be assigned to each criteria as appropriate.

BMP selection should also anticipate the evolution of the program. For example, we often recommend that a set of "baseline" BMPs be selected that fully exploits the existing control measures and focuses on additional source control. The selection process can then be used to select the baseline measures and also candidates for a reserve list of BMPs that could be implemented at a later time based on experience with the baseline BMPs.

Step 9: Implement Baseline Measures

Implement the baseline measures with appropriate phasing to allow for planning, pilot testing, etc., prior to full scale implementation. For each BMP, develop measures of effectiveness. As described above, baseline measures tend to be source controls.

Step 10: Monitor Effectiveness and Reevaluate BMPs

Monitor the effectiveness of each BMP and, based on monitoring, annually reevaluate each BMP. As appropriate, delete or select additional BMPs. Annual evaluation should also include any new information obtained through monitoring receiving waters and/or source identification studies.

Case Study 1: Areawide Municipal Program

The following describes a case study of the BMP selection process that multiple agencies who were part of an areawide stormwater program conducted.

County X is 200 square miles in area and contains 20 co-permittees consisting of municipalities, the county, and a special district. The county population is 1 million people. The municipalities cover a wide range of sizes and land uses, from one city of 100,000 population with major industrial facilities down to small residential cities

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of 10,000 population. At the behest of the state environmental agency, the co-permittees elected to form a countywide stormwater pollution control program to comply with the federal NPDES stormwater regulations. During the Part I application, the co-permittees compiled a list of existing BMPs.

The co-permittees were very concerned that their management plans reflected local conditions and resources and insisted that they each conduct the BMP selection process themselves. We refer to this approach as the "bottom up" approach, in contrast to the "top down" approach in which BMP selection is conducted by the program and then distributed to the co-permittees for their review and approval. Woodward-Clyde Consultants (WCC) acted as facilitators by designing a process for BMP selection that included development of guidance documents, workshops for all co-permittees, and meetings with individual cities. Program representatives and WCC met with the individual jurisdictions three times throughout the process to provide assistance or clarification. The process from start to finish took about 9 months.

The following guidance documents were developed:

1. Description of Management Plan Development Process
2. Selecting the "Right People" To Participate in the Process
3. Source Identification
4. BMPs for Industrial Facilities
5. BMPs for Agency Activities
6. Transportation BMPs
7. Illicit Discharge Elimination BMPs
8. Commercial Area BMPs
9. Construction and New Development BMPs
10. Public Education and Industrial Outreach BMPs
11. How To Complete Your Stormwater Management Plan

The guidance documents included tables that each co-permittee was asked to complete based on guidance provided. The tables formed the basis of each entity's plan. A key element in the process was a problem and source identification step (Guidance Document 3), in which each entity identified receiving water problems, water resources of special interest, and pollutant sources. Based on this problem identification, cities selected BMPs to address source areas in their jurisdictions.

Guidance Documents 4 through 9 described a menu of individual BMPs from which the cities could select. In addition, WCC recommended a basic list of BMPs applicable for most jurisdictions. The co-permittees chose to participate in a countywide public education program involving various BMPs described in Guidance Document 10. Guidance Document 11 explained how to "put it all together."

An example of a BMP description is given in Table 1. The information provided consisted of a BMP name and identifier, description, steps for implementation, methods to assess effectiveness, and remarks. For those BMPs selected, co-permittees were asked to show when tasks would be completed, and the budget for each BMP over the 5-year permit period.

The BMP information was intended for guidance only, and some jurisdictions revised or created new BMPs that better addressed their circumstances. Some jurisdictions showed real creativity and enthusiasm in developing BMPs. This participatory process results in a much more implementable, practical, and effective stormwater management plan.

Case Study 2: Industrial Facility

Selection of BMPs for industrial facilities is more site specific and tends to be guided by the types of activities being conducted at the facility. The process of BMP selection then involves identifying industrial activities that could potentially generate sources, identifying the types of pollutant releases associated with

Table 1. Best Management Practices for Agency Activities and Facilities

Number	AA-11
Best Management Practice	Reduce agency use of herbicides and pesticides.
Description	Reduce the use of herbicides and pesticides on city streets, landscaping in parks, flood control channels, municipal golf courses, etc.
Steps for Implementation	1) Assess current herbicide and pesticides uses (e.g., types, amounts, areas used). 2) Research areas where less toxic substances could be substituted or usage could be eliminated altogether (e.g., use of mosquitofish rather than pesticides). 3) Develop implementation programs for various areas.
Methods To Assess Effectiveness	Compare amounts and types of herbicides and pesticides currently used with amounts and types used after implementation of the program(s) to demonstrate overall reduction and/or transition to less toxic substances.
Remarks	Coordinate with public education and industrial outreach component for public education in the area of residential herbicide and pesticide use.

each source, identifying optional BMPs that would prevent or eliminate that source, and selecting the preferred option. The following describes a pared-down process of BMP selection that we have used on several industrial projects.

Step 1: Identify Drainage System and Receiving Water

Define the drainage system and receiving waters, including water quality and other concerns in receiving waters. Ensure plant personnel (particularly nonenvironmental personnel) understand the receiving water and regulatory issues when they are involved in the BMP selection process.

Step 2: Identify Industrial Activities and Associated Pollutant Sources

Discuss what industrial activities are conducted at the facility and how these activities might lead to discharges into storm drain systems. This can best be accomplished through a combination of a site investigation and a sit-down brainstorming session with plant personnel. Table 2 shows the result of this step for a steam plant. Indicated in the table are the source activities, drainage areas within the facility where these sources are located, potential pollutants associated with the source, and a relative measure of the importance of the source for creating receiving water problems.

Contamination potential:

1 = high

2 = medium

3 = low

Step 3: Develop Candidate Control Measures

Develop candidate control measures for consideration that address each of the potential and known sources of pollutants. The last column in Table 2 shows these measures.

Table 2. Example of Source and Pollutant Identification and BMP Selection for Industrial Facility

Source Areas	Drainage Areas	Potential Pollutant	Contamination Potential	Recommended Control Measure
Parking lots	1, 2, 4	Oil and grease TSS	2 2	• Inspect and clean catchbasins • Conduct good housekeeping practices
Loading docks	1, 2	Oil and grease Toxics	3 3	• Provide mats to cover catchbasins if spill occurs while raining
Construction equipment parking	1, 2	Oil and grease TSS	2 2	• Inspect and clean catchbasins • Conduct good housekeeping practices
Materials storage	1	TSS Metals Toxics	2 2 3	• Sweep after loading and unloading materials from concrete vaults • Place materials with greatest contamination potential under Ferry St. overpass
Curing oil storage	1	Oil and grease	2	• Move drums inside or to a bermed area that is covered
Vehicle fueling	2	Fuel Oil and grease	3 3	• None
Aboveground fuel storage	2, 3	Fuel	3	• None
Utility pole storage	2	PCP1 Creosol Metals Oil and grease	1 1 1 1	• Determine feasibility of moving poles under Ferry St. overpass
Vehicle rinse area	2	TSS Oil and grease	2 1	• Clean sediment trap more often • Consider adding oil/water separator
Steam cleaner	2	TSS Oil and grease Detergents Toxics	3 3 3 3	• Enlarge pad area • Post signs providing employees with proper instructions • Rinse pad after cleaning • Clean oil/water separator more often

Table 2. Example of Source and Pollutant Identification and BMP Selection for Industrial Facility *(Continued)*

Source Areas	Drainage Areas	Potential Pollutant	Contamination Potential	Recommended Control Measure
Transformer cleaner	2	Mineral oil	3	• None
		PCBs	3	
Sodium hypochlorite storage	2	NaOCl	2	• Relocate drums inside or to a bermed area that is covered
Hogged fuel pipe	3	Tannin and lignin	3	• Sweep street after heavy winds
		BOD	2	• Clean catchbasin more often
		COD	3	
Sulfuric acid storage	3	H_2SO_4	3	• None
Oil drum storage		Oil and grease	3	• None
Ash handling area	4	TSS	2	• Enlarge the loading area
		pH	2	• Improve the loading procedure
		Toxics	2	• Clean the catchbasins in the immediate area more often

Step 4: Conduct BMP Evaluation and Selection

Conduct a BMP evaluation and selection session with plant personnel. Just as in a municipality, involving the right plant personnel in the process is very beneficial. Such involvement allows the plan to reflect their extensive knowledge of the site and industrial activities, and encourages the plant staff to take ownership of the management plan. Often, we have found that personnel have been trying to implement some of the BMPs, and the NPDES permit requirements now give them the impetus to get them more fully implemented. In these sessions, we have sometimes used a formal decision process, while at other times a less formal, but still documentable, discussion of the potential BMPs was used to select BMPs. The focus of BMPs at industrial sites where we have worked has been source control. Compared with municipalities, however, industries tend to be more willing to consider installing or retrofitting structural controls.

Step 5: Prioritize BMPs and Develop Monitoring Program

Prioritize BMPs and develop and implement "monitoring" programs for assessment of effectiveness.

References

1. Woodward-Clyde Consultants. 1990. Urban targeting and BMP selection: An information and guidance manual for state NPS program staff and managers. Prepared for U.S. Environmental Protection Agency (May).

2. U.S. EPA. 1993. Handbook: Urban runoff pollution prevention and control planning. EPA/625/R-93/004.

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A Catalog of Stormwater Quality Best Management Practices for Heavily Urbanized Watersheds

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Abstract

Various federal and state environmental programs require the use of onsite structural best management practices (BMPs) to control the quality of stormwater discharges from development sites. Space constraints, extremely high property values, soil conditions, and the proximity of other building foundations often preclude the use of conventional stormwater BMPs for infill construction or redevelopment in the intensely builtup centers of major cities, where pollutant loads are usually the greatest. Unconventional solutions must be applied in these heavily urbanized environments.

Alexandria, Virginia, has adopted and published design criteria for several nonconventional BMPs, many of which employ intermittent sand filter technology; some of these BMPs were developed by pioneering jurisdictions throughout the United States; the city's engineering staff devised others:

- Stormwater sand filter basins in widespread use in Austin, Texas, are readily adaptable for large development projects.
- Underground vault sand filters employed in the District of Columbia (DC) allow full economic use of surface areas.
- Double-trench sand filters adopted by the state of Delaware can be placed either in or adjacent to paved areas.
- Simple trench and modular sand filters developed by the city of Alexandria are suitable for small or medium-size sites.
- A peat-sand filter adapted from a Metropolitan Washington Council of Governments design is applicable to situations where high pollutant removal is required.
- Water quality volume detention tanks for use in Alexandria's combined sewer areas capture the most polluted stormwater for later treatment in the wastewater treatment plant.

The Heavily Urbanized Environment

The U.S. Environmental Protection Agency (EPA) program for National Pollutant Discharge Elimination System (NPDES) permits for stormwater discharges envisions the use of onsite structural best management practices (BMPs) to control the quality of runoff from development sites. Many state programs already impose the requirement for onsite BMPs on developers. Under the Virginia Chesapeake Bay Preservation Act (VCBPA), no net increase in pollutants in stormwater runoff is allowable from previously undeveloped sites in Chesapeake Bay Preservation Areas (CBPAs). Runoff from redevelopment sites in CBPAs must contain 10 percent fewer pollutants than existed before redevelopment. In devising a local program to meet these pollutant removal performance requirements, Alexandria confronted the dilemma of which structural BMPs to employ. The entire city is designated as a CBPA. Most of the land is already developed, and large areas are heavily built up, in many cases with lot-line to lot-line structures. Property values are also extremely high. Such conditions exist in the central business districts of most metropolitan areas.

Use of conventional structural BMPs is often impractical in the heavily urbanized environment. Space and cost constraints severely inhibit the use of dry detention ponds and wet ponds. Soil conditions and high water tables in the river valleys where most older cities are located frequently preclude the use of infiltration devices because of the prevalence of marine clays. Unconventional solutions had to be found to remove the pollutants from stormwater runoff created by development activity. Research by the engineering staff of Alexandria's Transportation and Environmental Services Department revealed that very little information is available on how to remove pollutants from runoff in heavily urbanized environments.

BMP Design Criteria for Heavily Urbanized Areas

The Alexandria engineering staff consulted with jurisdictions throughout the United States where BMPs addressing heavy urbanization are being investigated, then synthesized the information obtained into comprehensive design criteria for local developers. The staff also developed several additional BMPs for use in the city. Design criteria for these BMPs for heavily urbanized areas were published in the *Alexandria Supplement to the Northern Virginia BMP Handbook* in February 1992 (1). The publication is being used by the Virginia Chesapeake Bay Local Assistance Department as a guide for other urban stormwater programs within the commonwealth.

The Concept of BMPs for Heavily Urbanized Areas

Stormwater quality management in the heavily urbanized environment involves the following activities for the most polluted runoff:

- Collection
- Pretreatment to remove sediments
- Storage
- Treatment to remove pollutants of a specific quantity

In Virginia, the minimum quantity of stormwater to be treated is the first 1/2 in. of runoff from the impervious areas on the site—the water quality volume (WQV). The WQV for each impervious acre is just over 1,800 ft^3.

Capturing the WQV

A typical approach for achieving isolation of the WQV is to construct an isolation/diversion weir in the stormwater channel or pipe such that the height of the weir equals the height of the water in the BMP when the entire WQV is being held. When additional runoff greater than the WQV enters the stormwater channel or pipe, it will spill over the isolation/diversion weir, and the extent of mixing with water stored in the BMP will be minimal. The overflow runoff then enters a peak flow rate reducer or exits directly into the stormwater collection system. Figure 1 illustrates this approach.

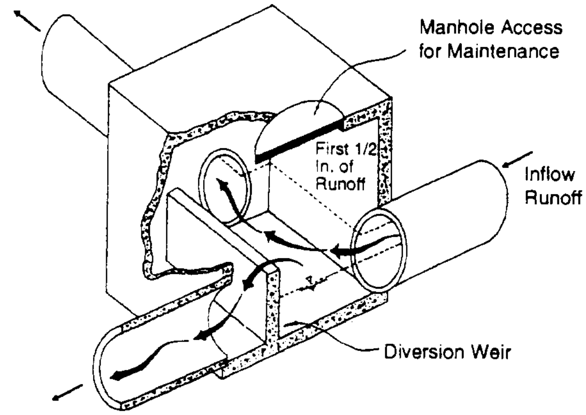

Figure 1. Typical isolation/diversion structure.

Pretreatment Requirements

Several conventional BMPs, such as buried infiltration devices, and most unconventional BMPs require some type of pretreatment system to remove excessive sediments, which would result in premature failure of the BMP. Pretreatment mechanisms may be installed either at the point of collection or after separation of the WQV. These mechanisms may be either separate devices or an integral part of the BMP itself.

Water quality inlets (WQIs), or oil-grit separators (OGSs), have been employed for several years for the removal of grit and oil, which are found in large quantities in parking lots and other areas where vehicular traffic is significant. Recent studies by the Metropolitan Washington Council of Governments (MWCOG), however, have established that WQIs provide little or no pollutant and questionable hydrocarbon removal (3).

Sedimentation basins have traditionally been the first step in water or wastewater treatment. Where site conditions allow, presettling basins may provide a low cost approach to removal of sediments, which can clog infiltration devices or filter systems. In situations where space is not a problem, presettling basins may be built directly into the ground. In the heavily urbanized environment, where space utilization is an important economic consideration, underground presettling chambers in vaults or pipe galleries may provide a more feasible solution. Alexandria sizes sedimentation basins using a methodology based on the Camp-Hazen equation, published by the State of Washington Department of Ecology (4).

Grassed filter strips are a common method employed in northern Virginia for removing sediments from stormwater to be treated in infiltration systems. To be effective, the strip must be at least 20 ft wide, have a slope of 5 percent or less (5), and be stabilized.

Storage of the WQV

Following isolation of the WQV and pretreatment to remove sediments and other pollutants, water must be stored until it can be processed in the primary treatment device (up to 40 hours in Alexandria). Creating over 1,800 ft^3 of water storage per impervious acre on the site is often the most costly item in the overall BMP system. In some cases, as with sedimentation basins, storage may be combined with pretreatment. In others, separate storage galleries of round or arched-section pipe may be required. Some BMPs for heavily urbanized areas combine pretreatment, storage, and primary treatment in a single underground vault.

Treatment of the WQV

Most of the BMPs described in this paper employ intermittent sand filters. Originally developed during the 1800s for treating both water supplies and wastewater, intermittent sand filters have regained popularity for use in the treatment of small wastewater flows (6).

Austin, Texas, and the state of Florida pioneered the use of sand filters in the treatment of stormwater runoff. Alexandria uses the Austin sand filter equation derived from Darcy's Law by the Austin Environmental and Conservation Services Department to size sand filters (2):

$$A_f = I_a H d_f / k(h+d_f) t_f$$

where

A_f = surface area of sand bed (acres or square feet)
I_a = impervious drainage area contributing runoff to the basin (acres or square feet)
H = runoff depth to be treated (feet)
d_f = sand bed depth (feet)
k = coefficient of permeability for sand filter (feet per hour)
h = average depth (feet) of water above surface of sand media between full and empty basin conditions (half maximum depth)
t_f = time required for runoff volume to pass through filter media (hours)

Based on long-term observation of existing sand filter basins, Austin uses k values of 3.5 ft/day for systems with full sedimentation pretreatment and 2.0 ft/day for systems with only partial sedimentation pretreatment. Alexandria has also adopted these values. Both Austin and Alexandria use a BMP drawdown time (t_f) of 40 hours. With these constants, the equation for sand filter systems with full sedimentation protection reduces to

$$A_{f(FS)} = 310 I_a d_f/(h+d_f),$$

where A_f is in cubic feet and I_a is in acres.

For sand filter systems with partial sedimentation protection, the equation reduces to

$$A_{f(PS)} = 545 I a d_f/(h+d_f),$$

where A_f is in cubic feet and I_a is in acres.

Descriptions of BMPs for Heavily Urbanized Areas

The BMPs discussed below should not be thought of merely as drainage structures. They are low technology treatment works that use water and sewage treatment technology from the late 19th century. Treatment works cannot always be made to function by gravity flow, although it is usually desirable from a cost-effectiveness standpoint.

Surface Sand Filter Basin Systems

Austin, Texas, was a pioneer in the use of intermittent sand filtration systems for treating stormwater runoff. The Austin program is managed by the Environmental and Conservation Services Department, which has published design criteria in their *Environmental Criteria Manual* (2).

Typical intermittent sand filters employ an 18- to 24-in. layer of sand as the filter media underlain by a collector pipe system in a bed of gravel. A layer of geotechnical cloth separates the sand and gravel to keep the sand from washing into voids in the gravel. Austin pretreats the stormwater runoff in a sediment trapping structure to protect the filter media from excessive sediment loading.

Figure 2 is a centerline cutaway of one Austin sand filter configuration. In this system, the sedimentation structure is a basin designed to hold the entire WQV, then release it to the filtration basin over an extended drawdown period. An alternate design allows use of a smaller sedimentation chamber but requires increasing the filter size to compensate for increased clogging of the filter media. While the system shown uses concrete basins, a sediment pond and a geomembrane-lined filter built directly into the ground may be used where terrain and soil conditions allow. The Austin sand filter systems are most appropriate for large developments covering several acres.

Austin has monitored the performance of their sand filters for several years and currently recognizes up to 60 percent phosphorus removal efficiency based on these studies (7). Alexandria is currently recognizing a 40 percent phosphorus removal rate pending further sand filter monitoring results by Austin and the District of Columbia. (Phosphorus is the "keystone pollutant" used to measure compliance with the VCBPA.)

Underground Vault Sand Filter Systems

Truong developed a stormwater quality sand filtration system in an underground vault (8). Over 70 of the structures have been installed since 1987. Figure 3 is a centerline cutaway of the original concrete vault DC sand filter. DC sand filters may be placed underneath parking lots, alleys, or driveways, taking up no usable space on the surface. This is an important advantage in the heavily urbanized environment. Truong believes that

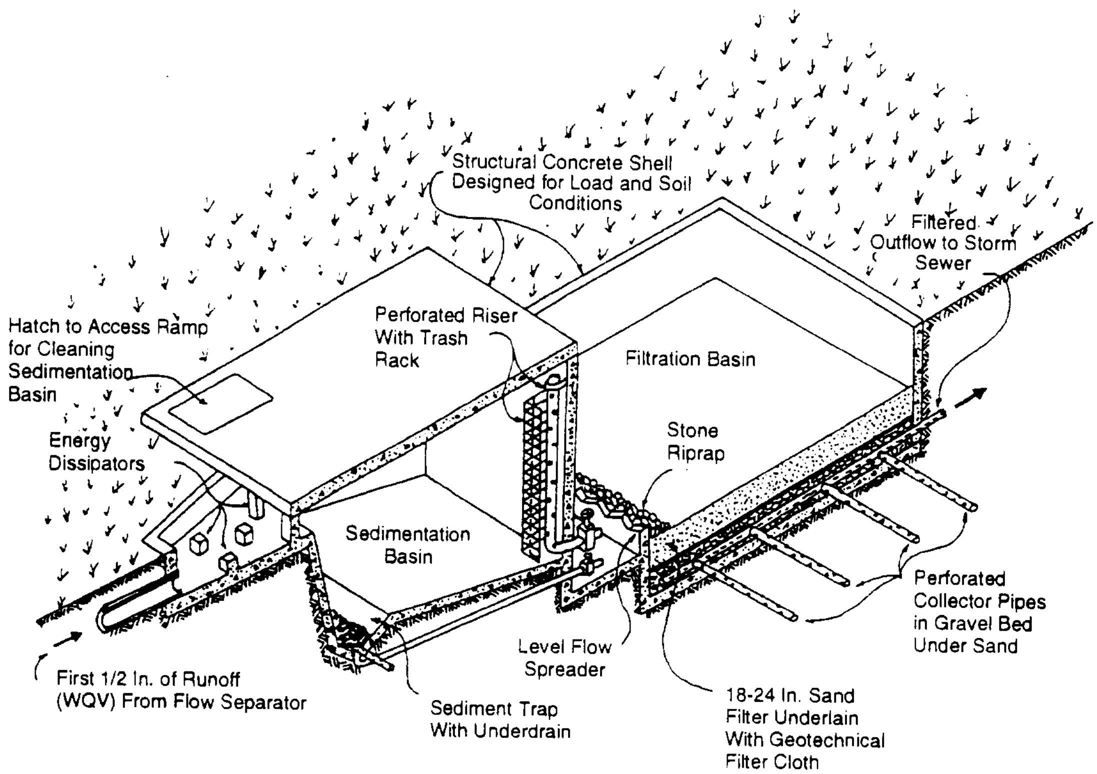

Figure 2. Austin basin sand filter system.

this system works best on watersheds with 1 acre or less of impervious cover.

The DC sand filter is a three-chamber gravity-flow system. The first chamber and the throat of the second chamber contain a permanent pool that traps grit and floating organic material, such as oil, grease, and tree leaves. A submerged rectangular opening at the bottom of the first dividing wall connects the two parts of the pool. The second chamber also contains a 24-in. deep sand filter underlain by a layer of geotechnical fabric and collector pipes in gravel. A top layer of plastic-reinforced geotechnical filter cloth held in place by a 1-in. layer of gravel is provided above the sand to compensate for the smallness of the sedimentation chamber.

New runoff entering the structure causes the pool to rise and overflow onto the filter. After percolating through the sand, the treated water enters the underdrains and flows out into the third chamber, or clearwell. The clearwell conveys the treated water to the storm sewer or drainage system. If possible, this BMP should be configured to allow gravity outflow; however, in instances where filters must be placed below the storm drainage system elevation, such as under the entrance driveway to a parking garage, a sump pump must be used.

The trash and hydrocarbon water trap in the first chamber must be pumped out and refilled with clean water every 6 months for proper functioning. Every 3 to 5 years, the top filter cloth layer and gravel must be removed and replaced because of fine sediment clogging. Placement of the second chamber manhole directly above the center of the filter allows the corners of the cloth to be peeled up and bound together to form a bag that can be lifted out as a unit.

The District of Columbia Environmental Regulation Administration is conducting a program of monitoring to establish the actual removal rates of this system. As of this writing, no data are available.

The Austin partial sedimentation sand filter may also be placed in underground vaults. Figure 4 shows a modified vault design developed by Alexandria from both Austin and District of Columbia methodologies. The Austin approach uses a gabion wall to separate the partial sedimentation chamber from the filter area. The gabion absorbs energy and provides initial filtration. Heavy sediments are deposited in this first chamber to dry out between storms. The filter is exactly like that used in the DC sand filter system.

Double Trench Sand Filter Systems

Shaver developed a surface sand filter system for use in Delaware (9). The Delaware sand filter is intended to be an in-line facility processing all stormwater exiting the site until it overflows.

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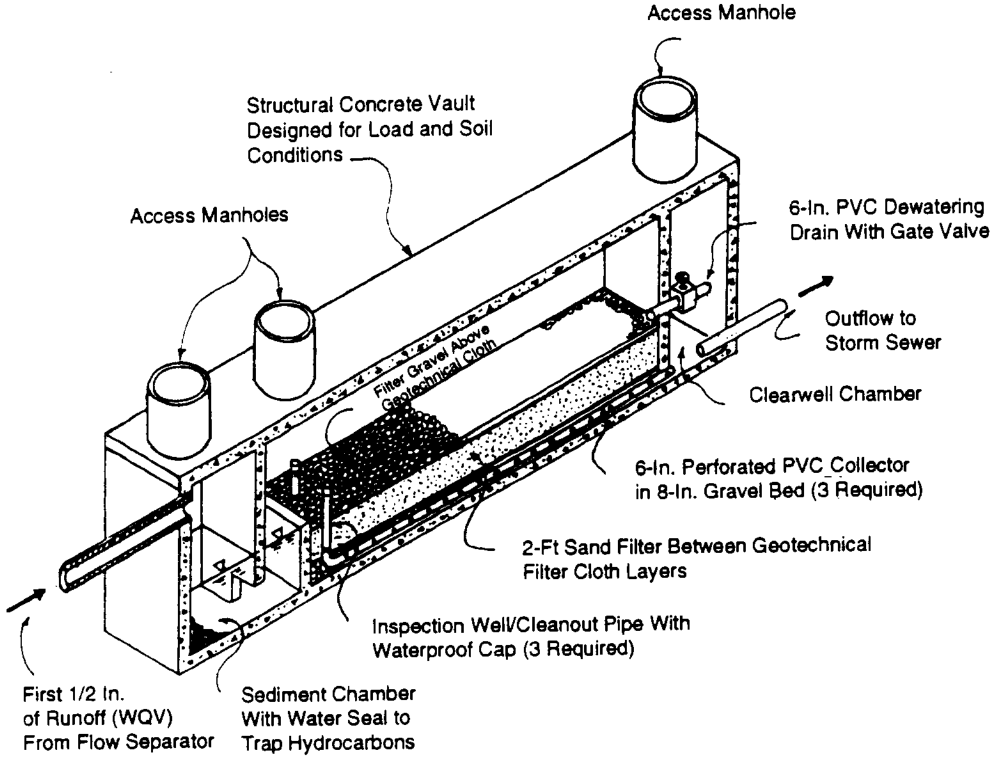

Figure 3. DC underground vault sand filter.

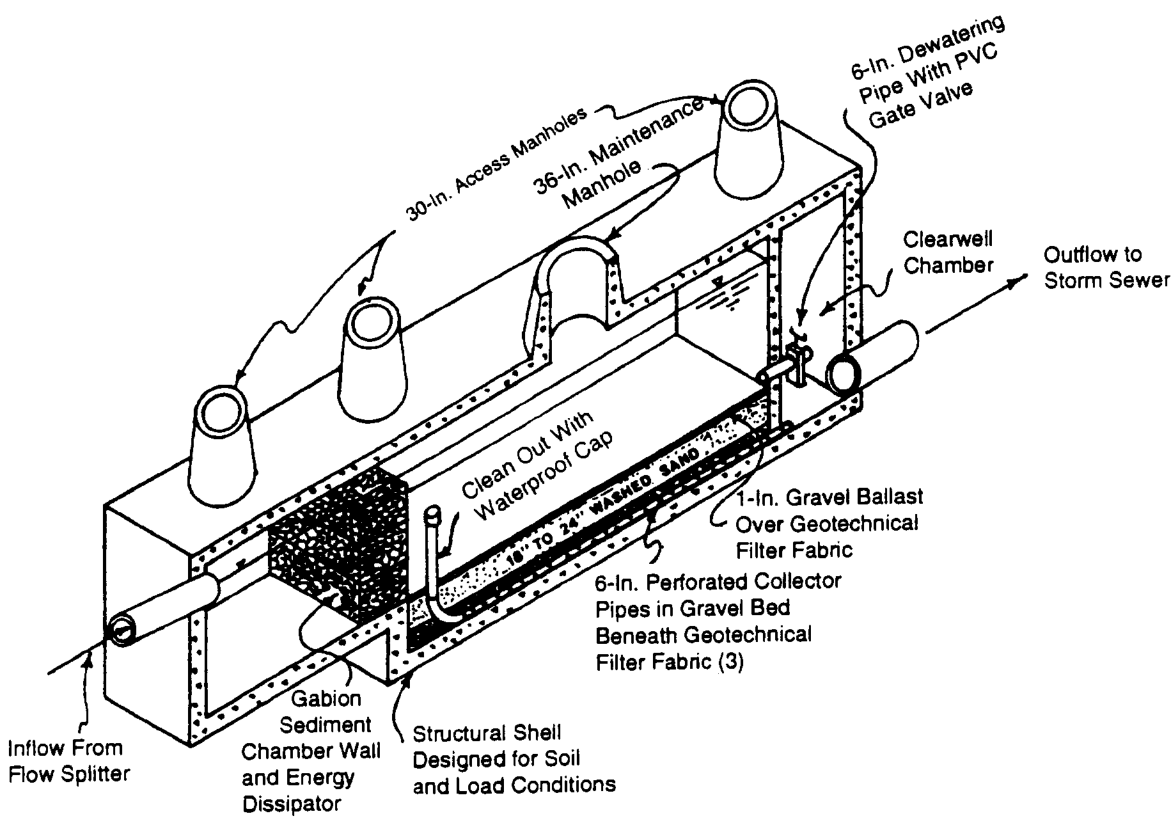

Figure 4. Dry vault stormwater sand filter.

Figure 5 is a schematic drawing of the Delaware sand filter system. The concept uses two parallel waterproof trenches connected by close-spaced wide notches in the top of the wall between them. The trench adjacent to the site being served is the sedimentation chamber. Polluted stormwater must be conveyed to the chamber in enclosed storm-drain pipes. The permanent pool in the sedimentation chamber inhibits resuspension of particles that were deposited in earlier storms and prevents the heavier sediments from being washed into the filter chamber. As new stormwater enters the system, the permanent pool overflows through the weir notches and onto the filter as sheet flow to prevent scouring out the sand.

The second chamber contains an 18-in. sand filter that is always fitted with a solid cover. No underdrain piping is provided. Water percolates through the sand and escapes from the filter through a geotechnical cloth-covered grate at the downhill end of the filter chamber.

Four Delaware sand filters were constructed in Alexandria during 1992. The first two systems served small parking lots and were built according to the original Delaware design. The third application, involving two separate filters, was used to treat runoff from a large (1.7 acre) parking lot. The high cost of steel grates and covers led the developer's consultant to propose moving the filter off the lot and providing slotted curb ingress and precast concrete lids. Premature failure of one of the filters led the owner to install a collector pipe in gravel below the sand layer. This design is shown in Figure 6.

Although the filters illustrated are contained in reinforced concrete shells, these systems may be installed in any waterproof container that will bear the wheel loads or soil pressures involved with the particular application; molded fiberglass or other plastic materials would work well. Delaware sand filters made of timber lined with rubberized roofing material have been proposed for use on temporary parking lots for development sales offices.

Delaware does not rate these systems for nutrient removal efficiency. Delaware has made a determination, however, that when treating the first 1 in. of runoff, this sand filter provides 80-percent suspended solids removal, as required by state environmental regulations (9).

Stone Reservoir Trench Sand Filter Systems

The filter system concepts embodied in the Austin and District of Columbia designs may be readily adapted for small and less complex applications. Alexandria's engineering staff has developed a simple trench sand filter for use on such projects as townhouses or small commercial developments in areas where infiltration devices are not practicable.

Figure 7 is a schematic drawing of a stone reservoir trench sand filter. The system is constructed in an excavation lined with impervious geomembrane (such as EPDM roofing material) sandwiched between protective layers of filter cloth. The bottom of the trench contains a simple sand filter that is connected to the storm sewer. The upper part of the system is built the same as an infiltration trench designed to treat the first 1/2 in. of runoff. Placement of perforated pipes in the stone reservoir greatly increases the voids available for storage.

Dispersed overland sheet flow is treated in a grassed filter strip before entering the system. The reservoir is further protected from sediment clogging by a layer of geotechnical filter cloth 6 in. beneath the top surface of

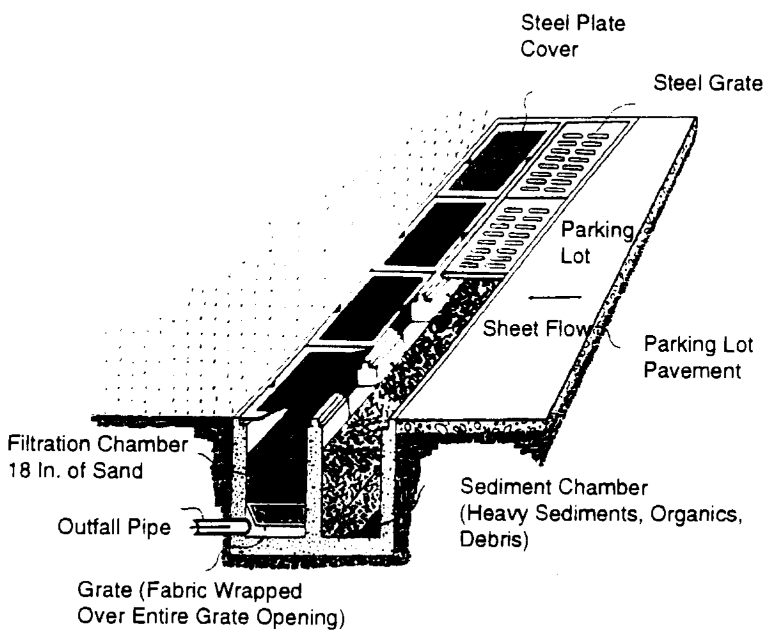

Figure 5. Delaware sand filter with grated inlets.

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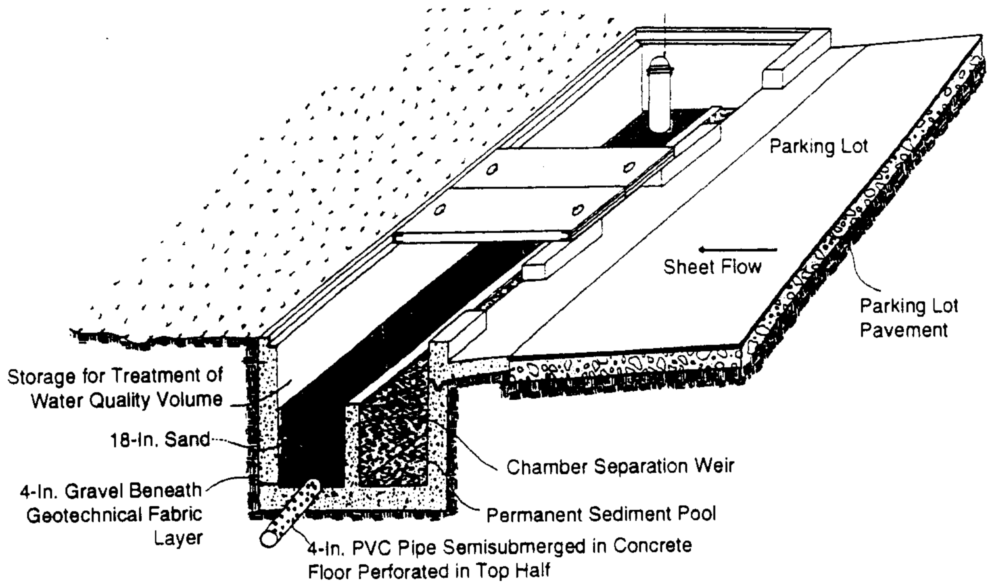

Figure 6. Slotted curb Delaware sand filter.

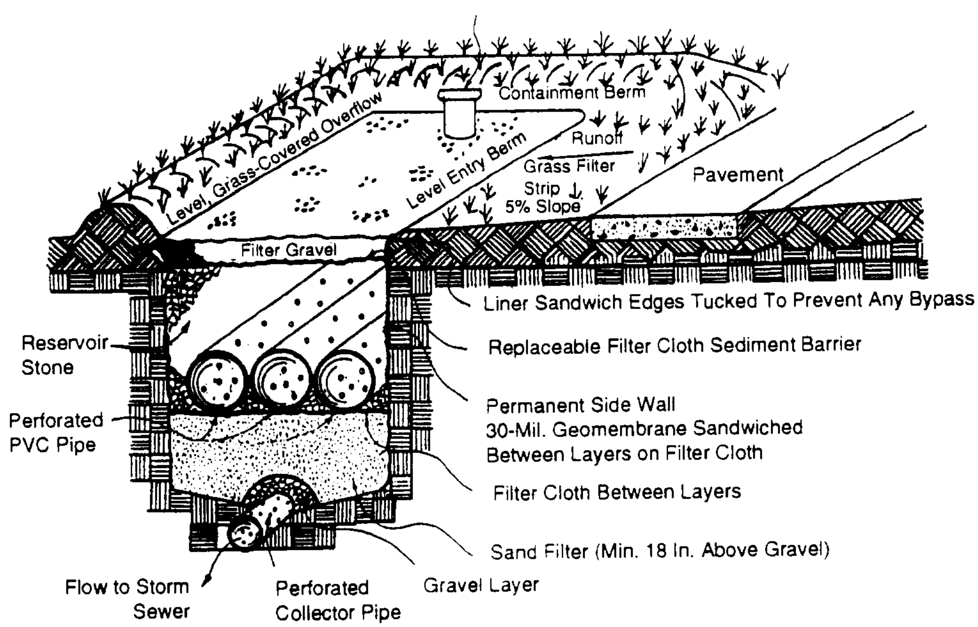

Figure 7. Stone reservoir trench sand filter.

the aggregate. The WQV flows into the reservoir until the voids in the rock and perforated pipes are completely full. Any overflow is directed to the storm sewer. Runoff collected in the reservoir filters down through the sand to the collector pipe, from which it is conveyed to the storm sewer.

Trench sand filter systems should have the same removal efficiency as an Austin sand filter.

Peat-Sand Filter Systems

Because of their high pollutant removal capabilities, simple design, low-maintenance, and affordability, peat-sand filters (PSFs) are potentially effective in heavily urbanized areas. A stormwater "end-of-pipe" PSF system was scheduled to be constructed in Montgomery County, Maryland, in the summer of 1993. MWCOG staff participated heavily in the development of this project.

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Figure 8 is a centerline cutaway of a stormwater PSF system concept developed by the Alexandria engineering staff. It combines features of the Austin sand filtration system with the PSF design proposed by John Galli of MWCOG for use in the Montgomery County application (10). The Alexandria concept is intended to operate as an off-line system treating the WQV from each storm. Any additional detention required for stormwater quantity restrictions should be provided separately downstream of the PSF system. PSFs would be appropriate for commercial developments for which a high pollutant removal is required or for end-of-pipe treatment of entire storm sewer watersheds.

The sedimentation basin design is essentially the same as that of the Austin sand filter. Because PSF systems cannot normally operate during the more severe winter months of the mid-Atlantic region, however, a gate-valve equipped bypass is provided to divert flow from the basin directly to the storm sewer. The invert of this pipe is placed at an elevation that will detain a permanent pool in the basin averaging at least 4 ft deep. In effect, this configuration converts the sedimentation basin to a small extended detention/wet pond during the winter months. As with the Austin sand filter, the basins may be either walled with concrete, as shown, or, if soil conditions permit, be constructed as soil structures.

The filtration basin is basically the Austin design with the sand filter enhanced by adding a 12- to 18-in. thick surface layer of hemic or fibric peat, a layer of calcitic limestone (for greater phosphorus removal), and a 4-in., 50:50 well-mixed layer of peat and fine-medium grain sand atop the normal filter sand and collector underdrains. A nutrient-removing grass-cover crop must be planted and maintained in the top of the peat layer. (PSFs will not function in underground applications because anaerobic conditions would develop.)

The system shown is designed for gravity flow. In situations where the terrain does not provide sufficient relief, pumps must be added to move the stormwater between basins.

Based on information provided by MWCOG (10), the Alexandria engineering staff estimates that their PSF design should have a phosphorus-removal efficiency approaching 90 percent during the months in which the filter is in operation. Assuming that the filter would be bypassed from mid-December to mid-March in the mid-Atlantic region, the annual phosphorus removal efficiency of the overall system, including the small extended detention/wet pond, is estimated at 70 percent.

Water Quality Volume Storage Tanks

This concept involves the collection and storage for later treatment in the wastewater treatment plant of the WQV from each storm. WQV storage tanks are used on all developments or redevelopments that require a BMP within Alexandria's combined sewer watersheds. Figure 9 shows a centerline cutaway of a WQV storage tank. The stored water is released into the combined or sanitary sewer system by telemetry-controlled pumps or automatic valves that ensure that none of the WQV escapes while combined sewer overflows into streams

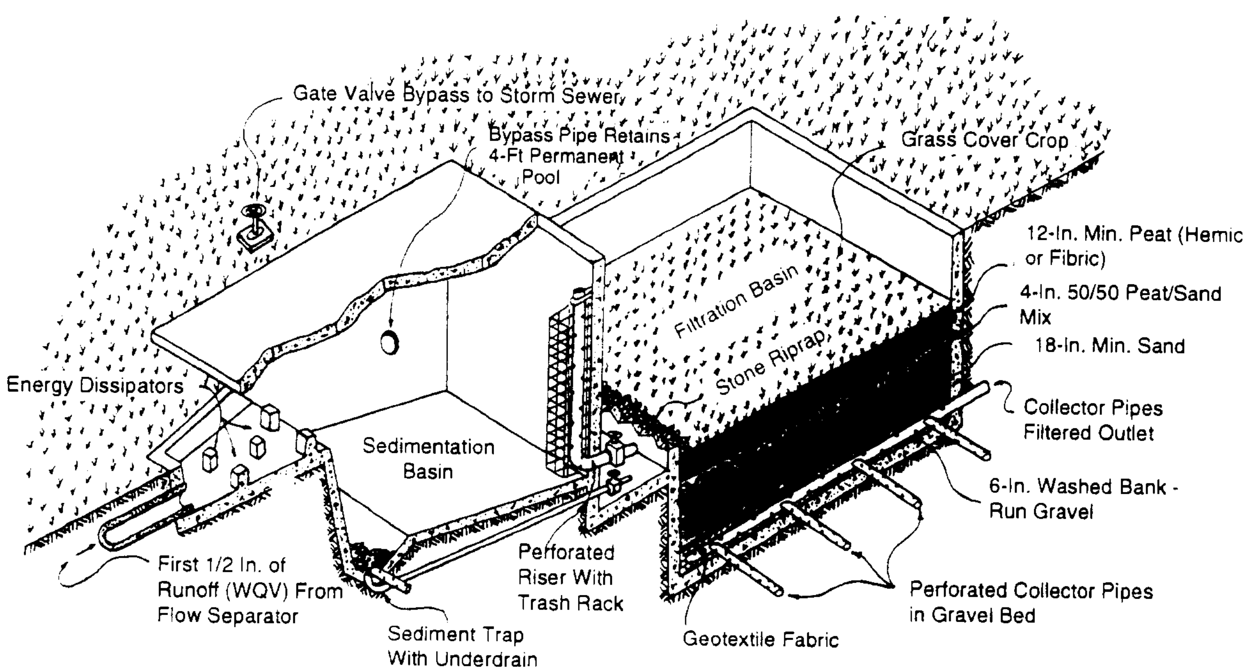

Figure 8. Stormwater peat-sand filter system.

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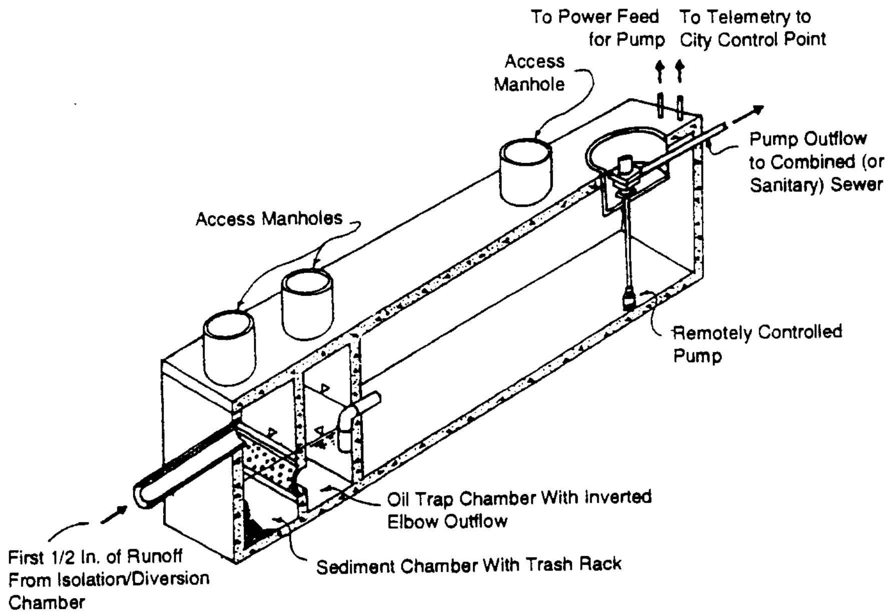

Figure 9. Water quality volume storage tank.

are occurring or in periods when inflow and infiltration are taxing the capacity of the wastewater treatment plant. This approach conforms to EPA's August 19, 1989, National Combined Sewer Overflow Strategy, which requires establishment of a high-flow management plan that maximizes the capacity of the combined sewage system for storage and treatment.

The tank shown in Figure 9 has a water quality inlet to provide sediment and petroleum hydrocarbon removal before the runoff is allowed to enter the storage tank. The inlet must be pumped out and refilled with clean water every 6 months for proper functioning.

WQV storage reservoirs may be either prefabricated tanks or vaults fabricated on site from such materials as Portland cement. Either single or multiple tanks may be employed. Although originally developed for use in combined sewer watersheds, WQV storage tanks may be applied in other situations where WQV runoff will not be routed into the storm sewer (e.g., landscaping irrigation systems or "gray water" toilet flushing systems).

When WQV water is discharged directly into a combined or sanitary sewer or used in gray-water flushing systems, the pollutant removal efficiency of the system becomes that of the receiving wastewater treatment plant. The phosphorus removal capacity of such plants is typically in the 95- to 100-percent range. When the WQV water is reused and retained on site for landscape irrigation, pollutant removal may approach 100 percent if the water is not allowed to escape from the site.

Challenges in Development and Use of BMPs for Heavily Urbanized Areas

The field of BMPs for heavily urbanized areas is in its infancy. The next few years must bring much wider use of this technology if the pollutant removal objectives of the NPDES stormwater program and other federal and state clean water initiatives are to be met. Several significant challenges need to be addressed.

Reduce Construction Effort and Costs

The construction cost for Austin sand filters serving projects with approximately 1 acre of impervious cover ranged from $13,000 to $19,000 in 1990 (1). The cost of DC sand filters was approximately $35,000 per impervious acre when the filters were first introduced but has since fallen to approximately $12,000 to $16,000 through the introduction of precasting and the maturity of the design (11). The large, slotted-curb Delaware sand filters recently constructed in Alexandria cost approximately $40,000 to serve 1.7 acres of impervious cover. This was, in essence, a prototype facility, and costs are expected to fall in a manner similar to the DC sand filter costs as contractors and engineers become familiar with the technology.

Applying prefabrication and modular concepts, especially for smaller projects, should further reduce construction effort and costs. Alexandria and the District of Columbia are exploring the rationalization of sand filter vaults in circular sections with manufacturers of aluminized corrugated pipe and fiberglass underground tanks. The pipe manufacturer has indicated that filters that would serve up to 1 acre of impervious cover could be prefabricated in a shop and delivered as a unit to a job site. The District of Columbia has also developed a sand filter in a standard precast sewer manhole. By introducing the runoff through a large catch basin with a hooded outlet, the addition of a 6-ft manhole with a sand filter in the bottom makes a BMP suitable for treating the runoff from approximately 5,200 ft^2 of impervious cover; 8-ft manhole filters can serve approximately 10,000 ft^2. Alexandria is examining the feasibility of adapting standard large highway precast curb inlets as the shells of both Delaware sand filters and underground vault sand filters. Storage of runoff awaiting filtration in arched corrugated-pipe galleries appears to be a promising approach in areas where storm sewers are too shallow to employ vault filters without pumping. Much more innovation is still needed for heavily urbanized areas.

One of the major costs of BMPs for heavily urbanized areas is creating a container to store the runoff before it undergoes treatment. More studies need to be performed characterizing different types of runoff to determine whether all sites need similar treatment. For instance, pollutants in runoff strictly from roofs may be concentrated in a smaller amount of "first flush." Pollution concentration versus time studies of roof water might well establish that treatment of a smaller amount of runoff would meet pollutant removal performance requirements. This development would likely have a significant impact on costs.

Reduce Maintenance Requirements and Costs

All BMPs for heavily urbanized areas require significant maintenance. Permanent pools require pumping out on a periodic basis (currently twice per year in Alexandria) to remove accumulated sediments and trapped hydrocarbons. As discussed above, sand filters require the replacement of the top few inches of sand or overlying layers of geotechnical cloth every 3 to 5 years. Trash must be removed from all BMPs as it accumulates to prevent premature clogging. Special care must be taken to ensure that sand filter systems are not placed in service before all open areas are stabilized with vegetation. Otherwise, the filters might quickly clog with topsoil, as occurred with one of Alexandria's Delaware sand filters. Trash screens need to be included in all designs to preclude the intrusion of materials into filter chambers that can cause premature failures. The provision of ready maintenance access is an absolute necessity. The initial cost/maintenance cost tradeoff must be carefully examined during the BMP design process.

Enhance Removal of Pollutants

The 1990 Austin report on removal of pollutants by that city's sand filters is the only scientific data available at present on long-term monitoring of such systems (7). The reported results are encouraging, but more monitoring data is needed to assess the impact of such factors as acid rain and variations in chemical content of the filter media on performance before the Austin experience can be generalized for application to other regions of the country.

While Austin reports very promising phosphorus removal values, enhancing the nitrogen and perhaps the heavy-metal removal efficiencies of BMPs may develop as a more pressing need as NPDES runoff monitoring data become available. One avenue that appears promising is the employment of a wet gravel filter component to introduce biological activity in the treatment process, an approach that is already being used to treat individual home sewage in Anne Arundel County, Maryland (12). The District of Columbia is considering adding a layer of activated carbon to a sand filter to assess the benefits through monitoring. BMPs for heavily urbanized areas represent a field that is ripe for additional innovation. Universities should take a more active role in developing BMP technologies for these areas.

Spread the Technology

Currently, the use of BMPs for heavily urbanized areas is limited to a relatively small area in the mid-Atlantic states, the Austin area in Texas, and the state of Florida. The technology is applicable to all areas of the country where pollution in stormwater runoff must be controlled under the NPDES permit program. Information on these BMPs needs to be disseminated throughout the country by EPA and other environmental agencies so that the technology is available to all parties who are wrestling with the problems of attaining NPDES compliance. This paper was written to facilitate that process.

References

1. City of Alexandria. 1992. Unconventional BMP design criteria. In: Alexandria supplement to the Northern Virginia BMP handbook. Alexandria, VA: Department of Transportation and Environmental Services.
2. City of Austin. 1988. Water quality management. In: Environmental criteria manual. Austin, TX: Environmental and Conservation Services Department.
3. Galli, J. 1992. Analysis of urban BMP performance and longevity in Prince George's County, Maryland. Washington, DC: Metropolitan Washington Council of Governments.
4. Washington State Department of Ecology. 1992. Stormwater management for the Puget Sound Basin (the technical manual), Vol. III. Runoff controls. Olympia, WA. pp. 4-42.
5. Northern Virginia Planning District Commission. 1992. BMP planning considerations. In: Northern Virginia BMP handbook. Annandale, VA: Northern Virginia Planning District Commission.
6. Anderson, D.L., R.L. Siegrist, and R.J. Otis. [No date]. Technology assessment of intermittent sand filters. Municipal Environmental Research Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, OH.
7. City of Austin. 1990. Removal efficiencies of stormwater control structures. Austin, TX: Environmental and Conservation Services Department.

8. Truong, H.V. 1989. The sand filter water quality structure. Washington, DC: District of Columbia Environmental Regulation Administration.

9. Shaver, E. 1991. Sand filter design for water quality treatment. Dover, DE: State of Delaware Department of Natural Resources and Environmental Control.

10. Galli, J. 1990. Peat-sand filters: A proposed stormwater management practice for urbanized areas. Washington, DC: Metropolitan Washington Council of Governments.

11. Truong, H.V. 1993. Application of Washington, DC, sand filter for urban runoff control. Washington, DC: District of Columbia Environmental Regulation Administration.

12. Piluk, R.J., and O.J. Hao. 1989. Evaluation of onsite waste disposal system for nitrogen reduction. J. Environ. Eng. 115(4).

Postconstruction Responsibilities for Effective Performance of Best Management Practices

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Abstract

Effective performance of best management practices (BMPs) is vital to achieving the high goals and justifying the equally high estimated costs of urban runoff management. This paper identifies inspection, maintenance, and performance monitoring as three key postconstruction activities for ensuring correct and continued performance of BMPs. These activities are equal in importance to planning, design, and construction BMPs.

The paper demonstrates how failure to meet inspection and maintenance BMP responsibilities not only leads to diminished BMP performance but may also create new health and safety threats that exceed those the BMPs were intended to prevent. It further demonstrates how such a result represents both a failure to realize a gain on the resources already invested in BMPs and the cause of significant additional expenditures.

The paper also describes the key components of a successful postconstruction inspection and maintenance program, including the need for self-evaluation and feedback components to inform planners, designers, construction contractors, and maintenance personnel about ways to reduce or facilitate future maintenance. Additionally, the paper emphasizes the importance of a stable source of program funding and discusses various methods for achieving it.

Finally, the paper emphasizes the need for accurate, scientific monitoring and reporting of BMP performance to achieve optimal BMP designs and expand the ability to address urban runoff impacts on a regional or watershed basis.

Introduction

One of the top priorities of any stormwater management program is the effective performance of structural best management practices (BMPs). Effective BMP performance not only helps ensure that the program's goals are accomplished but also represents a positive return on the time, effort, and materials invested in the structural BMP's planning, design, and construction. To achieve such performance, however, everyone involved with the stormwater management program must fulfill several key responsibilities before, during, and after construction.

Before construction, these responsibilities include the development by program managers of design standards and practices that are both accurate and practical. Designers must use these standards and practices to produce construction drawings that accurately convert their ideas into a tangible structure. Using these drawings, construction contractors must create a durable structure that meets the designers' requirements and is true to the regulators' intentions.

While stormwater management remains a relatively new field, the results to date of these relatively short-term preconstruction activities have been greatly improved by several factors, including the maturation of older flood control programs; the continued growth of hydrologic and hydraulic databases, design methods, and training programs; and the implementation of formal construction inspection programs. Other factors that have assisted in the improvement of regulatory, design, and construction activities include the continued development and greater availability of computer software and hardware and the greater level of construction experience and capability. As a result, the ability of program managers, designers, and construction contractors to meet their responsibilities for effective BMP performance has increased significantly in recent years. Furthermore, these improvements have helped to kindle further interest and involvement in stormwater management.

In addition to planning, design, and construction responsibilities, however, three key areas of responsibility must be met once construction has been completed and the structural BMP has been put into operation. These responsibilities consist of the inspection, maintenance, and monitoring of the structural BMP. For the purposes of this paper, these three activities are defined briefly as follows:

- *Inspection:* Periodic observation and evaluation of a structural BMP and its individual components by qualified personnel to determine maintenance needs.
- *Maintenance:* Periodic preventative and corrective measures taken by qualified personnel to ensure safe, effective, and reliable BMP performance.
- *Monitoring:* Extended observation and evaluation of BMP performance by qualified personnel to determine effectiveness and improvement needs.

Of the three activities, inspection and maintenance are the most well established in terms of BMPs, while monitoring represents a somewhat more recent aspect of stormwater management. More complete descriptions of each activity and their growing importance is presented in later sections of this paper. For now, it is important to note that each activity represents a long-term, ongoing responsibility carried out after the shorter term planning, design, and construction efforts have been completed. It is also important to note that BMPs for inspection, maintenance, and monitoring have not received the same level of attention typically devoted to planning, design, and construction. While lack of adequate funding may be a cause, the reasons for this imbalance are generally unclear. This is unfortunate, because such an imbalance may critically affect the long-term success of stormwater management programs and regulations. Possible reasons include the ongoing, long-term, and somewhat routine nature of inspection and maintenance in particular, which may not offer either the intellectual and creative challenge of planning and design or the immediacy of construction. Additional reasons may be an unacknowledged reluctance to confront the reality of current planning, design, and regulatory efforts (particularly the negative aspects of that reality), or the failure to fully appreciate the importance of BMPs in regard to inspection, maintenance, and monitoring and the serious consequences of their prolonged neglect.

Regardless of the reasons, it is apparent that BMPs for inspection, maintenance, and monitoring have suffered the neglect typical of long-term, ongoing activities. As noted above, this neglect has critical implications for the long-term success of efforts to manage stormwater, particularly through the use of structural BMPs. In an effort to correct this problem, this paper presents information emphasizing the importance of and need for BMPs in inspection and maintenance and describes the key components of a comprehensive inspection and maintenance program. Additionally, the paper highlights the increasing need for monitoring as a means to improve BMP performance and effectiveness and to reduce required inspection and maintenance efforts.

The Importance of BMP Inspection and Maintenance

A common requirement of virtually all stormwater structures, particularly those that encounter various weather conditions, is their need for periodic inspection and maintenance. While these needs may be obvious in a general sense, the particular importance of inspection and maintenance for structural BMPs needs to be stressed.

Perhaps the most recognizable reason is the need to reliably and consistently achieve the performance levels required by the stormwater management program and designed into the BMP. For example, a BMP that relies on the temporary storage of stormwater runoff to achieve required peak outflow or pollutant removal rates must be periodically cleaned of accumulated sediment and debris to maintain required storage capacity and prevent re-suspension of captured pollutants. The outlet structures at these facilities must also be periodically cleared of accumulated debris to maintain discharge rates at required levels. Maintenance of vegetation is also important, particularly for those BMPs that use the vegetation for pollutant filtration and/or uptake. This maintenance can range from mowing, seeding, and fertilizing turf grass areas to ensure stability and prevent erosion to harvesting wetland vegetation to promote and manage growth.

The maintenance described can also be viewed as an effective means of ensuring a positive return on the time, effort, and materials invested in the planning, design, and construction of a BMP. The total amount of this investment for a single BMP can be considerable, with total construction costs exceeding $50,000 and total project costs exceeding $100,000. Failure to adequately inspect and/or maintain such a facility can lead to ineffective performance, structural failure, and, consequently, a failure to realize a return on the investment. It is generally recognized that the cost of providing comprehensive water quality protection may be considerably greater than our present ability to pay for it. In such cases, we must strive to achieve the greatest possible return on the resources we do invest in such protection.

Perhaps the most important need for BMP inspection and maintenance is the need to avoid the health and safety threats inherent in their neglect. The foremost of these threats is the potential for structural failure, which can rapidly release stored waters and flood downstream areas, causing property damage, injury, and even death. The fact that this flooding threat would not exist if the BMP had not been constructed further highlights the need for proper inspection and maintenance to prevent it from ever occurring. Another health and safety threat from maintenance neglect is mosquito breeding, which can threaten a broad area in the general vicinity of the BMP. Other undesirable insects, animals, and odors can also result from maintenance neglect, adversely affecting those who must live or work nearby. In all such cases, the BMP can actually have worse environmental impacts than those it was originally constructed to prevent.

A final reason for effective BMP inspection and maintenance lies in preserving and nurturing the community and political support that stormwater management efforts have gained to date. Such continued support is vital to the success of our stormwater management efforts, particularly because much of the solution to stormwater pollution lies in source controls and lifestyle changes that the public will be asked to adopt. We cannot count on even passive public support, however, let alone active public involvement in nonstructural programs, if we are unable to create and maintain structural BMPs that are community assets rather than liabilities. Any support that we now have or hope to generate in the future will quickly be lost if we allow structural BMPs to become aesthetic nuisances or safety hazards due to a lack of adequate inspection and maintenance.

Comprehensive Inspection and Maintenance: An Overview

The key components of a comprehensive inspection and maintenance program for structural BMPs are described below. The exact character of each component and the manner in which it is implemented depends on the specific economic, political, environmental, and social characteristics of the community in which the program functions.

Official Inclusion of Inspection and Maintenance in Overall Stormwater Management Program

BMP inspection and maintenance should not be an afterthought but should be included from the beginning in the community's overall stormwater management program. As the overall program develops, determining how (and how often) inspections and maintenance efforts are performed is as important as determining allowable peak outflow rates and extended detention times. To ignore this fact is to invite eventual program failure through diminishing BMP performance and increasing health and safety threats. To ensure a secure role for inspection and maintenance in the overall stormwater management program, both the importance of inspection and maintenance and the ways in which they are achieved should be officially included in any implementing ordinances, resolutions, or laws establishing the overall program.

Sufficient and Stable Funding

Because BMP inspection and maintenance requires specific actions by qualified personnel, the availability of sufficient and stable funding may be the single most important component of a comprehensive program. The best intentions, talent, and equipment cannot overcome a paucity of funds, nor can regular, consistent inspections and maintenance be achieved if funding levels are erratic and/or uncertain.

Therefore, during the development of the overall stormwater management program, a stable source of funding for inspection and maintenance must be identified and formalized. This may include the use of general or specialized tax revenues, dedicated contributions from land developers or owners, and/or permit fees from those creating the need for the structural BMP. Funding may also be secured through the creation of a stormwater utility, which would provide BMP inspection and maintenance services funded by fees paid by those within the utility's service area. While the creation of a stormwater utility requires a significant amount of effort to organize and operate, several successful stormwater utilities have been created throughout the country in recent years.

Adequate Equipment and Materials

Having sufficient equipment and materials is particularly important for BMP maintenance efforts, which involve the regular performance of preventative maintenance activities such as grass mowing and debris removal and the prompt execution of emergency repairs and restorations. The long-term, repetitive nature of the preventative activities, in particular, demonstrates how a positive return can be quickly achieved from investments in equipment that expedite maintenance efforts and in materials that prolong the life of BMP components.

Fortunately, due in part to the basic nature of stormwater and its management, the character of the equipment necessary to conduct most maintenance efforts is not particularly complex or specialized. Instead, standard and relatively simple equipment such as lawn mowers, shovels, rakes, compressors, and trimmers can be used to perform the majority of maintenance tasks. This helps simplify the selection and acquisition process and keeps costs at more manageable levels.

Trained and Motivated Staff

Similar to equipment needs, many BMP maintenance tasks are not particularly complex or specialized. This means that, under most circumstances, program staff can be assembled from a relatively large labor pool, either directly by a public agency performing maintenance in house or by a contractor hired to provide such services. These factors, however, should not diminish the need for thorough training of maintenance staff. This has become increasingly true in recent years as the role of structural BMPs expands to provide higher levels of stormwater treatment and more comprehensive control of runoff rates. This has led to increasingly sophisticated facilities containing specialized vegetation and diverse habitats that require management as well as maintenance. This trend is expected to continue, further emphasizing the need for thoroughly trained staff.

The importance of motivation and enthusiasm must also be emphasized. Unfortunately, the repetitive and relatively simple nature of many BMP maintenance tasks can lead to indifferent staff performance. In addition to poor overall results, this indifferent attitude can also be dangerous, particularly for those staff members operating mowing or cutting equipment that, however simple, demands concentration and care. Indifference and a lack of enthusiasm can also stifle creativity, which is essential if improved and/or less costly maintenance techniques are to be honed from existing ones. Finally, experience has shown that the vegetated, "living" character of most structural BMPs requires a certain interest and concern on the part of maintenance staff (qualities that are evident in most successful gardeners) if proper maintenance, performance, and aesthetic levels are to be achieved.

Therefore, it is essential for maintenance staff to have an interest in the overall success of the BMP. One way that this may be accomplished is by having the long-term maintenance of a given BMP performed by the same maintenance crew, which then becomes the sole group responsible for its success or failure. Such "ownership" of the BMP helps promote more direct interest in its condition and a greater effort to maintain it.

In addition, competent BMP inspection, particularly of larger, more complex structures and dams, requires a high degree of skill, experience, and knowledge. Often, such levels require that some of the inspections be conducted by a licensed professional engineer who has a background in geotechnical and structural engineering. Other necessary skills may include biology or plant sciences, particularly if the BMP includes diverse vegetation and habitats. Obviously, the training required for such inspection personnel is more rigorous and the number of qualified personnel available to the program will be less. Finally, the training provided to maintenance workers should, in part, be directed at making them informal inspectors as well. When maintenance workers are trained and motivated to spot and report such problems as sloughing or settling of embankments, surface erosion, animal burrows, and structural cracks, repairs can be performed more promptly and with less expense and effort.

Regular Performance of Routine Maintenance Tasks

The essence or core of any facility maintenance program is the regular, consistent performance of the actual maintenance tasks that the remainder of the program has identified, planned, and scheduled, and for which staff, equipment, and funding have been provided. The competent and consistent performance of these routine tasks is the single greatest factor in determining the success of the overall BMP inspection and maintenance program. These routine tasks normally include grass mowing and trimming, trash and debris removal, soil fertilization, and sediment removal. Experience has shown that the regular, frequent (e.g., monthly or less) performance of these tasks often requires less overall time and effort on an annual basis than if the tasks are performed only a few times a year.

In addition, a flexible and informed definition of "regular" should be adopted when scheduling routine maintenance tasks. For example, while it will be easier to schedule maintenance at a given BMP for the first week of every month, the actual performance of the work should instead be based on weather conditions and maintenance need. This is particularly true of turf grass, which may be damaged by a regularly scheduled mowing during dry or drought conditions. During wet conditions, attempts to perform maintenance tasks may result in rutting and other ground disturbances, causing more facility damage. The ability to perform "regular" maintenance tasks on a somewhat "irregular" basis is one of the greatest challenges of a comprehensive inspection and maintenance program.

Timely Performance of Emergency Maintenance Tasks

Despite the best efforts of any inspection and maintenance program, emergency maintenance measures may be necessary at a structural BMP from time to time for a variety of causes, ranging from excessive rainfall to vandalism. As a result, the successful inspection and maintenance program must be ready to respond to this need in a timely and comprehensive manner. To do so, it is best to plan ahead for emergencies by developing an emergency response plan that identifies potential emergency problems and ways to address them. This may include the preparation of a list of typical repair materials, which then can be either stockpiled in house or quickly acquired through designated suppliers. The plan may also identify individuals and organizations that can provide technical input or services on short notice to assist in the emergency repair effort. Finally, a designated number of staff personnel should be available on a 24-hour basis to respond to maintenance emergencies.

Regular, Competent Inspections

One of the keys to program efficiency and overall BMP safety is the performance of competent BMP inspection on a regular basis. In view of the increasingly complex nature of structural BMPs and the wide range of technical aspects inherent in each, the need for competent inspectors should be obvious. In fact, a team of inspectors may be necessary to adequately review the geotechnical, environmental performance, structural, hydraulic, and biological aspects of many BMPs. Inspections must be performed on a regular basis to identify problems and special maintenance needs quickly and efficiently. This allows repairs to be performed promptly without the need for major remedial or emergency action.

The frequency of inspections varies with the size and complexity of a given BMP. Regular inspections by qualified personnel may range from once a year for large facilities with high damage potential to every 2 to 5 years for smaller, less complex sites. Additional inspections should also be performed as appropriate following major rain storms and other extreme climatological events such as droughts, extreme snowfalls, or high winds. It should also be noted that the growing complexity and technical range of structural BMPs is expected to require more frequent inspections covering a wider range of BMP features.

Finally, the formal inspections described above should be supplemented by informal inspections conducted by maintenance personnel during each of their site visits. This further enhances the program's ability to quickly identify and respond to special maintenance needs before they can become costly emergencies. As noted above, such informal inspections require further training of maintenance personnel.

Performance Guarantees and Defaults

In many BMP inspection and maintenance programs, the owners of the property on which the BMP is located are responsible for performing maintenance tasks. Such properties may range from single-family residences to major industrial or commercial complexes. Under such conditions, the governmental agency responsible for the overall success of the program must obtain some form of guarantee that the maintenance will in fact be performed. This guarantee is acquired through several steps. First, the property owner's responsibilities should be specified in a written agreement between the owner and the agency. This agreement should also grant the agency the right to enter the property and inspect the BMP to ensure that the stipulated maintenance is, in fact, being performed satisfactorily. In addition, the agreement should also provide a method by which the agency can perform both emergency and regular maintenance tasks in the event of default by the owner, including a provision to charge the owner for the cost. Finally, such an agreement should be binding on all future owners of the property to ensure continuity.

Accurate Recordkeeping

In view of the large number of tasks, equipment, and materials that may be involved in a comprehensive BMP inspection and maintenance program, accurate records of the maintenance effort should be kept. This includes logs of time and manpower, records of material quantities and costs, and the type and frequency of the various maintenance tasks performed. In addition, accurate records should also be kept of any complaints received from community residents regarding the adequacy and/or frequency of the various maintenance tasks as well as all reports of potentially hazardous conditions. The time and expense of such recordkeeping, including the need for staff training in the proper procedures, can be quickly offset if the recorded information is used to improve scheduling, task performance, and purchasing practices. Additional details of such use is described below.

Productive Self-Evaluation and Interaction

To achieve improved levels of efficiency, a BMP inspection and maintenance program should conduct regular reviews and self-evaluations. The availability of thorough program records is of great assistance in this effort. The program review should include input from all program personnel and should address such aspects as maintenance frequency, the sequence of facility visits, equipment suitability, staffing levels, and training needs. In addition, establishing a positive dialogue with stormwater regulators, designers, and contractors is highly desirable because all of these people are responsible for creating the structural BMPs that the inspection and maintenance program must ultimately (and forever) maintain. Studies and experience have shown that many of the problems encountered during BMP maintenance are actually the result of poor or misinformed regulations, designs, or construction efforts. Therefore, maintenance personnel need to identify such problems and be given a means to inform those responsible. Such interaction can be achieved through conferences and meetings with professional societies, industry groups, and governmental agencies and departments. Public input should also be sought through individual contacts (using the complaint records noted above) and community meetings.

The Growing Need for BMP Performance Monitoring

More than just grass mowing, BMP inspection and maintenance represent a broad range of integrated technical activities. In fact, this can also be said for the entire field of modern stormwater management, which requires technical interaction between regulators, designers, contractors, maintenance personnel, and the public to truly achieve the goal of comprehensive runoff management. Unfortunately, due to the random and, at times, unpredictable behavior of storm events and the inherent complexity of the rainfall-runoff process, it is often difficult to determine how well our runoff goals are being met, regardless of the proficiency of design, construction, and maintenance efforts. For this reason, BMP performance monitoring should also be included in any stormwater management program.

By closely and accurately monitoring BMP performance through field monitoring, sampling, and laboratory analysis, BMP monitoring can enable us to better define the "problem" of runoff pollution and allow regulators and designers to gain a better understanding of both BMP function and performance. This information can be used more conclusively to identify those runoff goals and management functions that either can or cannot be realistically achieved by structural BMPs. This will further allow regulators and designers to improve those functions that are viable and to develop alternatives to those that are not, both through enhanced design standards and techniques and updated regulations. BMP performance monitoring can also provide information regarding construction and maintenance practices that may have an effect on facility performance, which can in turn lead to improved or new practices or equipment.

In overview, BMP performance monitoring can be seen as a means of achieving greater return on the time, materials, and property invested now and in the future in our stormwater management programs. And because these amounts are expected to grow considerably as we expand our programs to address more complex stormwater problems, the importance of such improved returns will certainly increase.

In addition, BMP performance monitoring can also be seen as a way to help ensure overall program credibility and achieve stronger community acceptance. In recent years, much attention has focused on the need to expand traditional stormwater management programs beyond structural measures to also include nonstructural measures in order to achieve more comprehensive results. To do so, we must achieve greater community involvement in our stormwater management efforts, both through lifestyle changes (involving a wide scope of activities, from pet care to car washing to home landscaping) and through participation in various nonstructural stormwater programs (ranging from household waste disposal to carpooling to resource preservation). With the real data obtained through BMP performance monitoring, it will be easier to convince the community of both the need for and the promise of stormwater management.

Such data will also lend greater credibility to our concerns over runoff pollution and will enable us to credibly demonstrate the value of both structural and nonstructural measures. Such credibility is vital if we are to expect the public to make the changes and sacrifices demanded by both the structural and nonstructural BMPs we now have or hope to implement in their communities (and even their backyards) in the future. Finally, BMP performance monitoring will help us to more closely monitor our progress and more quickly identify program problems and shortcomings. This will help us to develop and implement program modifications and improvements in a manner that will not threaten community acceptance. As noted earlier, we will not be able to rely on public support for nor participation in vital nonstructural stormwater programs if we are unable to create and maintain aesthetically pleasing structural BMPs. We can also expect similar results if we discover that those same BMPs simply do not work.

Summary

- To achieve comprehensive success in our stormwater management efforts, it is vital that inspection, maintenance, and monitoring be considered as equal in importance to structural BMP planning, design, and maintenance.
- The neglect of BMP inspection and maintenance can actually result in worse environmental impacts to a community than the ones that the BMP was intended to prevent. This result can threaten the viability of the entire stormwater management program.
- BMP inspection and maintenance must be an official component of a comprehensive stormwater management program, with adequate staffing, equipment, and funds.
- Self-evaluation and interaction with regulators, designers, constructors, and members of the community are vital to reducing overall maintenance needs, efforts, and costs.
- BMP performance monitoring is increasingly important to the continued effectiveness and growth of stormwater management programs.

Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters

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Abstract

This paper describes the technology-based management measures developed under Section 6217(g) of the Coastal Zone Act Reauthorization Amendments to control sources of nonpoint pollution in the coastal zone. The implementation of state coastal nonpoint source control programs, including the development of enforceable policies and mechanisms, is the subject of other papers. The management measures, and the various practices that can be implemented cost-effectively to achieve conformity with the management measures, are the subjects of this paper. The U.S. Environmental Protection Agency document *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters* (1) contains most technical information available on the effectiveness of practices to control nonpoint source pollutants and the costs of these practices. Nonpoint sources addressed in the document include agriculture, forestry, urban areas, marinas, and hydromodification (dams, shorelines, and channels). Practices include nonstructural methods such as planning, pollution prevention, and source reduction alternatives in addition to structural methods such as detention ponds and composting facilities. A separate chapter of the document contains information on the protection and restoration of wetlands with nonpoint source pollution abatement functions and the use of vegetated treatment systems in nonpoint source control programs.

Introduction

Section 6217 of the Coastal Zone Reauthorization Amendments of 1990 (CZARA) requires the development of coastal nonpoint source (NPS) control programs to protect and restore coastal waters. States with coastal zone management plans that the National Oceanic and Atmospheric Administration (NOAA) has already approved will develop the new NPS control programs by implementing management measures found in the U.S. Environmental Protection Agency (EPA) document *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters* (1). The development process, including determination of program content, use of alternative management measures, and development of additional management measures to meet water quality standards, is described in a separate document (2) and is the subject of other papers. This paper focuses on the development of the management measures and their basis—the structural and nonstructural practices that can be used to cost-effectively control NPS pollution and achieve conformity with the management measures. The value of the management measures guidance as a comprehensive technical reference should not be underestimated because it was developed as guidance for coastal state programs; the management measures guidance contains detailed information on the cost and effectiveness of a wide variety of methodologies and technologies that have proven effective in controlling nonpoint sources of pollution in both coastal and noncoastal areas.

Legislative Background

Congress enacted CZARA on November 5, 1990. A major focus of this law is the control of NPS pollution to avoid impacts on coastal waters. Congress showed concern in section 6202(a) that growing populations in the coastal zone are endangering wetlands and marine resources. Section 6217 addresses this concern by requiring that each state with an approved coastal zone management program develop a coastal NPS control program and submit it to NOAA and EPA for approval. The purpose of the coastal NPS control program is to develop and implement management measures for NPS pollution to restore and protect coastal waters, working closely with other state and local agencies. Simply stated, EPA develops the management measures and publishes them as guidance, and the states develop and implement programs in conformity with the management measures and program guidance.

Section 6217(g) of CZARA defines management measures as the best available controls that can be economically achieved to reduce pollutants from existing and new categories and classes of NPS pollution. The charge is clearly to develop technology-based controls to reduce pollution from nonpoint sources. In addition, Section 6217(b) of CZARA requires the implementation of additional water-quality-based management measures to protect impaired and critical coastal areas if implementation of the measures developed under Section 6217(g) is not effective at improving water quality.

Guidance Development

To develop the guidance, EPA formed work groups composed of more than 250 people recognized as knowledgeable in the control of NPS pollution. The work groups corresponded to the six technical chapters of the management measures guidance and were cochaired by EPA staff and a combination of staff from NOAA, the U.S. Department of Agriculture (USDA) and the U.S. Forest Service. Other work group members included staff from state agencies, interstate agencies, research agencies, universities, and other federal agencies including the Bureau of Land Management, Fish and Wildlife Service, Army Corps of Engineers, Federal Highway Administration, National Park Service, and Geological Survey.

Work group members provided references, literature reviews, and advice as EPA worked with its own contractors and experts to pull together, analyze, and summarize information on management practices and their effectiveness. EPA released the proposed management measures guidance in May 1991. EPA and NOAA also published a proposed program implementation guidance in October 1991.

Input on the proposed management measures guidance was solicited from the public during a 7-month comment period. The major problems identified in the public comments on the technical chapters were a lack of cost information and a perceived "East Coast bias" in the practices identified. There were, however, many positive comments on the usefulness of the guidance as a compendium of structural and nonstructural control alternatives for NPS pollution in all areas of the country.

The final management measures guidance was released in January 1993. That document incorporated most suggested improvements and additional information received from the public comments, as well as 1) a more thorough literature review; 2) additional focus on regional differences in climate, weather, and geomorphology; 3) additional cost information; and 4) information on economic achievability. The final management measures guidance is more than twice the size of the May 1991 proposed guidance and, hopefully, twice as useful. There are more alternative practices, better descriptions, additional source reduction and pollution prevention programs, and examples of successful implementation of cost-effective practices under a variety of site conditions. Based on the favorable response to date on the final management measures guidance, the guidance is a valuable technical reference for identifying NPS problems and cost-effective solutions.

Description of the Final Management Measures Guidance

Problem Identification

Each chapter contains a discussion of NPS pollutants and problems as a rationale for the management measures and controls to be implemented as part of state coastal NPS control programs.

Agricultural Runoff

Coastal waters are affected by NPS pollution resulting from the erosion of crop land; from the manure and other wastes produced in confined animal facilities; from the application of nutrients, pesticides, and irrigation water to crop land; and from physical disturbances caused by livestock and equipment, particularly in and along streambanks.

Urban Runoff

Urbanization in the form of new development changes the natural hydrology of an area and increases runoff volumes, erosion, sediment loadings to surface waters, and loadings of sediment, nutrients, oxygen-demanding substances, pathogens, metals, hydrocarbons, and other pollutants. These changes and increases can impair water quality, alter habitats, close and destroy fisheries and shellfish beds, and close recreational areas such as beaches. Decreases in base flows caused by impervious areas can also adversely alter habitat and impair water quality. Existing urban activities such as the use of onsite disposal systems, improper disposal of household wastes, turf and lawn management, pets wastes, and road maintenance can also cause water quality problems.

Silvicultural (Forestry) Operations

Forestry operations can degrade water quality in water bodies receiving drainage from forest lands. Sediment concentrations can increase because of accelerated erosion; water temperatures can increase because of removal of the overstory riparian shade; slash and other debris can deplete dissolved oxygen; and organic and inorganic chemical concentrations can increase due to harvesting and the use of fertilizers and pesticides. Increased stream flow can also result from the removal of trees and vegetation.

Marinas and Recreational Boating

Because marinas are located at the water's edge, a variety of nonpoint effects are associated with poor flushing of boat basins, spills from refueling areas, bilge pumping, and wastes produced by the cleaning and repair of boats.

Hydromodification

Hydromodification activities have been separated into three categories:

- *Channelization and channel modification* frequently diminish the suitability of instream and streamside habitat for fish and wildlife, and alter instream patterns of water temperature and sediment transport. Hardening of banks, in particular, can increase the speed of movement of NPS pollutants from the upper reaches of watersheds into coastal waters.
- *Dams* can affect the hydraulic regime, the quality of surface waters, and the suitability of instream and streamside habitat for fish and wildlife.
- *Shoreline and streambank erosion* is a natural process that can have either beneficial or adverse impacts on surface water quality and on the creation and maintenance of coastal habitat. Eroded shoreline sediments help maintain beaches and replenish the substrate in tidal flats and wetlands. Excessively high sediment loads, however, can smother submerged aquatic vegetation, cover shellfish beds, fill in riffle pools, and contribute to increased levels of turbidity and nutrients.

Wetlands and Vegetated Treatment Systems

Wetlands and riparian areas reduce NPS pollution by filtering pollutants—especially sediment, nitrogen, and phosphorus—from surface waters. Wetlands and riparian areas can also attenuate flows from higher-than-average storm events, thereby protecting receiving waters from peak flow hydraulic impacts such as channel scour, streambank erosion, and fluctuations in temperature. Degraded wetlands lose this important set of NPS control functions. Also, degradation of wetlands and riparian areas can cause these areas to become sources of nonpoint pollution because they will then deliver increased amounts of sediment, nutrients, and other pollutants to adjoining water bodies.

Management Measures and Practices

The management measures are major subheadings within each chapter. The coastal NPS control programs that states are to develop must be in conformity with these measures. An applicability section for each measure contains information on the activities and locations to which each measure applies. A description section is included for each measure to illustrate goals and objectives and provide more detail on what the measures mean. The selection section provides the rationale used in selecting the management measure. Usually, selection is based on widespread use of a management practice or combination of practices that can be used to achieve the management measure. The economic achievability of the management measures was evaluated separately (3). If this evaluation affected the selection of a measure, the effect is described in the selection section.

Management practices are described in a separate section under each management measure for illustrative purposes. State programs do not have to specify or require the implementation of any of these management practices. EPA does expect, however, that one or a combination of these practices appropriate to local conditions can be used to achieve conformity with the management measures. For example, the management measure for runoff from new development calls for 80 percent reduction in the average annual total suspended solid (TSS) loadings. Several management practices such as sand filters or extended detention wet ponds can be used to achieve the required TSS removal. If local conditions are not appropriate for one of those practices, however, a combination of vegetated filter strips, grass swales, wet ponds, or constructed wetlands could also be used to achieve the measure. The costs and effectiveness of the management practices are usually included within the description of each practice or in a separate summary section at the end of each management measure chapter. An economic impacts study (3) was prepared based on representative practices and combinations of practices and their costs.

Management Measures by Chapter

Presented below are brief synopses of the major management measures presented in each of the technical chapters. The discussion below is not comprehensive, and the management measures guidance should be consulted to establish the exact requirements and applicability of the management measures.

Agriculture

- *Sediment and erosion control:* Rely on USDA's conservation management system to promote practices such as conservation tillage and strip-cropping.
- *Animal facilities (large units):* Contain runoff and animal waste in storage structures.
- *Animal facilities (small units):* Use less-stringent requirements for economic reasons.
- *Nutrient management:* Develop and implement comprehensive nutrient management plans that involve fertilizer application rates, timing, and use efficiency.

- *Pesticide management:* Evaluate the problem and site, use integrated pest management (IPM) where possible, and apply pesticides properly and safely.
- *Livestock grazing:* Protect sensitive areas through appropriate grazing management techniques (e.g., providing alternative water, salt, and shade sources away from sensitive areas and providing livestock crossing areas).
- *Irrigation:* Optimize water use and use chemigation safely.

Forestry

- *Preharvest planning:* Consider the timing, location, and design of harvest activities.
- *Streamside management areas (SMAs):* Establish SMAs to protect against soil disturbance and delivery of sediment and nutrients from upslope activities; retain canopy species to moderate water temperature.
- *Road construction/reconstruction and road management:* Reduce the generation and delivery of sediment.
- *Timber harvesting:* Protect waters during harvesting, yarding, and hauling.
- *Site preparation and forest regeneration:* Confine onsite potential NPS pollution and erosion resulting from these activities.
- *Management of fire, chemicals, and forested wetland areas:* Reduce NPS pollution of surface waters.
- *Revegetation of disturbed areas:* Prevent sedimentation from harvest units or road systems.

Urban

- *Runoff control for new development:* Reduce runoff levels of TSS by 80 percent, and maintain natural hydrology.
- *Watershed protection/site development:* Use comprehensive planning to protect areas that are ecologically sensitive, provide water quality benefits, or are prone to erosion.
- *Construction erosion/sediment and chemical control:* Reduce construction-related erosion, retain sediment onsite, and properly manage chemical use.
- *Runoff management for existing development:* Identify and implement runoff quality controls as appropriate and feasible.
- *New and operating onsite disposal systems (OSDSs):* Select, site, and operate OSDSs to reduce OSDS impacts on coastal waters.
- *Pollution prevention for urban areas:* Target and implement NPS reduction and public education programs.
- *Roads, highways, and bridges:* Site, construct, operate, and maintain roads, highways, and bridges properly.

Marinas

- *Marina siting and design:*
  - Allow for maximum flushing of the marina basin.
  - Perform water quality and habitat assessments to protect against adverse impacts on shellfish resources, wetlands, and submerged aquatic vegetation.
  - Control stormwater runoff (additional controls exist for hull maintenance areas).
- *Fueling station design:* Design to allow for ease of cleanup, and develop spill contingency plans.
- *Sewage facilities:* Ensure availability of pumpouts and pump stations, and develop maintenance procedures.
- *Operation and maintenance:* Establish marina operation and maintenance programs to control and to provide for proper disposal of solid waste, fish waste, liquid materials, petroleum products, and boat cleaning byproducts.
- *Public education:* Develop public education programs for marina users.

Hydromodification

- *Channelization and channel modification:* Evaluate effects of new projects on physical and chemical characteristics of surface waters and on instream and riparian habitats
- *Dams:* Control erosion/sediment and chemicals during and after construction; develop and implement an operation and maintenance plan to protect surface water quality and instream and riparian habitat.
- *Eroding shorelines and streambanks:* Stabilize streambanks and shorelines where erosion is a nonpoint problem; vegetative methods are strongly preferred over engineering structures where vegetation will be cost-effective. Protect streambanks and shorelines from erosion from the use of the shore and adjacent waters.

Wetlands, Riparian Areas, and Vegetated Treatment Systems

- *Protection:* Protect wetlands and riparian areas serving a NPS pollution abatement function to maintain water quality benefits and ensure that they do not become a source of nonpoint pollution.
- *Restoration:* Promote the restoration of damaged and destroyed wetlands and riparian systems where they will have a significant NPS pollution abatement function.

- *Vegetated treatment systems:* Promote the use of constructed wetlands and filter strips where they will serve a significant NPS pollution abatement function.

Next Steps

1993

NOAA and EPA began meeting with states and other interested parties to assist in program development and determine their needs for future technical assistance. Activities included:

- Regional workshops with state coastal zone management and NPS control agencies.
- Briefings of other federal agencies and interest groups (e.g., trade associations and environmental groups).
- Presentations at meetings of other interested parties (e.g., International Marina Institute, National Association of Conservation Districts, Water Environment Federation, and Coastal State Organization).

1994

NOAA and EPA formulated and implemented a technical assistance program using information on needs obtained from state and local government, industry, trade organizations, and others. Elements of this program include:

- Publishing several guidance documents, including *State and Local Government Guide to Environmental Program Funding Alternatives* and *Developing Successful Runoff Control Programs for Urbanized Areas* (4, 5).
- Providing funds to help produce additional technical guidance, including *Urbanization and Water Quality, Watershed Protection Techniques,* and *Fundamentals of Urban Runoff Management* (6-8).
- Conducting workshops on such topics as stream restoration, NPS monitoring, and marina NPS controls.
- Developing educational curricula and sponsoring train-the-teacher programs on runoff NPS pollution.
- Developing an expert system for identifying and selecting agricultural NPS controls.

References

1. U.S. EPA. 1993. Guidance specifying management measures for sources of nonpoint pollution in coastal waters. EPA/840/B-92/002. Washington, DC.
2. U.S. Department of Commerce/NOAA/U.S. EPA. 1993. Coastal nonpoint pollution control program, program development, and approval guidance. Washington, DC: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, and U.S. EPA.
3. RTI. 1992. Economic analysis of coastal NPS pollution controls. Project 5990-91. Prepared by Research Triangle Institute for U.S. EPA Nonpoint Source Control Branch, Washington, DC.
4. U.S. EPA. 1994. State and local government guide to environmental program funding alternatives. EPA/841/K-94/001.
5. U.S. EPA. 1994. Developing successful runoff control programs for urbanized areas. EPA/841/K-94/003.
6. Terrene Institute/U.S. EPA. 1994. Urbanization and water quality. Washington, DC.
7. Center for Watershed Protection. Watershed protection techniques. Quarterly bulletins (February and Summer).
8. Horner, Skupien, Livingston, and Shaver/Terrene Institute/U.S. EPA. 1994. Fundamentals of urban runoff managment: Technical and institutional issues. Washington, DC.

Biotechnical Streambank Protection

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Abstract

Streams in areas of intense residential and commercial development have high rates of surface water runoff, so bank erosion and downstream flooding become more common and severe. Throughout the greater Chicago area, this has resulted in destabilized streams lacking habitat for fish, wildlife, and people. The Illinois Environmental Protection Agency and the U.S. Environmental Protection Agency funded the urban stream restoration projects on Glen Crest Stream and the Waukegan River. During the spring and summer of 1992, stabilization sites were completed on Glen Crest Stream, in Glen Ellyn, and in Washington Park of the Waukegan Park District. The lunker technique was chosen for its low cost of installation and ability to resist the high-velocity runoff while increasing instream habitat for gamefish and the stream side habitat for the urban population. At Glen Ellyn, lunkers were constructed of recycled plastic lumber for increased longevity. Low-cost vegetative stabilization incorporated an initial matrix of grasses and willows, plus rooted stock of redosier dogwood near the water's edge, followed by appropriate riparian trees on the upper bank that the landowner chose. Both projects trained senior members and staff personnel of the park district and the city in the application of lunkers and vegetative stabilization.

Introduction

This paper describes methods of biotechnical stabilization and instream habitat enhancement that have been field trialed in Illinois. These practices have been authorized and funded by the U.S. Fish and Wildlife Service, the Soil Conservation Service, the U.S. Environmental Protection Agency, and all Illinois state agencies responsible for stream modification permits. The following methods are described: willow post bank stabilization, lunker instream habitat enhancement with vegetative bank stabilization, and A-jack structural and vegetative bank stabilization (Figures 1, 2, and 3).

In rural Illinois areas, bank erosion is not addressed because of limited financial resources. In agricultural states, U.S. Army Corp of Engineers district offices receive many requests for assistance on bank erosion protection. Within recent years, the need for bank erosion control has been coupled with the need for environmental protection of the stream habitat and riparian areas for wildlife and fisheries. Keeping costs low while considering various environmental issues has made bank erosion control a difficult challenge for the Corps.

In Illinois, stream channel erosion increased when prairies were converted to rowcrop agriculture and residential development, thereby increasing surface water runoff rates. Man has become a dominant geomorphic factor in the watershed hydrology of both rural and urban watersheds. In most urban and agricultural areas, streams were channelized to move floodwaters away from valued lands, to maximize the size and uniformity of land holdings, even to decrease channel erosion (1). One result of increased water runoff rates and poorly designed channelization efforts has been massive bank erosion in the floodplains of Illinois streams.

Watershed studies by the Illinois State Water Survey have documented the channel erosion damages to floodplain fields and the consequent increased sediment yield. Channel erosion contributed 40 to 60 percent of the sediment yield in two monitored Illinois watersheds (2). Within these watersheds, increased runoff rates and stream channelizations caused the streambed to be downcut at first and then erode laterally to regain a meander shape (Figure 4). This process was hastened by channel incision into extremely unstable glacials and gravel deposits below an 8- to 20-ft layer of loess clays. The Crow Creek watershed study demonstrates both the bridge damages from channel incision and the field damages from bank erosion (3).

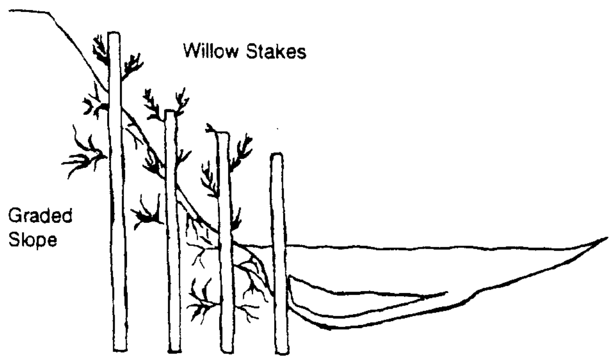

Figure 1. Willow posts installed below depth of streambed scour.

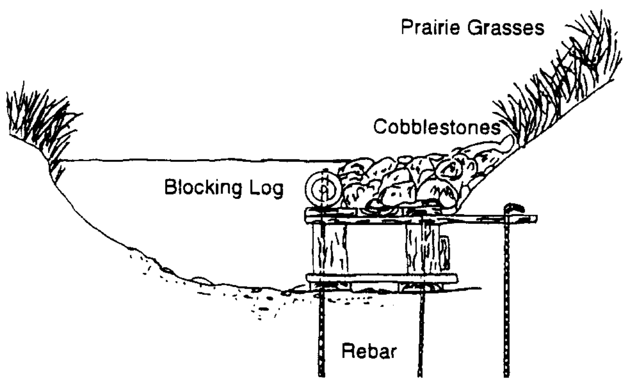

Figure 2. Lunker with riprap below baseflow stage. Rebar is driven below bed scour depth.

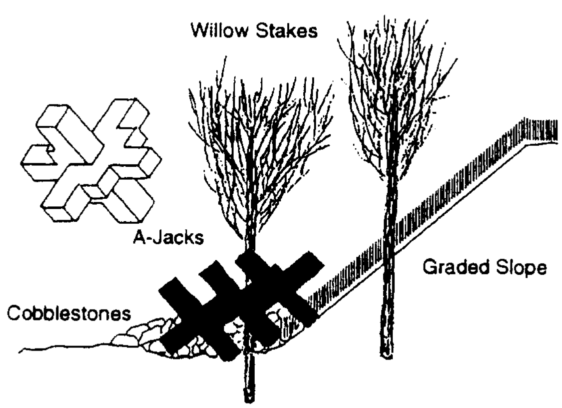

Figure 3. A-jack bank structures.

Willow Post Bank Stabilization

The willow post method differs from most European bioengineering techniques (4, 5) in that individual willows are positioned vertically below the depth of channel scour. Most biotechnical bank stabilization techniques have used vegetation with a riprap mentality. Layers of horizontally bundled woody vegetation are entrenched in the bed and bank. This type of earth

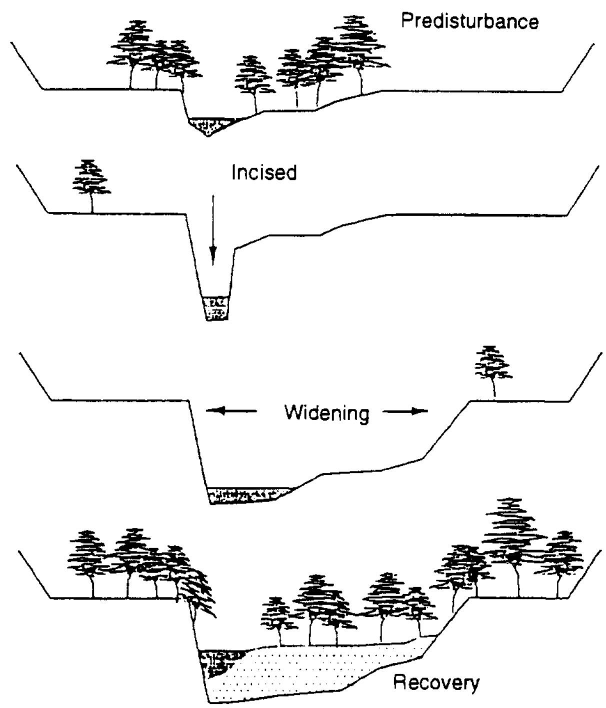

Figure 4. Incision and recovery process. Vegetative bank stabilization can be applied during the widening phase.

moving and hand labor often doubles installation costs and installation times.

Willows and most woody riparian vegetation do not naturally extend root systems very deeply below the water table. The posts are implanted much deeper than native seedlings would grow. Lateral root growth rapidly binds adjacent posts together in the bank soil. Lateral branch growth also interlocks adjacent posts to slow flow velocity near the bank.

The willow post method was mentioned by Scheichtl (4) as a method of ravine stabilization in Germany during the 1800s. Both the Corps of Engineers and the Soil Conservation Service used large willow poles in the 1930s (6, 7). In most cases, the posts or poles were laid as a layer along the sloped bank. York (8) placed willow posts in vertical holes to protect the base of levees in Arizona.

Willows are cut into 10- to 14-ft posts when the leaves have fallen and the tree is dormant. At this time, growth hormones and carbohydrates are stored in the root system and lower trunk. Dense stands of 4- to 6-year-old willows make the best harvesting areas. These stands are commonly found on the stream deltas in lakes or in old stream channel cutoffs. The willow posts are 4 to 6 in. in diameter and may be stored up to 1 month if kept wet.

The eroding streambank is shaped to a 1:1 slope with the spoil placed in a 6-in. deep layer along the top of the bank. In major erosion sites, post holes are formed in the bed and bank so that the end of the post is 2 ft below maximum streambed scour. The posts are placed 4 ft apart in rows up the streambank. The posts in one row are offset from the posts in adjacent rows.

While the steel ram and excavator is more efficient at depths of 6 ft in clay soils, a hydraulic auger and excavator unit forms deeper and longer lasting holes in stony or sand streambeds. Large stone layers of streambed material cause damage to the excavator when the steel ram is used. In fine sand layers, ram holes collapse before the post reaches the bottom of the holes. In highly fluid sands, even auger holes fill but the post can be pushed deeper with the bucket or boom. In streams with sand or gravel beds, the hydraulic auger places posts 9 to 11 ft deep in the bed. Almost all contractors in Illinois currently use an excavator and hydraulic auger unit.

In larger streams with noncohesive sand banks, large cedar trees are cabled to the willow posts along the toe of the bank. The cedars not only reduce bank scour while root systems are growing but also retain moisture during drought periods. In larger streams, such as Illinois's only designated scenic river, the Middle Fork, large rounded boulders were used as additional bank protection with the willow posts.

In Illinois, the contractor slopes 15-ft banks on a 1:1 grade for 80 cents per linear foot. Each post hole is augered 10 ft deep for $2.90. Each willow post costs $1 to $2. With a five-man crew at $10.00 per hour per man, bank sites are estimated to cost between $5 and $8 per linear foot.

Bank Erosion Site Assessment

The following questions should be asked when determining the applicability of willow bank post stabilization:

1. Does sunlight fall directly on the eroding bank? (Willows must have sun.)
2. Is bedrock close to the surface? (Streambed material should be 4 ft deep; check with a tile probe.)
3. Are lenses of fine sand exposed in the eroding bank?
4. Is the stream channel stable upstream of the erosion site? (If the stream cuts behind the upper end of willow posts, the entire bank will erode.)
5. How deep is the stream along the eroding bank? (Willow posts must be 2 ft deeper than the deepest water or the posts will be undercut below the root zone. The length of the willow posts depends on the water depth. In sand or cobble streams, a hydraulic auger forms a deeper and more stable hole.)
6. How wide is the stream channel at the erosion sites compared with stable channels upstream and downstream? (If the channel is wider at the erosion site, vegetation will not choke the stream channel and cause other erosion problems.)
7. Do you have a source of large willows close to the site? (Your costs are small when the willows are close.)
8. Will the site be wet during dry summers? (Willow posts require a lot of water while the roots are regrowing; willow posts should only extend 1 to 2 ft aboveground in dry sites.)
9. Can you keep cattle away from the posts during the first summer? (Willows must be able to produce leaves for photosynthesis and regrowth.)
10. Have debris jams forced floodwater into the eroding bank? (Large debris jams must be removed according to guidelines established by the American Fisheries Society (9).)

The willow post method of bank stabilization is the lowest cost bank stabilization method that provides both wildlife and fisheries benefits. This method has received widespread support by both the agricultural and environmental communities: Farm Bureau, soil and water conservation districts, American Fisheries Society, and Nature Conservancy. The willows serve only as a pioneer plant on the disturbed soils. Succession to wooded or grass banks is speeded by additional trees or grass plantings with active site management if the landowner desires.

Lunker Instream Habitat Structures

Lunkers are constructed of 2-in. oak planks (10). The planks form upper and bottom layers so that the interior is open to water flow at both ends and on the stream side of the structure (Figure 2). A series of lunkers are placed along the base of the eroding bank. When necessary, the lunkers are placed into an excavated trench, especially on the upper and lower ends of the sites. Each lunker is held with nine lengths of rebar, which are driven 5 ft into the streambed. In the Illinois adaptation, riprap was placed only on lunkers behind the blocking log.

In rural areas and in state parks, the bank above the lunkers was stabilized with willow posts. The bank was steeply sloped to keep the lunkers scoured (11) and to prevent silt deposition in the lunkers. In Court Creek, the upper bank was seeded with prairie grasses. During the second year, the posts were cut down so that only a narrow fringe of willow grew along the water's edge. By the third year, with active burn management, the prairie grasses had become established.

At Franklin Creek State Park, the banks were seeded with cool season grasses because the erosion site was located beside the equestrian corral. Once again, the willow posts were to be cut during the second year. A large population of protected beavers sped up the postcutting schedule. A spray of Ropel, an unpleasant-tasting liquid, mixed with a tackifer (to decrease water solubility) gave protection until the grasses became established. When Ropel applications were discontinued, the large posts were quickly cut down. Even with heavy browsing, however, the willow stubs regrew branches because the root systems were not damaged.

While the cool season grasses became established more quickly than the prairie grasses, the root systems of cool season grasses are shallow and therefore more susceptible to scour during high velocity flows. While damages have been minor after 4 years, two 9 ft^2 areas were seeded with grasses and 18-in. willow cuttings in April 1993. Adult smallmouth bass populations increased over 50 percent. Of more importance to stream bass populations, the yearling bass survival increased 300 percent at the lunker site (12).

Costs of lunker installation were $25 to $35 per linear foot, with prairie grass seeding and maintenance accounting for higher costs at the Court Creek site. Labor was 45 percent of costs, contractual equipment was 30 percent, and materials were 25 percent. A 300-ft site is estimated to cost $8,000 to $10,000.

Urban Lunkers

In northeastern Illinois near Chicago, urban streams respond quickly to rainfall events so that floods are extremely erosive. Damage to homes and the higher cost of lands allow more intensive stream management. Often this has led to concrete or heavily riprapped stream channels with acute environmental damages. While necessary in some urban settings, the value of residential homes and parks can be increased if stream channel stabilization can be made more environmentally sensitive. In the smaller stream, the lunkers were constructed from recycled plastic lumber so that lunkers would not dry rot during lowflow drought periods. In larger stream segments, deeper pools allowed the use of wooden lunkers.

In urban streams, the higher cost of materials, the higher cost of contractual equipment as excavators, and the very high cost of landscape repairs to private lawns substantially increase the cost of lunker installation. The lunker installations are $45 to $55 per linear foot of bank.

Summer scheduling of stream restoration required the use of rooted and therefore smaller willow saplings. Additional rooted stock as redosier dogwood played a greater role in riparian revegetation of urban sites. Tree corridors were preserved as sound barriers to traffic noises and visual privacy barriers between homes. The resulting shade, however, denied the use of willows in some areas. In these shaded areas, redosier dogwood were planted with very good survival.

These urban sites were only 1 year old at the time this paper was presented, but the Chicago area had just undergone an extremely wet fall and spring. Two fall floods and three spring floods did not damage the urban lunkers sites.

A-Jack Structures With Willow and Dogwood Bank Revegetation

A-jacks look like small versions of the World War II tank traps (see Figure 3). The A-jacks can be placed so that each A-jack will interlock within each row and with A-jacks in adjacent rows. The lowest rows of A-jacks are trenched along the base of the eroding bank, with the excavated sediment placed along the top of the bank. In the Glen Crest Stream and the Waukegan River, 2-ft diameter A-jacks were used.

Fibredam, a geotechnical fabric that locks the curled wood fibers in excelsior blankets, was placed between the rows of A-jacks and the bank soils to reduce soil movement through the A-jacks. Fibredam is easily torn apart and molded into crevices between A-jacks.

Willow cuttings were driven into the streambed between A-jacks and behind the last interior rows of A-jacks. The fluid sediment was placed on the rows and allowed to fill the interior spaces. The vertical streambank was then sloped over the A-jacks.

This structure ran $45 to $50 per linear foot of bank when composed of two base rows and one upper row. The cost of materials was $25 per foot. Ease of handling and suitability for transport by small marsh vehicles are advantages of this system. Each A-jack is composed of two halves that lie flat on pallets during transport. A-jacks are assembled at the bank site.

When the willows and dogwood are fully grown, root systems lock the entire structure together while giving a natural appearance to the streambank. Small stone is added to A-jack rows near the waterline to give a more natural appearance.

References

1. Keller, E.A. 1976. Channelization: Environmental, geomorphic, and engineering aspects. In: Coates, D.R., ed. Geomorphology and engineering. Stroudburg, PA: Dowden, Hutchinson and Ross, Inc. pp. 115-140.
2. Roseboom, D.P., and W. White. 1990. The Court Creek restoration project. In: Erosion control: Technology in transition. Proceedings of the XXI Conference of the International Erosion Control Association, Washington, DC. pp. 25-40.
3. Roseboom, D., W. White, and R. Sauers. 1991. Streambank and habitat strategies along Illinois River tributaries. In: Proceedings of the Governor's Conference on the Management of the Illinois River. pp. 112-122.
4. Schiechtl, H. 1980. Bioengineering for land reclamation and conservation. Edmonton, Alberta: University of Alberta Press. p. 400.

5. Gray, D.H., and A.T. Leiser. 1989. Biotechnical slope protection and erosion control. Malabar, FL: R.E. Krieger.

6. Lester, H.H. 1946. Streambank erosion control. Agricultural Engineering. September: 407-410.

7. Foster, A.B. 1959. Approved practices in soil conservation. Danville, IL: Interstate Press.

8. York, J.C. 1985. Dormant stub planting techniques. Proceedings of the First North American Riparian Conference, University of Arizona, Tucson, AZ.

9. AFS. 1983. Stream obstruction removal guidelines. American Fishery Society, 5410 Grosvenor Lane, Bethesda, MD 20814.

10. Ventrano, D.H. 1988. Unit construction for trout habitat improvement structures for Wisconsin coulee streams. Administrative Report No. 27. Madison, WI: Wisconsin Department of Natural Resources.

11. Nunnally, N.R. 1978. Stream renovation: An alternative to channelization. Environ. Mgmt. 2(5):403-411.

12. Roseboom, D., R. Sauer, D. Day, and J. Lesnack. 1992. Value of instream habitat structures to smallmouth bass. Misc. Pub. 139. Peoria, IL: Illinois State Water Survey.

The Use of Wetlands for Stormwater Pollution Control

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Abstract

This paper presents the results of a literature review that summarizes the current state of knowledge regarding the use of wetlands for stormwater pollution control. The paper reviews the primary removal mechanisms in wetlands, including sedimentation, adsorption, precipitation and dissolution, filtration, biochemical interactions, volatilization and aerosol formation, and infiltration. The results from 26 wetlands are reviewed and contrasted regarding their ability to remove pollutants from stormwater. The systems range from salt marshes to high-elevation riverine wetlands. The study sites are reviewed in relation to the type of wetlands system, including design features and upstream watershed characteristics. The wetlands receive stormwater from different land uses, including residential, commercial, highway, golf courses, and open. The observed pollutant removal efficiencies are quite variable but generally show good removals of phosphorus (median of 46 percent average removal) and the heavy metals cadmium, copper, lead, and zinc (median of 70, 40, 83, and 42 percent average removal, respectively) from stormwater. Constructed wetlands generally perform better and with greater consistency. In general, larger wetlands perform better than their watershed areas as well. Nevertheless, some carefully planned constructed systems with a small area performed quite well compared with their watershed areas. Because there is little information on noted impacts to biota, these are just briefly reviewed. Finally, the paper suggests collecting additional information in new studies. This would make comparisons among different sites more useful in assessing the factors that affect the abilities of constructed wetlands to remove pollutants from stormwater.

Introduction

Constructed wetlands are receiving increasing attention as attractive systems for removing pollutants from stormwater runoff. Other potential benefits that such systems provide include flood control and habitat. Wetlands have long been used for the treatment of wastewaters from municipal, industrial, and agricultural sources (1). The U.S. Environmental Protection Agency (EPA) encourages the use of constructed wetlands for water pollution control through the innovative and alternative technology provisions of the construction grants program (2).

The purpose of this paper is to assist EPA, state, and local technical personnel in assessing the capabilities and limitations of using wetlands as a control measure to reduce the environmental impacts of stormwater pollution on downstream water bodies. The paper summarizes a report prepared for EPA by Strecker et al. (3) that reviewed published literature and documented reports on aspects of stormwater wetland design, operation, and performance. An appendix that accompanied the published report included a one- to six-page summary of each pertinent study reviewed for the report. The summaries covered influent and effluent water quality, the effectiveness of the system, flows and volumes, wetland and watershed areas, and the biological characteristics of the system.

Table 1 presents a list of selected reports with which researchers have documented the ability of wetland systems to remove pollutants from stormwater. The table includes some general characteristics of the wetland systems. Figure 1 shows the wetlands' geographic locations. The wetlands differed widely in location and wetland type (e.g., Florida's southern swamplands, Minnesota's northern peatlands, California's brackish marshlands, and Puget Sound's palustrine wetlands). Each of these locations differs in climate, vegetation, and soil types.

Wetland Stormwater Pollutant Removal Mechanisms

Wetlands can combine various actions to remove pollutants from stormwater:

- Incorporation into or attachment to wetland sediments or biota.
- Degradation.

Table 1. **Literature Researched To Investigate Performance Characteristics of Wetlands**

Study/ Reference	Year of Publication	Location	Name/I.D.	Detention Pond/Wetland	Constructed/ Natural	Wetland Classification
Martin and Smoot (4)	1986	Orange County, FL	Orange County Treatment System	Detention pond and wetland	Constructed	Hardwood cypress dome
Harper et al. (5)	1986	FL	Hidden Lake	Wetland	Natural	Hardwood swampland
Reddy et al. (6)	1982	Orange County, FL	Lake Apopka	Wetland	Constructed	Cattail marsh
Blackburn et al. (7)	1986	Palm Beach, FL	Palm Beach PGA Treatment System	Wetland	Constructed and natural	Southern marshland
Esry and Cairns (8)	1988	Tallahassee, FL	Jackson Lake	Detention pond and wetland	Constructed	Southern marshland
Brown, R. (9)	1985	Twin Cities Metro Area, MN	Twin Cities Metro	Wetlands	Natural and constructed	Northern peatland
Wotzka and Oberts (10)	1988	Roseville, MN	McCarrons Treatment System	Detention pond and wetland	Constructed	Cattail marsh
Hickok et al. (11)	1977	MN	Wayzata	Wetland	Natural	Northern peatland
Barten (12)	1987	Waseca, MN	Clear Lake	Wetland	Constructed	Cattail marsh
Meiorin (13)	1986	Fremont, CA	DUST Marsh	Wetland	Constructed	Brackish marsh
Morris et al. (14)	1981	Tahoe Basin, CA	Tahoe Basin Meadowland	Wetland	Natural	High elevation riverine
Scherger and Davis (15)	1982	Ann Arbor, MI	Pittsfield-Ann Arbor Swift Run	Detention pond and wetland	Constructed and natural	Northern peatland
ABAG (16)	1979	Palo Alto, CA	Palo Alto Marsh	Wetland	Natural	Brackish marsh
Jolly (17)	1990	St. Agatha, ME	Long Lake Wetland-Pond Treatment System	Detention pond and wetland	Constructed	Cattail marsh
Oberts et al. (18)	1989	Ramsey-Washington Metro Area, MN	Tanners Lake, McKnight Lake, Lake Ridge, and Carver Ravine	Detention pond and wetland	Constructed	Cattail marsh
Reinelt and Horner (19, 20)	1990	King County, WA	B3I and PC12	Wetland	Natural	Palustrine
Rushton and Dye (21)	1990	Tampa, FL	Tampa Office Pond	Wetland	Constructed	Cattail marsh
Hey and Barrett (22)	1991	Wadsworth, IL	Des Plaines River Wetland Demonstration Project	Wetland	Constructed	Freshwater riverine

Figure 1. Location of wetlands researched for their ability to treat stormwater runoff.

- Export of pollutants to the atmosphere or ground water.

Both physical and chemical pollutant removal mechanisms probably occur in wetlands. These mechanisms include sedimentation, adsorption, precipitation and dissolution, filtration, biochemical interactions, volatilization and aerosol formation, and infiltration. Because of the many interactions between the physical, chemical, and biological processes in wetlands, these mechanisms are generally not independent. Sedimentation is usually the most dominant removal mechanism. The large variation in wetland characteristics (e.g., hydrology, biota) may cause the dominant removal mechanisms to vary from wetland to wetland. Variations in wetland characteristics can also help explain why wetlands differ so widely in their pollutant removal efficiencies. Following is a brief description of the principal removal mechanisms.

Sedimentation

Sedimentation is a solid-liquid separation process using gravitational settling to remove suspended solids. It is considered the predominant mechanism for the removal of many pollutants from the water column in wetland and other flow detention systems. Sedimentation of suspended material, along with pollutants that are highly adsorbed, has been documented as the primary removal mechanism in wetlands by many study authors, including Martin and Smoot (4) and Oberts (23). The most significant factors affecting settling of suspended material pertain to the hydraulic characteristics of the wetland system, including the detention time, inlet-outlet conditions, turbulence, and depth. The opposite of sedimentation is flotation. Floatable pollutants such as oil and grease, litter, and other pollutants can accumulate in the surface microlayer. These pollutants can be removed by adsorption.

Adsorption

Adsorption of pollutants onto the surfaces of suspended particulates, sediments, vegetation, and organic matter is a principal mechanism for removing dissolved or floatable pollutants. The literature suggests that these processes remove pollutants such as phosphorus, dissolved metals, and other adsorbents (including colloidal pollutants) (5, 11, 16). Adsorption occurs through three main processes:

- Electrostatic attractions.
- Physical attractions (e.g., Van der Waals forces and hydrogen bonding).
- Reactions.

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The rates by which these processes occur are thought to be inversely related to the particle size and directly related to the organic content of the particles in the wetland soils (5). Increasing the contact of stormwater with the underlying soils and organic matter can enhance adsorption processes. In addition, high residence times, shallow water depths, and even distribution of influent enhance the interactions of water with soil and plant substances, thereby increasing the adsorption potential.

Precipitation and Dissolution

Many ionic species (e.g., metals) dissolve or precipitate in response to changes in the solution chemistry of the wetland environment. Metals such as cadmium, copper, lead, mercury, silver, and zinc can form insoluble sulfides under the reduced conditions commonly found in wetlands (24). Decaying organic matter releases fulvic and humic acids that can form complexes with metal ions. In addition, decreased pH can promote the dissolution of metals, thereby making them available for bonding to inorganic and organic molecules (25).

Filtration

Filtration occurs in most wetlands simply because vegetation acts like a sieve to remove pollutants and sediments from the water column. Dense vegetation can be very effective at removing floatables (including oil and grease) and litter from stormwater. Filtration can also take place in the soil matrix when infiltration occurs. Brown (9) and Wotzka and Oberts (10) also noted that increased density of vegetation slows the velocity and wave action, thereby allowing increased settling of suspended material.

Biochemical Interactions

Vegetative systems possess a variety of biochemical interaction processes that can remove nutrients and other material from the water column. In general, these processes are:

- High plant productivity and associated nutrient uptake
- Decomposition of organic matter
- Adsorption
- Bacterially aerobic or anaerobic mediated processes

Through interactions with the soil, water, and air, plants can increase the assimilation of pollutants within a wetland system. Plants provide surfaces for bacterial growth and adsorption, filtration, nutrient assimilation, and the uptake of heavy metals (26).

Volatilization and Aerosol Formation

Volatilization (or evaporation) can remove volatile pollutants from wetlands. Air and water temperature, wind speed, subsurface agitation, and surface films can affect the rate of volatilization. Surface films may act as a barrier for the volatilization of some substances. Alternatively, evaporation may be a key mechanism for exporting substances such as chlorinated hydrocarbons or oils, which are often found in the surface films of water bodies receiving urban stormwater runoff (26). Aerosol formation may play only a minor role in removing pollutants in wetlands and occurs only during strong winds (26).

Infiltration

For wetlands with underlying permeable soils, infiltration can remove pollutants. Stormwater percolates through the soil, eventually reaching ground water. Passage through the soil matrix can provide physical, chemical, and biological treatment depending on the matrix thickness, particle size, degree of saturation, and organic content. Infiltration is also dependent on the ground-water level at a site. In some instances, seasonal fluctuations in ground-water levels may cause some wetlands to discharge ground water during part of the year and recharge to ground water during other times of the year. The potential of pollutants to migrate to ground water depends highly on the type of pollutant, the soil type and properties, the hydrology, and the characteristics of the aquifer. Contamination of unconfined aquifers by stormwater is likely to be more significant from upland infiltration than from recharge through wetlands because of the high filtering action of typical wetland soils (27).

Wetland Stormwater Pollutant Removal Efficiencies

Only a limited number of studies have investigated the effectiveness of wetlands to treat stormwater runoff (Figure 1), and those have primarily focused on a few geographical locations (e.g., Florida, Minnesota, and California). The studies that this paper summarizes represent a wide diversity of wetland types, ranging from southern cypress swamplands and northern peatlands to brackish marshlands and high-elevation meadowlands. This section presents a discussion of wetland stormwater pollutant removal efficiencies found in the literature.

Table 2 summarizes reported removal efficiencies for total suspended solids (TSS) and selected nutrients and metals. The broad ranges of pollutant removal efficiencies were not surprising because wetlands vary in their hydraulic conditions, climate, and vegetation, and because the studies employed various monitoring and reporting procedures. Figure 2 presents histograms of pollutant removal efficiencies reported for TSS, total phosphorus (TP), ammonia (NH_3), and lead (Pb).

Table 2. Average Removal Efficiencies for Total Suspended Solids and Nutrients in Wetlands Reported in the Literature

Study	System Name	System Type	Pollutant Removal Efficiency (Percent)[a]							Lead		Zinc		Copper		Chromium	
			TSS	NH_3	NO_3	TP	Dis. P	COD	BOD	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Martin and Smoot (4)	Orange County Treatment System	Detention pond*	65	60	-17	33	76	7		39	29	15	-17				
		Wetland*	66	54	40	17	-30	18		73	54	56	75				
		Entire system	89	61	9	43	21	17		83	70	70	65				
Harper et al. (5)	Hidden Lake	Wetland	83	62	80	7			81	55	56	41	57	40	29	73	75
Reddy et al. (6)	Lake Apopka	Reservoirs		57.5	68.1	60.9	75.1										
		Flooded fields		51.9	64.2	7.3	16.7										
Blackburn et al. (7)	Palm Beach PGA Treatment System	System	50	17	33	62			35								
Esry and Cairns (8)	Jackson Lake	System	96	37	70	90	78										
Brown (9)	Fish Lake	Wetland/pond	95	0		37	28										
	Lake Elmo	Wetland	88	50		27	25										
	Lake Riley	Wetland	-20	25		-43	-30										
	Spring Lake	Wetland	-300	-86		-7	-10										
Wotzka and Oberts (10)	McCarrons Wetland Treatment System	Detention pond*	91		60	78	57	90		85							
		Wetland*	87		22	36	25	79		68							
		System	94		63	78	53	93		90							
Hickock et al. (11)	Wayzata Wetland	Wetland	94	-44		78				94		82		80			
Barten (12)	Clear Lake	Wetland	76	55		54	40										
Meiorin (13)	DUST Marsh																
	Basin A	Wetland*	63	-8	32	46			-25	30		42		-20		55	
	Basin B	Wetland*	40	-5	2	-4			-46	27		24		-60		47	
	Basin C	Wetland	51	18	12	36			-18	83		-29		17		13	
	System	Wetland*	76	16	29	58			-57	88		42		-19		66	
Morris et al. (14)	Angora Creek	Wetland	54	20	50	5											
	Tallac Creek	Wetland	36	33	35	-120											

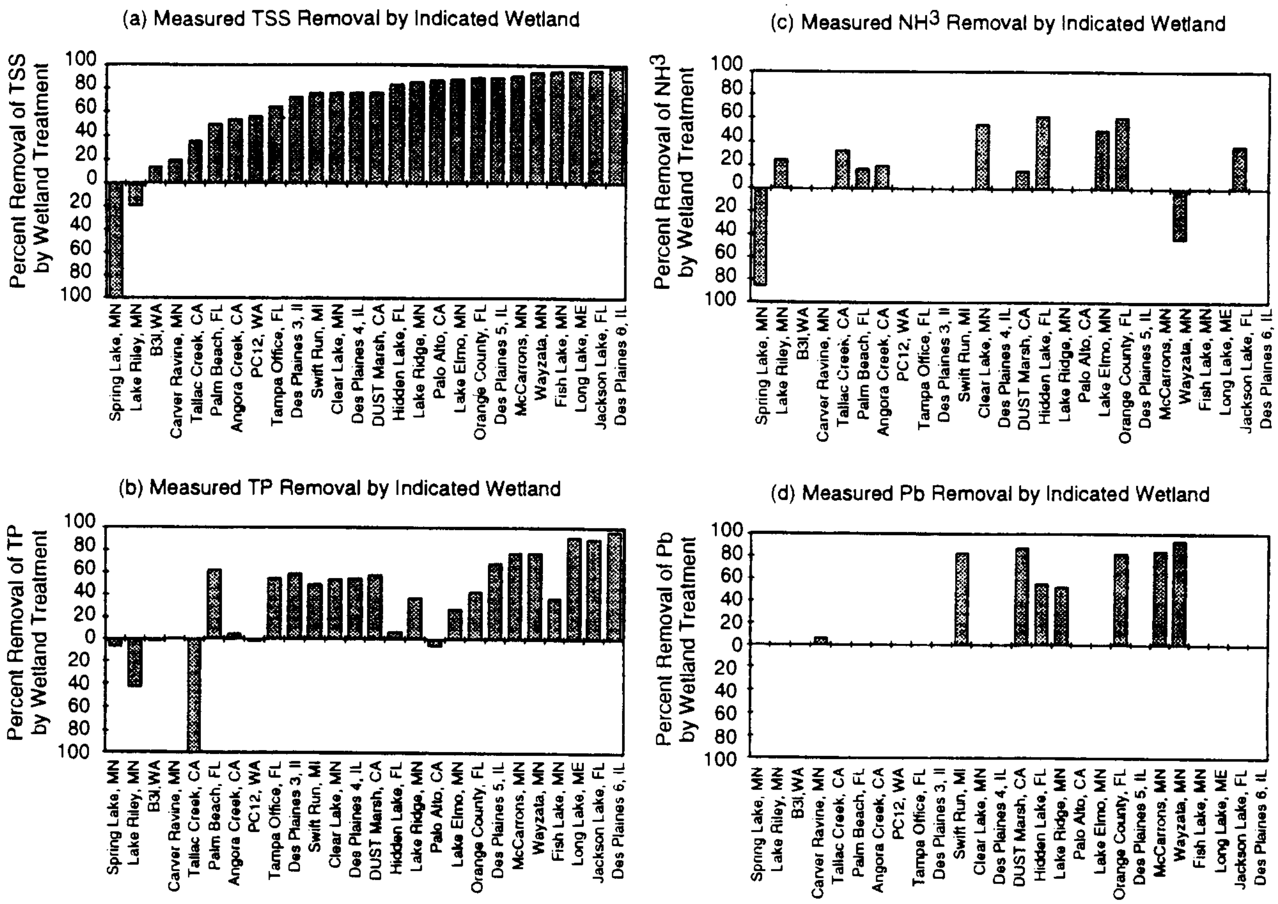
Table 2. Average Removal Efficiencies for Total Suspended Solids and Nutrients in Wetlands Reported in the Literature (continued)

			Pollutant Removal Efficiency (Percent)[a]							Lead		Zinc		Copper		Chromium	
Study	System Name	System Type	TSS	NH_3	NO_3	TP	Dis. P	COD	BOD	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
Scherger and Davis (15)	Pittsfield-Ann Arbor Swift Run	Detention pond*	39			23				61							
		Wetland	76			49				83							
ABAG (16)	Palo Alto Marsh	Wetland	87			-6			54								
Jolly (17)	Long Lake Wetland-Pond Treatment System	Entire system	95			92											
Oberts et al. (18)	Tanners Lake	Detention pond*	63		1	7	-14			59							
	McKnight Lake	Detention ponds*	85		11	34	12			63							
	Lake Ridge	Wetland	85		17	37	8			52							
	Carver Ravine	Wetland-pond system	20		9	1	1			6							
Reinelt and Horner (19, 20)	B3I	Wetland	14		4	-2											
	PC12	Wetland	56		20	-2											
Rushton and Dye (21)	Tampa Office Pond	Wetland	64			55						34					
Hey and Barrett (22)	Des Plaines River Wetland																
	EWA 3	Wetland	72		70	59											
	EWA 4	Wetland	76		42	55											
	EWA 5	Wetland	89		70	69											
	EWA 6	Wetland	98		95	97											
Median pollutant efficiency for wetland systems (without *)			76	33	46	46	23	55	45	83	63	42	61	40	29	70	75

[a]Negative removal efficiencies indicate net export in pollutant loads.

COD = chemical oxygen demand

BOD = biochemical oxygen demand



Note: No bar indicates that the removal estimates were not reported for this parameter at the indicated wetland.

Figure 2. Pollutant removal rates for a) TSS, b) TP, c) NH_3, and d) Pb.

Despite the variability observed in pollutant removal efficiencies, some similarities exist among the wetlands. The following observations can be made:

- Suspended solids and total lead (TPb), followed by total zinc and chromium, show the greatest consistency with pollutant removal efficiencies.
- Suspended solid removal efficiencies tend to be more consistent and larger in constructed wetlands than in natural systems. This is likely due to the design and management of the constructed systems.
- In some cases, concentrations of dissolved Pb, zinc, and copper appear to be reduced significantly.
- Nutrient removal efficiencies vary widely among wetlands. The variations appear to be a function of the season, vegetation type, and wetland systems management methods.
- Total phosphorus and nitrate show the greatest consistency for nutrient removal efficiencies. Total phosphorus removal efficiencies tend to be more variable for the natural wetlands and less variable for detention basins and constructed wetlands.

Probable Causes of Variations and Dissimilarities of Reported Wetland Pollutant Removal Effectiveness

In addition to the efficiencies that the authors tabulated, several reports presented conclusions to help explain the effectiveness of wetland treatment and variations. Hydrology is reportedly the most critical parameter influencing wetland performance. Variations in local hydrology, detention times, rates of runoff, water level fluctuations, and seasonality all reportedly affect the function of wetlands and thus their effectiveness at removing pollutants (25). Table 3 presents geographic, hydrologic, and hydraulic characteristics for each of the wetlands reviewed.

The size and volume of a wetland system can greatly affect both the actual removal efficiencies and the ability to estimate these efficiencies. EPA (26) reported difficulties in estimating pollutant removal efficiencies due to the volume of the wetland basin. The volume of the Demonstration Urban Stormwater Treatment (DUST) marsh is large enough that the treatment cycle spans several storms; therefore, no one storm provided a complete picture of pollutant efficiencies. The DUST marsh accu-

Table 3. Wetland Geographic and Hydraulic Characteristics

Study	System Name	Watershed Land Use	% Land Use	System Type	Constructed/ Natural	Wetland Size (acres)	Watershed Size (acres)	Wetland/ Watershed Ratio	Average Flows (ft^3/sec)	Basin Volume (acre-ft)	Detention Time (hr)	Depth (ft)	Inlet Condition	Comments
Martin and Smoot (4)	Orange County Treatment System	Residential	33	Detention pond	Constructed	0.2	41.6	0.5%	2.5	1.2-1.9	7.5	8-11	Discrete	a
		Highway	27	Wetland	Constructed	0.78	NA	1.9%	NA	0.5-2.8	8	0-5	Discrete	
		Forest	40	System	Constructed	0.98		2.4%						
Harper et al. (5)	Hidden Lake	Residential	NA	Wetland	Natural	2.5	55.2	4.5%	0.22	NA	NA	NA	Diffuse	b
Reddy et al. (6)	Lake Apopka	Agriculture	100	Reservoirs	Constructed	0.9	NA	NA	0.56	2.6	9.4 days	3.3	Diffuse	c
				Flooded fields	Constructed	0.9	NA	NA	0.23	0.6	4.8 days	0.7	Diffuse	
Blackburne et al. (7)	Palm Beach PGA Treatment System	Residential	NA	Wetland	Constructed	89	2,350	3.8%	NA	NA	NA	NA	Diffuse	c
		Golf course	NA	Wetland	Constructed + natural	296	2,350	12.6%	NA	NA	NA	NA	Diffuse	d
Esry and Cairns (8)	Jackson Lake	Urban	NA	Detention pond	Constructed	20	2,230	0.9%	NA	150	NA	7.5	Diffuse	c
			NA	Wetland	Constructed	9	2,230	0.4%	NA	13.5	NA	1.5	Diffuse	
Brown (9)	Fish Lake	Residential	30	Wetland	Natural	16	700	2.3%	0.001–0.01	64	NA	4	Discrete	e
		Commercial	5											
		Agricultural	12											f
		Open	53											
	Lake Elmo	Residential	12	Wetland	Natural	225	2,060	10.9%	0.001-0.65	900	NA	4	Discrete	g
		Commercial	1											
		Agricultural	34											
		Open	53											
	Lake Riley	Residential	13	Wetland	Natural	77	2,475	3.1%	0.004-1.35	231	NA	3	Discrete	
		Commercial	2											
		Agricultural	30											
		Open	55											
	Spring Lake	Residential	5	Wetland	Constructed	64	5,570	1.1%	0.008-4	256	NA	4	Discrete	
		Commercial	1											
		Agricultural	57											
		Open	37											

Table 3. Wetland Geographic and Hydraulic Characteristics (continued)

Study	System Name	Watershed Land Use	% Land Use	System Type	Constructed/ Natural	Wetland Size (acres)	Watershed Size (acres)	Wetland/ Watershed Ratio	Average Flows (ft^3/sec)	Basin Volume (acre-ft)	Detention Time (hr)	Depth (ft)	Inlet Condition	Comments
Wotzka and Oberts (10)	McCarrons Wetland Treatment System	Urban	NA	Detention pond	Constructed	29.7	600	5.0%	0.05-0.2	2.3-9.7	24 days	2.5	Diffuse	h
				Wetland	Constructed	6.2	600	1.0%						
				System	Constructed	35.9		6.0%						
Hickok et al. (11)	Wayzata Wetland	Residential Commercial	NA	Wetland	Natural	7.6	65.1	11.7%	0.08	NA	NA	NA	Discrete	i
Barten (12)	Clear Lake	Urban	NA	Wetland	Constructed	52.9	1,070	4.9%	1.5	10	3-5 days	0.5	Diffuse	
Meiorin (13)	DUST Marsh	Urban	93	Wetland:					10-250	150	4-40 days	4.7	Diffuse	j
		Agricultural	7	A	Constructed	5	—	—						
				B	Constructed	6	—	—						
				C	Constructed	21	2,960	0.7%						
				System	Constructed	32	2,960	1.1%						
Morris et al. (14)	Angora Creek	Residential	NA	Wetland	Natural	NA	2,816	NA	8.46	NA	NA	NA	Diffuse	k
		Forest	NA											
	Tallac Creek	NA	NA	Wetland	Natural	NA	2,781	NA	8.68	NA	NA	NA	Diffuse	
Scherger and Davis (15)	Pittsfield-Ann Arbor Swift Run	Residential	45	Detention pond	Constructed	25.3	4,872	0.5%	0-2,916	21-176	4-105	0-6	Discrete	f
		Commercial	19	Wetland	Natural	25.5	1,207	2.1%	0-166	15-60	12-82	0-3	Discrete	
		Agriculture	13											
		Open	23											
ABAG (16)	Palo Alto Marsh	Residential	62	Wetland	Natural	613	17,600	3.5%	150-320	400-750	30	1-6	Discrete	l
		Commercial	12											m
		Open	26											
Jolly (17)	Long lake Wetland-Pond Treatment System	Agriculture	100	Wetland/ pond	Constructed	1.5	18	8.3%	0.01	1.5	NA	0.5-8	Diffuse	n
Oberts et al. (18)	Tanners Lake	Residential	NA	Pond	Constructed	0.07	1,134	Neg.	NA	0.1	NA	3.0	Discrete	o
	McKnight Lake	Residential	NA	Pond	Constructed	5.53	5,217	0.1%	NA	13.2	NA	4.9	Discrete	
	Lake Ridge	Residential	NA	Wetland	Constructed	0.94	531	0.2%	NA	2.0	NA	4.8	Discrete	

Table 3. Wetland Geographic and Hydraulic Characteristics (continued)

Study	System Name	Watershed Land Use	% Land Use	System Type	Constructed/ Natural	Wetland Size (acres)	Watershed Size (acres)	Wetland/ Watershed Ratio	Average Flows (ft^3/sec)	Basin Volume (acre-ft)	Detention Time (hr)	Depth (ft)	Inlet Condition	Comments
	Carver Ravine	Residential	NA	Wetland/ pond	Constructed	0.37	170	0.2%	NA	1.0	NA	2.0	Discrete	
Reinelt and Homer (19, 20)	B31	Urban	NA	Wetland	Natural	4.9	461.7	1.1%	1.5	0.03–0.43	3.3	NA	Discrete	p
	PC12	Rural	NA	Wetland	Natural	3.7	214.8	1.7%	0.7	0.05-0.60	2.0	NA	Discrete	q
Rushton and Dye (21)	Tampa Office Pond	Commercial	100	Wetland	Constructed	0.35	6.3	5.6%	NA	0.32	NA	0-1.5	Discrete	r
Hey and Barrett (22)	Des Plaines River Wetland Demonstration Project	Agriculture Urban	80 20	Wetland:										
				3	Constructed	5.6	—	—	5	NA	NA	1	Discrete	s
				4	Constructed	5.6	—	—	0.6	NA	NA	1	Discrete	
				5	Constructed	4.5	—	—	4	NA	NA	1	Discrete	
				6	Constructed	8.3	—	—	1	NA	NA	1	Discrete	

NA = Not available

System = summary information

a Short-circuiting was observed during several storms.

b The wetland is not a basin but similar to a grassy swale.

c Design configuration suggests little short-circuiting occurred.

d Generally sheet flow exists within the artificial wetland.

e The major influent to these natural wetlands is discrete channelized flow.

f The schematic suggests large areas of dead storage exist.

g Short-circuiting was not discussed by the author.

h Three discrete inlets help to minimize short-circuiting and dissipate surface water energy.

i Design configuration suggests minimal short-circuiting existed regardless of a single discrete inlet.

j Design configuration suggests little short-circuiting occurred due to long and narrow wetland basins.

k Flow occurs as channelized flow until the storm volume is large enough to force sheet flow through the meadowlands.

l Water level and volume are controlled by the tidal cycle.

m Channelized flow exists until the tide increases, causing the surrounding marsh to become inundated.

n Entire system consists of a sedimentation basin, grass filter strip, constructed wetland, and deep pond.

o Monitoring occurred during a dry period.

p Storm flows reduce detention times.

q Channelization reduced effective area in wetland.

r Overflow from adjacent wetlands occurred during extremely high water; leak and breach problems occurred during study.

s Water is pumped to the system from the river (drainage area of 210 square miles) for 20 hr/wk.

mulates stormwater flows within the system and discharges effluent slowly over days or weeks, depending on the interval between storms. Thus, the water collected at the discharge from the DUST marsh is probably a mixture of water that entered from the previous storms.

The type of inlet structure and the flow patterns through wetland areas also can significantly affect pollutant removal efficiencies. Morris et al. (14) found that sheet flow (as opposed to channelized flow) was the most critical factor in the effectiveness of meadowland treatment. This finding is consistent with the theory that shallow, vegetative overland flow decreases velocities and increases sedimentation. In addition, close contact with the soil matrix was found to increase assimilation of nutrients and bacteria. Brown (9) found that an undefined inflow (multiple input locations) to the wetland, which results in better dispersion of incoming load, was critical in the effectiveness of the wetland. An undefined inflow reduced short-circuiting and increased mixing and contact of the stormwater with the soil and plant substrates.

The change in seasons has been considered another important factor in the effectiveness of wetland treatment of storm runoff. Typical factors of seasonality are evapotranspiration rates and seasonal productivity and decay of plant and animal life. Removal efficiencies in wetlands located in areas with strong seasonal variation may vary significantly between seasons. For example, Meiorin (13) reported that high summer evapotranspiration rates caused a 200- to 300-percent increase in the total dissolved solids concentrations within the DUST marsh. Furthermore, high productivity during warm periods can lead to decreases in nutrients and increases in biochemical oxygen demand (BOD) and suspended solids. Morris et al. (14) reported that flushing and leaching effects of spring snowmelt caused an increase in total Kjeldahl nitrogen and organic carbon in flows leaving the Tahoe Basin meadowland. Harper et al. (5) reported that detention times greater than 2 days caused an increase in the export of orthophosphorus from the Hidden Lake wetland.

Hickok et al. (11) described microbial activity as the most important factor affecting phosphorus removal. Other factors that probably cause variations in the reported pollutant removal effectiveness include maturity of the wetland, the buildup of nutrients and heavy metals in a wetland system, particle-size distribution (which affects the settling of suspended sediments), and maintenance practices performed at a wetland.

Comparison of Factors Affecting Reported Treatment Efficiencies

This study reviewed data on removal efficiencies for 26 different wetland systems. The study evaluated the following factors regarding their effects on wetlands pollutant removal performance:

- Constructed versus natural systems.
- Vegetation types found in the wetland.
- Land-use types draining to the wetland.
- Area of the wetland system compared with the contributing watershed.
- Estimated average storm-flow quantities draining to the wetland.
- Inlet types.

These factors affected only a few meaningful direct relationships. This was because of the limited amount

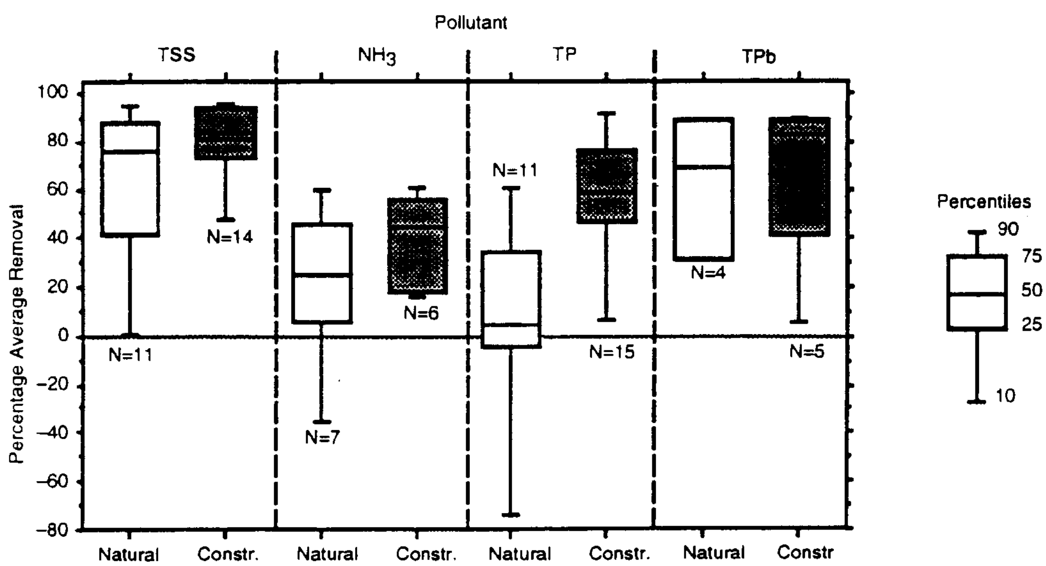


Figure 3. Box plot percentiles comparison of site average pollutant removals for natural and constructed wetland systems: TSS = total suspended solids, NH_3 = ammonia, TP = total phosphorus, TPb = total lead, and N = number of wetland sites.

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of data available to determine these relationships as well as the multiple factors that affect performance. Without a large database, a meaningful multiple regression analysis was not possible.

Several trends, however, were noted. First, constructed systems generally had a higher average removal performance than natural systems, with less variability. Second, larger wetlands compared with their tributary watershed areas also showed the same trend: a higher average removal performance, with less variability. Figure 3 presents TSS, TP, NH_3, and TPb in a percentile box plot for the constructed and natural systems. Note that, in all cases for the pollutants summarized, constructed systems showed a higher average and median performance level. More significant, however, is the difference in variability between the two types of wetlands. Constructed sites were much less variable. This is not a surprising finding, given that constructed systems have generally been designed to handle expected incoming flows and to minimize short-circuiting. They should generally show a higher performance level with more consistency.

Investigators also looked at the area of the wetland system compared with the size of its contributing watershed. Regression of the wetland to watershed area ratio

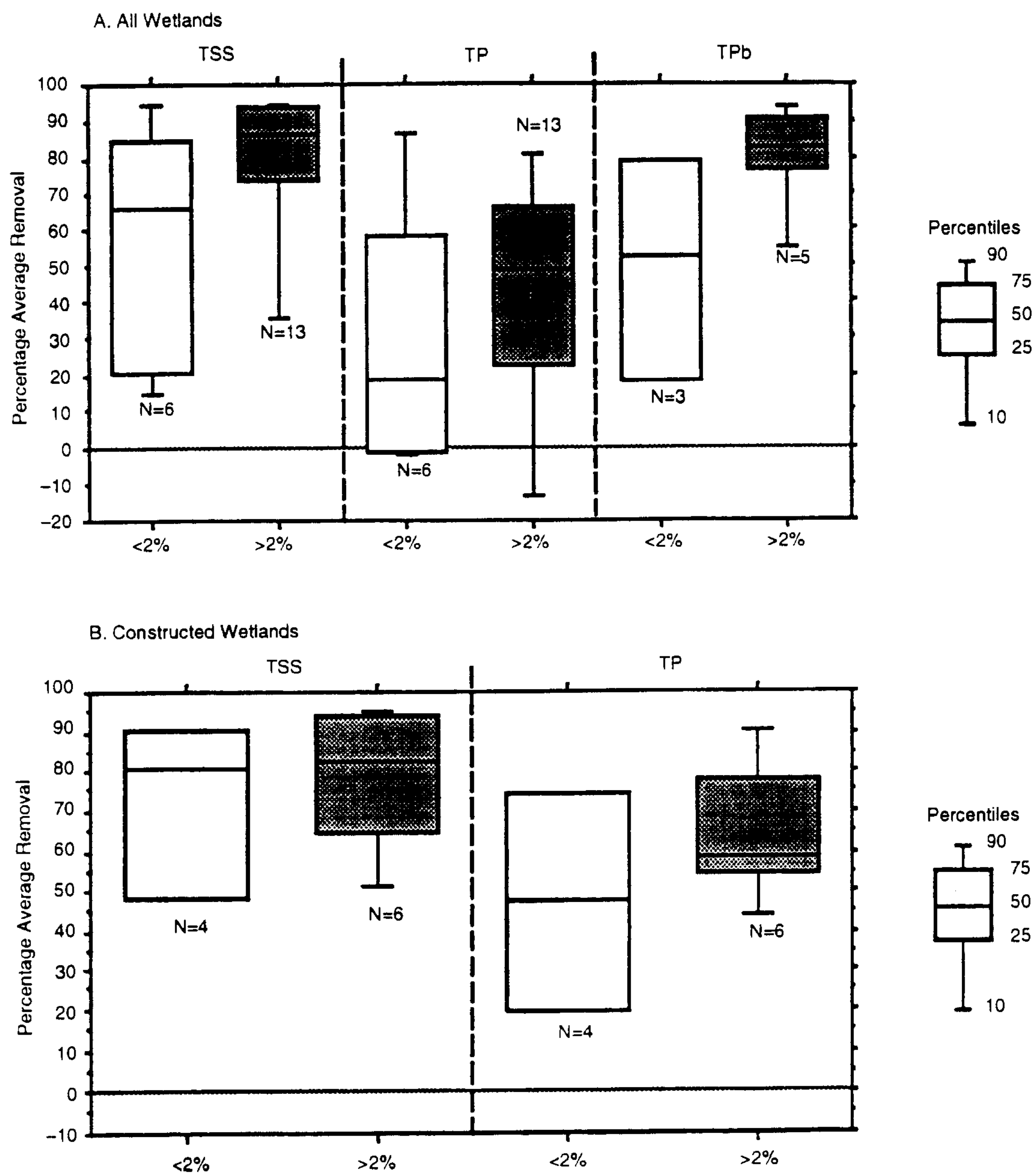

Figure 4. Average site percentile box plots for TSS, TP, and TPb pollutant removals for wetlands with less than 2 percent and greater than 2 percent wetland-to-watershed size ratios (WWAR): N = number of wetland sites, TSS = total suspended solids, TP = total phosphorus, and TPb = total lead.

(DAR) to pollutant removal performance did not reveal good direct relationships. Grouping sites according to a greater than or less than 2 percent DAR, however, did result in some general trends. Figure 4 presents performance results for all wetland systems with reported tributary watershed areas. In general, the larger DAR wetlands had higher performance levels, with less variability. This analysis included all wetland sites, natural and constructed. To separate out the effects of natural versus constructed systems, Figure 4 also presents a similar analysis for constructed sites only. Generally, for constructed sites the trends are the same, although the differences in performance levels and variability in performance are much less. The data indicate that carefully constructed systems can probably mitigate the importance of DAR as a factor in determining performance. Therefore, at this time we are not suggesting that 2 percent minimum DAR is a proper design criteria for constructed wetlands.

The Jackson Lake wetland is an example of a wetland with a small DAR that still achieved excellent performance (85 percent TSS removal). The DUST marsh and the Lake Ridge wetlands also showed high performance levels (76 and 85 percent TSS removals, respectively). One factor that explains the DUST marsh performance is that it is an "off-line" device: it only receives flow volumes up to a certain flow rate, then bypasses high flows. This type of design is particularly appropriate for wetlands receiving stormwater from larger catchments relative to wetland size.

To better measure the capacity of a wetland to treat runoff from a given watershed would entail evaluating average storm runoff volumes of wetland tributary areas with wetland storage volumes and/or contact surface areas. The data from the studies, however, did not consistently include data on rainfall statistics, percent impervious for land uses, specific percentages for land uses in a catchment, flow volumes to the wetland, capacity of the wetland system, and surface areas for contact with stormwater (including soils and plants). Therefore, we were not able to analyze the wetland systems using this approach. The summary of this paper contains some recommendations regarding reporting information for future studies, so that such analyses can be completed.

Finally, no good studies or documentation exists regarding maintenance activities in wetlands that are treating stormwater. In addition, the need for maintenance and level of maintenance are not well understood or documented. These activities could affect performance characteristics of wetlands, particularly over the long term.

Assessment of the Reliability of Wetland Data

There are various difficulties in comparing one wetland study to another. Table 4 presents a list of the selected literature, including information on the sampling characteristics that each study employed. The table shows that the studies identified generally lasted a year or less. There was quite a variation in the number of samples collected (from 3 to about 150), as well as in the sampling methods used (i.e., grab sample or samples versus composite sample for an event). These factors all contribute to the difficulty of comparing results from the different studies. Another complication in comparing the performance of wetlands involves the method of quantifying their effectiveness.

Noted Impacts of Stormwater Runoff on Wetland Biota

Many researchers have expressed concern over the impact of the quantity and quality of stormwater runoff on wetland biota, especially in natural wetlands (27, 28). The quantity of stormwater runoff determines the hydrologic characteristics of a wetland, including the average and extreme water levels and duration and frequency of flooding. Stormwater runoff also contains pollutants that can adversely affect wetland biota if accumulated in high concentrations. The hydrology of a wetland is one of the most important factors in establishing and maintaining specific types of wetlands and wetland processes (29). Hydrology is a key factor in wetland productivity, vegetation composition, nutrient imports, salinity balance, organic accumulation, sedimentation transport, and soil anaerobiosis.

Few of the reports reviewed indicated concern regarding the effects of contaminants in urban stormwater on wetland systems. Many of the reports referenced studies performed in wetlands receiving sewage effluents or industrial discharges of some type. Urban runoff, especially from residential watersheds, frequently has much lower concentrations of pollutants than do sewage effluents or industrial discharges.

Sediments typically constitute the most significant store of toxic substances available to organisms in a wetland (29). Plants can take up metals and toxic organic compounds from the sediments, thus introducing them into the food web (30-32). Both metals and organics tend to be adsorbed to finely divided solids, depending on conditions such as pH, oxidation-reduction potential, and salinity (33). The way a metal is complexed determines its availability to plants (33).

Water resides longer in wetlands compared with more swiftly moving waters because of the flatness of wetlands and the filtering action of the vegetation. This longer residence time allows suspended solids to drop out and be retained (32, 33). Woodward-Clyde Consultants (34) found that the greatest concentration of metals in sediments occurred at the location nearest the stormwater inlet and declined with distance from the inlet. They found the sediment concentration and bioavailabil-

Table 4. Sampling Characteristics From the Wetlands Reviewed

Study	Location	Time of Study	Length of Study	Type of Sample	Number of Storms Monitored	Method of Computing Efficiencies
Martin and Smoot (4)	Orange County, FL	1982–1984	2 years	7 multigrab, 6 composite	13	ROL
Harper et al. (5)	FL	1984–1985	1 year	Composite	18	ER
Reddy et al. (6)	Orange County, FL	1977–1979	2 years	Single grab	Approx. 150	MC
Blackburn et al. (7)	Palm Beach, FL	1985	1 year	Single grab	36	MC
Esry and Cairns (8)	Tallahassee, FL	1985	NA	NA	1	NA
Brown (9)	Twin Cities Metro Area, MN	1982	1 year	Composite	5–7	SOL
Wotzka and Oberts (10)	Roseville, MN	1984–1988	2 years	Composite	25	ROL
Hickok et al. (11)	MN	1974–1975	10 months	NA	NA	SOL
Barten (12)	Waseca, MN	1982–1985	3 years	Composite	27	ER
Meiorin (13)	Coyote Hills, Fremont, CA	1984–1986	2 years	Composite	11	SOL
Morris et al. (14)	Tahoe Basin, CA	1977–1978	1 year	Single grab	Approx. 75	MC
Scherger and Davis (15)	Ann Arbor, MI	1979–1980	8 months	Composite	7	SOL
ABAG (16)	Palo Alto, CA	1979	3 months	Composite	8	ER
Jolly (17)	St. Agatha, ME	1989	5 months	Composite	11	SOL
Oberts et al. (18)	Ramsey–Washington Metro Area, MN	1987–1989	2 years	Composite	7–22	SOL
Reinelt and Horner (19, 20)	King County, WA	1988–1990	2 years	Composite	13	SOL
Rushton and Dye (21)	Tampa, FL	1989–1990	12 months	Composite	3–8	ER
Hey and Barrett (22)	Wadsworth, IL	1990	8 months	Discrete	Continuous	SOL

ER = event mean concentration
MC = mean concentration
NA = not available
ROL = regression of event loads
SOL = sum of event loads

ity of copper, lead, and zinc to be at or near background levels in the downstream marsh area.

Plants take more metals from the sediment than from the water column. Phytoplankton, however, can remove metals directly from the water, releasing them to the sediments or to the water upon death (35). In general, far greater amounts of metals remain in the sediment than are taken up by plants (36-39). Some plants are apparently able to exclude toxic metals selectively. Organic compounds undergo many of the same processes in wetlands as metals, including adsorption to sediments and plant uptake. In addition, they can be biodegraded.

The uptake of toxic materials by plants can introduce these materials into the grazing and detrital food chains, with potentially deleterious effect. Metals from sewage effluents introduced to wetlands tend to accumulate in the food chain (32). Finally, the relative responses of plants and animals to toxic metals and organic compounds indicate that these contaminants are more likely to affect animals negatively.

Comparison of Wetland and Detention Basin Performance

Detention facilities have traditionally been constructed to control stormwater runoff quantities. These facilities temporarily store stormwater runoff and later release the water at a lower flow rate. Design of detention basins and ponds can provide for water quality enhancement by including a permanent pool of water and inlet and outlet structures to maximize detention. Quiescent velocities within the basins allow sediments to settle out of the stormwater and undergo chemical and biological removal processes. Detention basins usually do not have vegetation within the permanent pool, but the banks may be planted with grasses for erosion control.

Detention basin/constructed wetland treatment systems have been recommended for stormwater treatment (4, 10, 40). Typically in these systems, stormwater runoff discharges to the detention basin, which then releases the water to the wetland for additional treatment. The detention basin can provide pretreatment for the wetland, reducing the sediment and pollutant loads to the wetland. In other instances, detention basins and constructed wetlands are competing alternatives under consideration for stormwater treatment. To make a decision, the designer or planner requires knowledge of the relative pollutant removal efficiencies, environmental impacts, maintenance requirements, and costs of the two alternatives.

To further illustrate how those systems compare, the following discussion focuses on the results from a case study of the McCarrons treatment facility system, which compared the performance of wetlands with that of detention basins through simultaneous monitoring of both systems. Wotzka and Oberts (10) presented a paper discussing the combined detention-wetland stormwater treatment facility. The McCarrons treatment facility consisted of a 30-acre detention basin with an average depth of 1.2 ft and a 6.2-acre constructed wetland with an average depth of 2.5 ft. The detention basin received stormwater and then discharged to the wetland. The contributing watershed consisted of 600 acres of primarily urban land use. The predominant vegetation in the wetland consisted of cattails with other emergent plant species.

Overall, the system produced very good results. The detention basin proved to be more effective than the wetland in reducing several pollutants. For example, Table 5 lists removal efficiencies for the detention basin and wetland.

Wotzka and Oberts (10) discussed some of the possible explanations for the good results of the detention basin and for its differences from the wetland. In general, they believed that the treatment efficiencies were lower in the wetland due to pretreatment by the detention basin. They stated that the inflows into the detention basin spread equally around the perimeter of the detention basin, thus dissipating the entry velocities of the storm runoff. Dissipation of inflow energy probably promoted settling and minimized short-circuiting.

Table 5. Removal Efficiencies (%) for Detention Basin and Wetland

Parameter	Detention Basin	Wetland
TSS	91	87
TP	78	36
TN	85	24
TPb	85	68

Wotzka and Oberts (10) suggested that the percentage of phosphorus in the dissolved and particulate phases affected the reduction potential. They found that more than 80 percent of the phosphorus was in the particulate form, resulting in high removal efficiencies due to settling. Apparently, the wetland did not perform as well as the detention basin because of the periodic release of nutrients from decaying vegetation and the fact that significant pretreatment had occurred. The authors also suggested that the high removal of phosphorus was due in part to the newly exposed soils on the bottom of the detention basin. They explained that the newly exposed soils probably had more adsorption capacity available than the soils in the wetland further downstream. They also suggested that saturated soil conditions could lead to a reduction in phosphorus removal.

In conclusion, this study indicated that the detention basin performed better than the wetland system. This may be misleading, however, because the wetland received pretreated waters from the detention basin. The detention basin removed the fraction of pollutants that were more readily settled and treated, leaving the wetland with the more difficult-to-treat, finer particulates and dissolved pollutants.

Summary

Wetlands have a good capability for removing pollutants from stormwater runoff. Several factors contribute to and influence removal efficiencies, including sedimentation, adsorption, precipitation and dissolution, filtration, biochemical interactions, volatilization and aerosol formation, and infiltration. The reported removal efficiencies are, as expected, quite variable. For the wetlands systems reviewed, removal efficiencies for TSS had a median of 76 percent. TSS removal is a good indicator of pollutant removal potential for heavy metals and phosphorus, as well as other pollutants associated with fine particulate matter. Constructed wetlands tended to be more consistent than natural wetlands in their removal of TSS and the other analyzed parameters. Wetlands have also shown the ability to remove dissolved metals. Nutrient removal in wetlands is variable, depending on both wetlands characteristics and seasonal effects.

Because many dissimilarities exist between the wetlands studied, wetlands stormwater pollutant removal efficiencies vary widely. Properly designed, constructed, and maintained wetlands, however, can be effective pollution control measures. Examining additional wetlands in a variety of geographical areas, as well as long-term pollutant removal efficiencies, is definitely necessary.

A significant issue, however, involves whether stormwater control measures should include natural wetland systems. In general, natural wetlands have been found to be somewhat less predictable than constructed wetlands in terms of pollutant removal efficiency. This difference may be due to the fact that constructed wetlands have generally been engineered specifically to provide favorable flow capacity and routing patterns. As a result, they tend to detain inflows for longer periods and have less short-circuiting than many natural systems.

People often question the appropriateness of using a natural, healthy wetland for such purposes. Their concern is whether the modified flow regime and the accumulation of pollutants will result in undesirable environmental effects. There are many situations where natural wetlands have been receiving urban runoff for years. Some of these wetlands reflect significant degradation because of many factors, including urban runoff, whereas others have been less affected. A general consensus from the literature is to discourage the use of a healthy natural wetland for stormwater pollution control. In the case of rehabilitating a natural but degraded wetland, modifications should ensure that the applied runoff receives sufficient pretreatment. One pretreatment technique would be to use pond areas to provide an opportunity for suspended materials to settle out before the flows enter the wetland. Other possible options include routing inflows to the wetlands through upstream grass swales, oil/water separators, heavily vegetated areas (e.g., thick, shallow cattail areas), and overland flow areas.

These techniques would not only act on solids but also on floatables such as oil and water. Although little evidence exists of problems in wetlands that have been receiving stormwater runoff, the available data are quite limited, and developing additional information on impacts is critical. Additional studies on the impacts to biota should be undertaken.

In addition, the maintenance needs of wetland systems that treat stormwater merit further study. Such maintenance activities could include sediment removal and plant harvesting. Further studies should address the need for and the frequency and appropriateness of maintenance.

Gathering more information on wetland effectiveness would benefit design development procedures for sizing wetland treatment facilities. There is currently not enough information in the existing literature to develop design guidelines for constructed wetland treatment systems. Additional studies are needed to broaden the type of wetland systems reviewed, develop information on long-term performance, and evaluate seasonal characteristics of wetland performance.

A review of the data available on wetland stormwater treatment effectiveness revealed that most studies did not contain enough information on study and wetland characteristics to analyze in detail the factors affecting treatment performance among different wetlands. Table 6 presents a summary of the information that would hopefully provide a better means to compare wetland

Table 6. Suggested Reporting Information for Studies That Assess the Ability of Wetlands To Treat Stormwater Pollution

Wetland classification

Constructed or natural or combination wetland?

Vegetation species

Vegetation density (percentage open and vegetated)

Vegetation types (submerged, emergent, floating)

Wetland size

Wetland aspect (length-to-width ratio)

Side slopes

Soil type and depths

Watershed size (acres)

Watershed land use (percent residential, industrial, agricultural, undeveloped, etc.)

Watershed percent impervious (percent impervious area)

Rainfall data/statistics

Average rainfall during study (in./year)

Average number of storms per year

Average storm intensity (in./hr)

Average storm duration (hr)

Average time between storms (days)

Low flow inflow rate(s)

Ground-water interaction?

Total flow from average storm

Wetland volume (maximum storage volume)

Average detention time for average storm (hours)

Water depth (minimum, maximum, average)

Inflow condition (discrete or diffuse inlets)

Pretreatment of inflow (settling forebays, overland flow, detention basin, grassed swales, etc.)

Maintenance practices (including frequency)

Plant harvesting?

Flushing?

Sediment removal?

Chemical treatment?

Other maintenance?

Provide hydrology and water quality data for all storms monitored

Type of samples (grab or composite)

Number of storms monitored

Method used to compute pollutant removal efficiencies

Dominant removal mechanisms (sedimentation, adsorption, filtration, biochemical, etc.)

designs and treatment effectiveness from different wetland systems. This type of information could be useful when comparing watershed to wetland characteristics regarding performance.

This paper compared watershed to wetland size ratios. A comparison of average storm volume to wetland volume would have made a better analysis of the effect of wetland "sizes" on treatment abilities. The currently available data, which predominantly present areas of wetlands and watersheds, did not allow for this kind of comparison. Percent impervious factors and therefore runoff volumes could be very different in different watersheds. Data such as percent imperviousness, land use information, and rainfall statistics, along with wetland volume information, would have allowed us to compare average runoff volumes, wetland volumes, and resulting performance characteristics.

Acknowledgments

The author would like to thank EPA and specifically Thomas Davenport, the project officer, for his support and guidance on the original project. The author gratefully acknowledges the coauthors of the study report on which this paper is based, Joan Kersnar, Eugene Driscoll, and Richard Horner.

References

1. Hammer, D.A., ed. 1989. Constructed wetlands for wastewater treatment, municipal, industrial, and agricultural. Chelsea, MI: Lewis Publishers.
2. Bastian, R.K., P.E. Shanaghan, and B.P. Thompson. 1989. Use of wetlands for municipal wastewater treatment and disposal—regulatory issues and EPA policies. Constructed wetlands for wastewater treatment, municipal, industrial, and agricultural. Chelsea, MI: Lewis Publishers.
3. Strecker, E.W., J.M. Kersnar, E.D. Driscoll, and R.R. Horner. 1992. The use of wetlands for controlling stormwater pollution. Prepared by Woodward-Clyde Consultants for U.S. EPA. Washington, DC: Terrene Institute.
4. Martin, E.H., and J.L. Smoot. 1986. Constituent-load changes in urban stormwater runoff routed through a detention pond-wetland system in central Florida. Report 85-4310. U.S. Geological Survey Water Resources Investigation.
5. Harper, H.H., M.P. Wanielista, B.M. Fries, and D.M. Baker. 1986 Stormwater treatment by natural systems. Report 84-026. Florida Department of Environmental Regulation.
6. Reddy, K.R., P.D. Sacco, D.A. Graetz, K.L. Campbell, and L.R Sinclair. 1982. Water treatment by aquatic ecosystem: Nutrient removal by reservoirs and flooded fields. Environ. Mgmt. 6(3):261-271.
7. Blackbum, R.D., P.L. Pimental, and G.E. French. 1986. Treatment of stormwater runoff using aquatic plants. West Palm Beach, FL: Northern Palm Beach County Water Control District.
8. Esry, D.H., and D.J. Cairns. 1988. Effectiveness of the Lake Jackson restoration project for treatment of urban runoff. Presented at the joint meeting of the American Society of Civil Engineers (ASCE), Florida/South Florida Section.
9. Brown, R.G. 1985. Effects of wetlands on quality of runoff entering lakes in the Twin Cities metropolitan area, Minnesota. Investigation Report 85-4170. U.S. Geological Survey Water Resources.
10. Wotzka, P., and G. Oberts. 1988. The water quality performance of a detention basin-wetland treatment system in an urban area. In: Nonpoint pollution: Policy, economy, management, and appropriate technology. American Water Resources Association. pp. 237-247.
11. Hickok, E.A., M.D. Hannaman, and N.C. Wenck. 1977. Urban runoff treatment methods, Vol. 1. Nonstructural wetland treatment. EPA/600/2-77/217. Wayzata, MN: Minnehaha Creek Watershed District.
12. Barten, J.M. 1987. Nutrient removal from urban stormwater by wetland filtration. Lake Line 3(3):6-7, 10-11. North American Lake Management Society.
13. Meiorin, E.C. 1986. Urban stormwater treatment at Coyote Hills marsh. Association of Bay Area Governments.
14. Morris, F.A., M.K. Morris, T.S. Michaud, and L.R. Williams. 1981. Meadowland natural treatment processes in the Lake Tahoe Basin: A field investigation. Final report. EPA/600/54-81/026.
15. Scherger, D.A., and J.A. Davis, Jr. 1982. Control of stormwater runoff pollutant loads by a wetland and retention basin. In: Proceedings of the International Symposium on Urban Hydrology, Hydraulics, and Sediment Control, Lexington, KY. pp. 109-123.
16. Association of Bay Area Governments (ABAG). 1979. Treatment of stormwater runoff by a marsh/flood basin. Interim report. Oakland, CA.
17. Jolly, J.W. 1990. The efficiency of constructed wetlands in the reduction of phosphorus and sediment discharges from agricultural watersheds. M.S. thesis. Orono, ME: University of Maine.
18. Oberts, G.L., P.J. Wotzka, and J.A. Hartsoe. 1989. The water quality performance of urban runoff treatment systems, Part 1. Report to the Legislative Commission on Minnesota Resources. St. Paul, MN: Metropolitan Council of the Twin Cities Area.
19. Reinelt, L.E., and R.R. Horner. 1990a. Characterization of the hydrology and water quality of palustrine wetlands affected by urban stormwater. Seattle, WA: King County Resource Planning Section.
20. Reinelt, L.E., and R.R. Horner. 1990b. Urban stormwater impacts on the hydrology and water quality of palustrine wetlands in the Puget Sound region. In: Ransom, T.W., ed. Proceedings of the Puget Sound Research Conference, Seattle, WA (January). Olympia, WA: Puget Sound Water Quality Authority.
21. Rushton, B.T, and C.W. Dye. 1990. Tampa office wet detention stormwater treatment. Southwest Florida Water Management District annual report for stormwater research program: Fiscal year 1989-1990. Brooksville, FL: Southwest Florida Water Management District. pp. 39-59.
22. Hey, D.L., and K.R. Barrett. 1991. Hydrologic, water quality, and meteorologic studies. In: The Des Plaines River Wetlands Demonstration Project, Draft Final Report to the Illinois Department of Energy and Natural Resources. Chicago, IL: Wetlands Research.
23. Oberts, G.L. 1982. Impact of wetlands on nonpoint source pollution. Presented at the International Symposium on Urban Hydrology, Hydraulics, and Sediment Control, Lexington, KY.
24. Benforado, J. 1981. Ecological considerations in wetland treatment of wastewater. In: Richardson, B., ed. Selected proceedings of the Midwest Conference on Wetland Values and Management, St. Paul, MN (June). pp. 307-323.
25. U.S. EPA. 1984. The removal of heavy metals by artificial wetlands. EPA/600/D-84/258. Ada, OK.

26. U.S. EPA. 1981. The use of wetlands for water pollution control. EPA/600/S2-82/086. Cincinnati, OH.

27. Stockdale, E.C. 1991. Freshwater wetlands, urban stormwater, and nonpoint pollution control: A literature review and annotated bibliography, 2nd ed. Olympia, WA: Washington Department of Ecology.

28. Newton, R.B. 1989. The effects of stormwater surface runoff on freshwater wetlands: A review of the literature and annotated bibliography. Publication 90-2. Amherst, MA: The Environmental Institute at the University of Massachusetts.

29. Mitsch, W.J., and J.G. Gosselink. 1986. Wetlands. New York, NY: Van Nostrand Reinhold.

30. Kadlec, R.H., and J.A. Kadlec. 1979. Wetlands and water quality. In: Greeson, P.E., J.R. Clark, and J.E. Clark, eds. Wetland functions and values: The state of our understanding. Minneapolis, MN: American Water Resources Association. pp. 436-456.

31. Kreiger, R., D. Kreiger, K. Tomson, and W. Warner. 1986. Lead poisoning in swans in the lower Coeur d'Alene river valley. Paper No. 651. Presented at the Annual Meeting of the Society of Toxicology, New Orleans, LA (March).

32. Kadlec, R.H., and D.L. Tilton. 1979. The use of wetlands as a tertiary wastewater treatment alternative. CRC Crit. Rev. Environ. Control 9:185-212.

33. Horner, R.R. 1986. A review of wetland water quality functions. In: Strickland, R., ed. Wetland functions, rehabilitation, and creation in the Pacific Northwest: The state of our understanding. Olympia, WA: Washington State Department of Ecology. pp. 33-50.

34. Woodward-Clyde Consultants. 1991. Sediment and storm runoff concentrations of copper, zinc, and lead in the Crandall Creek-DUST marsh system. Prepared for County of Alameda, Public Works Agency, Hayward, CA.

35. Hart, J.T. 1982. Uptake of trace metals by sediments and suspended particulates: A review. Hydrobiologia 91:299-313.

36. Dubinski, B.J., R.L. Simpson, and R.E. Good. 1986. The retention of heavy metals in sewage sludge applied to a freshwater tidal wetland. Estuaries 9(2):102-111.

37. Banus, M.D., I. Valiela, and J.M. Teal. 1975. Lead, zinc, and cadmium budgets in experimentally enriched salt marsh ecosystems. Estuarine Coastal Mar. Sci. 3:421-430.

38. Teal, J.M., A. Giblin, and I. Valiela. 1982. The fate of pollutants in American salt marshes. In: Gopal, B., R.E. Turner, R.G. Turner, R.G. Wetzel, and D.F. Whigham, eds. Wetlands ecology and management. Jaipur, India: National Institute of Ecology and International Scientific Publications. pp. 357-366.

39. Horner, R.R. 1988. Long-term effects of urban stormwater on wetlands. In: Roesner, L.A., B. Urbonas, and M.B. Sonnen, eds. Design of urban runoff quality controls. New York, NY: American Society of Civil Engineers. pp. 451-466.

40. Meyer, J.L. 1985. A detention basin/artificial wetland treatment system to renovate stormwater runoff from urban, highway, and industrial areas. Wetlands 5:135-146.

Constructed Wetlands for Urban Runoff Water Quality Control

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Abstract

Like all options for urban runoff water quality control, constructed wetlands have their advantages, disadvantages, and limitations. To realize their advantages, avoid problems, and use them appropriately requires recognition and adherence to certain principles. A hallmark of true constructed wetlands is their structural diversity, which yields the substantial advantages of breadth in treatment capabilities and potential for ancillary benefits as well as the disadvantage of larger land requirements for equivalent service than alternative measures. Prerequisites for success are functional objectives for the project to achieve and a corresponding design concept based on the structural characteristics of natural wetlands that are responsible for effective performance of the identified functions. Critical implementation considerations are proper siting, sizing, configuring of design features, construction, and various aspects of operations. Careful site-specific hydrologic analysis must be performed to ensure a sufficient water supply to sustain a wetland. The basis for sizing is limited at present, but application of climatological statistics and existing knowledge of needed hydraulic residence times for given treatment objectives provide some foundation. Equal in importance to planning, siting, and sizing are shaping, contouring, vegetating, and following up with short- and long-term maintenance, for which specific guidance is offered.

Background

Scope

Wetlands specifically constructed to capture pollutants from stormwater runoff draining urban and agricultural areas are gaining attention as versatile treatment options. Several recent major pieces of work have covered constructed wetland treatment, including those by Hammer (1), Strecker et al. (2), Olson (3), and Schueler (4). This paper draws on these resources and is intended to offer a concise summary of the current state of stormwater treatment using constructed wetlands and the methods for developing projects. The paper was derived from a 1-day continuing education course on the subject at the University of Washington, for which a course manual is available (5). In particular, this paper emphasizes the fundamental concepts on which successful application is based.

More than 150 wetlands have been constructed in the United States to treat municipal and industrial, especially mining, wastewaters (2). No complete accounting of stormwater constructed wetlands exists, but their number is certainly fewer.

The two basic types of municipal and industrial systems are both forms of attached growth biological reactors: free water surface (FWS) and subsurface flow (SF), or vegetated submerged bed (VSB) (6). The first type is similar to natural wetlands, with a soil base, emergent vegetation, and water exposed to air. The second type has a soil base overlain by media, emergent vegetation, and a water level below the media surface. The majority of municipal and industrial applications, most of small scale, are of this type. The advantages of a submerged system in these applications are reduced odor, insect problems, and land requirements because of the greater surface area for biological growth offered by the media. The FWS type is generally more appropriate for stormwater applications, where usually no odor problem exists, flows vary widely, and often there is a desire to integrate the treatment system with the landscape and to provide ancillary benefits. This paper covers only the FWS type of system.

Legal and Regulatory Considerations

From a legal and regulatory standpoint, "constructed wetlands" are designed, built, and continually maintained for the purpose of waste treatment. In this status, they are not regarded under the Clean Water Act as "waters of the United States." Accordingly, no regulations apply to water quality within, but the discharge is regulated in the same way as any treatment system.

This designation is in contrast to wetlands built for such purposes as mitigation of wetland losses under Clean Water Act Section 404 or to develop waterfowl habitat, known as "created wetlands." These systems have the same legal protections as natural wetlands, including prohibition on using them for the conveyance or treatment of waste. They usually have multiple functions, with any water quality improvement benefit being only incidental; entering water must be managed to prevent damage to any intended function. A constructed wetland also differs in purpose and legal status from a wetland "restoration," the purpose of which is to return a degraded system with reduced acreage or functional ability to the condition preceding degradation. If the wetland is not completely restored but one or more functions are increased, it is termed an "enhanced wetland." Restored and enhanced wetlands also have the same legal protections as natural wetlands.

A somewhat fuzzy issue with respect to constructed wetlands is their regulatory status if the principal purpose is waste treatment but ancillary benefits (e.g., wildlife habitat) are gained by design or incidentally. This situation is subject to interpretation by state and federal agencies. Such benefits are often among the objectives of project developers and are certainly possible to attain along with stormwater treatment in many circumstances; this paper provides advice on pursuing these objectives in a judicious way.

Constructed Wetlands in Relation to Alternative Methods

Alternatives to constructed wetlands for general-purpose stormwater treatment include wet ponds, extended-detention dry ponds, infiltration basins and other devices that drain into ground water, filtration, and "biofiltration" through terrestrial or hydrophytic plants in swales or on broad surface areas. Constructed wetlands have both advantages and disadvantages relative to these other options. Principal advantages are:

- More diversity in structure than any alternative, which offers the potential for relatively effective control of most types of pollutants.
- Wider range of potential side benefits than any alternative.
- Relatively low maintenance costs.
- Wider applicability and more reliable service than infiltration.

Disadvantages of constructed wetlands include:

- Larger land requirements for equivalent service than wet ponds and other systems, especially if intended to serve quantity as well as quality control purposes.
- Relatively high construction costs.
- Delayed efficiency until plants are well established.
- Uncertainty in design, construction, and operating criteria, a drawback also hampering competitive methods.
- Public concern about nuisances that can develop with stormwater constructed wetlands without care in siting, design, construction, and operation.

Functioning of Constructed Wetlands

Pollutant Removal Mechanisms

Numerous physical, chemical, and biological mechanisms can potentially operate in constructed wetlands to trap and transform entering pollutants. Understanding these mechanisms is the basis for determining effective treatment systems. That understanding can inform the entire process, from conception of the project, through preliminary planning and all phases of implementation, and, finally, to the long-term operation of the system. Table 1 summarizes the various mechanisms, the pollutants that they affect, and features that can promote their operation.

Some beneficial features are controllable through choices made during the project development process, while others are largely outside of the designer's influence, especially in a stormwater application. As can be seen in Table 1, some features are helpful in achieving multiple treatment objectives, but others are more specialized. Features that are largely under the project developer's control and help achieve any objective are 1) increasing hydraulic residence time (HRT); 2) providing an environment that creates flow at a low level of turbulence; 3) propagating fine, dense, herbaceous plants; and 4) establishing the wetland on a medium-fine textured soil, or amending soils to attain that condition.

Somewhat more specialized features, still mostly controllable, include 1) circumneutral Ph, which advances microbially mediated processes such as decomposition and nitrification-denitrification and avoids the mobility of certain pollutants at extreme pH; 2) a relatively low level of toxic substances in the site soils and entering flow, also needed for microbes; and (3) high soil organic content, which advances adsorption and decomposition and can be attained by site selection or soil amendment. Even more specialized are measures that can aid phosphorus capture, one of the most difficult treatment objectives to achieve. High soil exchangeable aluminum and iron contents have been found to enhance phosphorus reduction (7) but would require special soil amendments where naturally lacking, which thus far is an undemonstrated option in a full-scale wetland system. Addition of precipitating agents is an active treatment measure that is difficult to apply in passive

Table 1. Constructed Wetland Pollutant Removal Mechanisms

Mechanism	Pollutants Affected	Promoted By
Physical		
Sedimentation	Solids, BOD, pathogens; particulate COD, P, N, metals, synthetic organics	Low turbulence
Filtration	Solids, BOD, pathogens; particulate COD, P, N, metals, synthetic organics	Fine, dense herbaceous plants
Soil incorporation	All	Medium-fine textured soil
Chemical		
Precipitation	Dissolved P, metals	High alkalinity
Adsorption	Dissolved P, metals, synthetic organics	High soil Al, Fe (P); high soil organics (met.); circumneutral pH
Ion exchange	Dissolved metals	High soil cation exchange capacity
Oxidation	COD, petroleum hydrocarbons, synthetic organics	Aerobic conditions
Photolysis	COD, petroleum hydrocarbons, synthetic organics	High light
Volatilization	Volatile petroleum hydrocarbons and synthetic organics	High temperature and air movement
Biological		
Microbial decomposition	BOD, COD, petroleum hydrocarbons, synthetic organics	High plant surface area and soil organics
Plant uptake	P, N, metals	High plant activity and metabolism and surface area
Natural die-off	Pathogens	Plant excretions
Nitrification	NH_3-N	Dissolved oxygen >2 mg/L, low toxics temperature >5-7°C circumneutral pH
Denitrification	NO_3 + NO_2-N	Anaerobic, low toxics, temperature >15°C

Al = aluminum, BOD = biochemical oxygen demand, COD = chemical oxygen demand, Fe = iron, N = nitrogen, NH_3 = ammonia, NO_2 = nitrite, NO_3 = nitrate, P = phosphorus.

stormwater treatment systems subject to unpredictable and variable flow conditions.

Also outside the control of the designer and operator in a stormwater wetland is exploitation of the nitrification-denitrification processes to achieve nitrogen removal ultimately through evolution of nitrogen gas to the atmosphere. Full operation of the several steps in the bacterially driven processes requires alternating aerobic and anaerobic conditions at favorable temperatures, the first condition to permit oxidation to nitrate and the second to allow nitrate reduction to free N_2 gas. While these processes can be brought under some control in municipal and industrial treatment applications through timing of flow introduction, that degree of management is usually not possible in stormwater cases.

Expected Performance of Constructed Wetlands

Strecker et al. (2) conducted a full literature review of the use of both natural and constructed wetlands for controlling stormwater pollution. This review considered more than 140 papers and reports and assembled detailed information on 18 locations throughout the United States. Median pollutant removals in constructed wetlands were 80.5 percent for total suspended solids (TSS), 44.5 percent for NH_3-N, 58.0 percent for total phosphorus (TP), 83.0 percent for lead (Pb), and 42.0 percent for zinc (Zn). Coefficients of variation (standard deviation/mean) for these contaminants ranged from 27.7 to 56.1 percent, pointing out that both substantially higher and lower performances than median levels were reported. Pollutant reductions in constructed wetlands were overall higher than in natural wetlands, which was attributed to the specific design features and more intensive management of the constructed systems.

Schueler (4) estimated the performance potential of wetlands designed as he recommended based on the overall literature (Table 2). He considered these efficiencies to be provisional pending monitoring of the new systems.

Table 2. Projected Long-Term Pollutant Removal Rates for Wetlands Constructed as Recommended by Schueler (4)

Pollutant	Removal Rate (percent)[a]
TSS	75
TP	45[b]
Total nitrogen (TN)	25[c]
BOC, COD, total organic carbon	15
Pb	75
Zn	50
FC	Two orders of magnitude

[a] Lower by an unknown amount for pocket wetlands (see below for description of wetland types).
[b] 65 percent in pond/marsh system.
[c] 40 percent in pond/marsh system.

The Constructed Wetland Design and Implementation Process

Developing a constructed wetland treatment system should proceed carefully through a number of steps, as follows:

1. Planning the project.

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2. Selecting the site.
3. Sizing the facility.
4. Configuring the facility, and incorporating design features that promote pollution control.
5. Designing for ancillary benefits.
6. Selecting vegetation and developing a planting plan.
7. Constructing the facility and establishing vegetation.
8. Developing and implementing an operation and maintenance plan.

The remainder of this paper explains these steps.

Project development for a constructed wetland must be a team effort, with a number of skills and specialties represented, including:

- Hydrology
- Water quality
- Soils
- Botany
- Wildlife ecology
- Landscape architecture
- Design engineering
- Construction engineering
- Stormwater facility maintenance

It bears emphasizing that a high level of hydrologic expertise should be employed to ensure that the most essential need—water supply—is met.

Planning and Site Selection

Preliminary Planning Considerations

Constructed wetland projects should be planned systematically and on a watershed scale as much as possible. This comprehensive analysis should start with consideration of management and source control practices that can prevent pollutant release. Another general consideration that should receive attention is the overall place of constructed wetlands and how they can best be used in conjunction with other treatment practices.

If the constructed wetland option is pursued, project objectives should be stated in functional terms, for example:

- The type of protection to be provided to the receiving water, pollutants to be controlled, and levels of control to be achieved (if possible).
- Benefits to be provided in the areas of, for example, open space, aesthetics, and recreation.
- Animals and life stages for which habitat is to be provided.

The potential for constructed wetlands to play a key role in stormwater management has developed from the understanding of natural wetland functioning gained during the past 20 years. Natural wetlands serve their recognized functions, which include providing flood flow control, water quality improvement, and ecological benefits, as a consequence of their structure and the interactions among their component parts. Mimicking these functions in an engineered system can best be done with reference to natural models. Therefore, using nearby natural wetlands as reference models for the configuration and planting of the wetland to be designed is strongly recommended. The reference system(s) should be characterized through formal observations and measurements of its hydrology, water quality, soils, vegetation, and, if appropriate, animal habitat and species. It is not necessary to mimic the reference plant community entirely, but studying it provides an idea of how the constructed system is likely to evolve.

With the natural model(s) in mind, a design concept can be developed. Schueler (4) proposed four basic stormwater wetland designs:

- *Shallow marsh:* A system with a relatively large land requirement that generally is used in larger drainage basins.
- *Pond/Marsh:* A two (or more) cell arrangement with a land requirement that is reduced by a relatively large deep pool.
- *Extended-detention wetland:* A more highly fluctuating hydrologic system in which the land requirement is reduced by adding high marsh to the shallow marsh zone.
- *Pocket wetland:* A design for smaller drainage basins (0.4 to 4 hectares) that may provide insufficient baseflow for permanent pool maintenance and cause greater water level fluctuations.

Figure 1 illustrates the pond/marsh type design. For diagrams of the other designs, see Schueler (4). Table 3 summarizes some of the principal selection criteria for the respective wetland types.

To complete preliminary planning, the design process and its aftermath should be organized. The following list of general principles for project design and implementation, derived from the various comprehensive references cited earlier, provides guidance for these steps:

- Design and implement with designated objectives constantly and clearly in mind.
- Design more for function than for form. Many forms can probably meet the objectives, and the form to which the system evolves may not be the planned one.

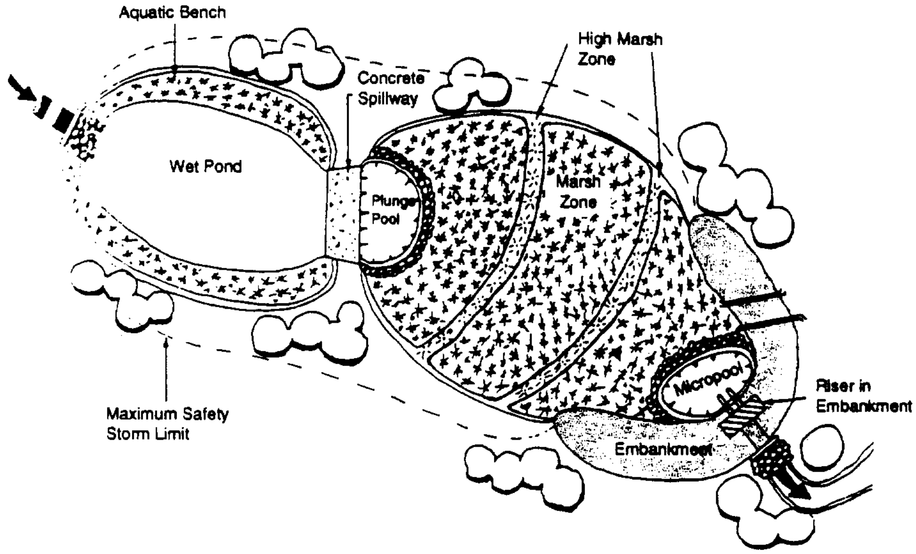

Figure 1. Two-cell pond/marsh design concept (4).

Table 3. Design Concept Selection Criteria (adapted from Schueler [4])

Attribute	Shallow Marsh	Pond/ Marsh	Extended-Detention Wetland	Pocket Wetland
Minimum wetland-to-watershed area ratio	0.02	0.01	0.01	0.01
Minimum watershed area (hectares)	10	10	4	0.4
Dry weather baseflow	Yes	Yes	Not necessarily	Not necessarily
Relative potential for ecological benefits	High	High	Moderate	Low to moderate

- Design relative to the natural reference system(s), and do not over-engineer.
- Design with the landscape, not against it (e.g., take advantage of natural topography, drainage patterns).
- Design the wetland as an ecotone. Incorporate as much "edge" as possible, and design in conjunction with a buffer and the surrounding land and aquatic systems.
- Design in structural complexity for beneficial distribution of water (e.g., its contact with vegetation and soils) and for biological advantages, as appropriate to objectives.
- Design to protect the wetland from potential high flows and sediment loads.
- Design to avoid secondary environmental and community impacts.
- Plan on sufficient time for the system to develop before it must satisfy objectives. Attempts to short-circuit ecological processes by overmanagement usually fail.
- Design for self-sustainability and to minimize maintenance.

Constructed Wetland Site Selection

Prospective constructed wetland sites should be evaluated carefully and a selection made after analyzing a number of conditions. Brodie (8) presented a generalized site screening procedure, which is reproduced in Figure 2. Table 4 summarizes the major considerations that should enter into this analysis. Application of these recommendations implies a significant data-gathering effort, which is essential at this sensitive stage in project development.

The need for a sufficient water supply to sustain a wetland is an especially important consideration; neglect of this consideration has led to constructed and created wetlands that are not viable. Thus, a water balance should be carefully established using the following formula to ensure that water availability and inputs at least balance outputs at all periods throughout the year:

$$I + P + D + S > O + E + R$$

where
I = surface inflow
P = precipitation
D = ground-water discharge

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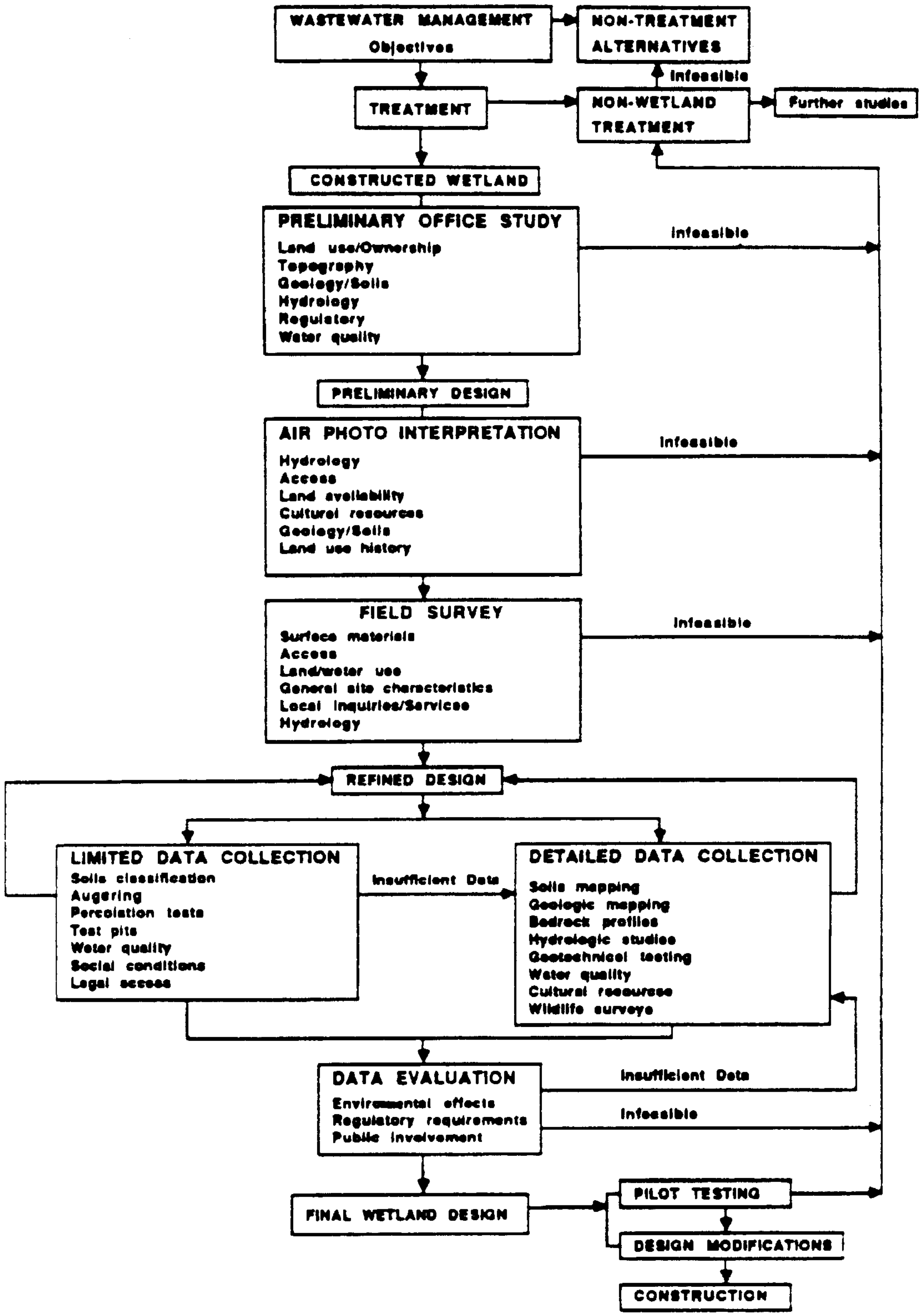

Figure 2. A generalized methodology for screening sites for constructed wetlands (8).

Table 4. Considerations in Constructed Wetland Site Selection

Category	Considerations
Land-use and general factors	Land availability Existing site use and value Site problems (e.g., previous dumping, utility lines) Adjacent land use and value Connection to wildlife corridors and potential for adjacent areas to be biological donors Public opinion Accessibility for construction and maintenance Ability to control public access according to project objectives
Environmental and regulatory factors	Federal, state, and local laws and regulations Avoidance of archaeological and cultural resources Avoidance of critical wildlife habitat areas
Hydrology and water quality factors	Water supply reliability Low potential for disruptive flooding Water supply of adequate quality to sustain biota Low potential for the project to adversely affect downstream water bodies and adjacent properties and their water supplies Need for lining to retain water or avoid ground-water contamination
Geology factors	Preferably flat or gently sloped topography Adequate soil development Sufficient depth to bedrock Soil characteristics consistent with pollution control objectives Suitability of site materials for use in construction

S = wetland storage at beginning of calculation period
O = surface outflow
E = evapotranspiration
R = ground-water recharge

All units are expressed in terms of volume or water depth over the wetland surface.

The water balance should be estimated during site selection and checked after preliminary design. In areas with pronounced seasonal drought (e.g., most of the western United States), the calculation should definitely be performed for this period. Ground-water terms are difficult to establish with assurance, but they should at least be estimated as closely as possible by a hydrogeologist familiar with the location. As demonstrated by the fact that natural wetlands often dry below the soil surface, permanent standing water is not required for a wetland to be viable. Research on natural wetlands in Washington State has found that plant community richness declines substantially when drying extends longer than 2 months, compared to wetlands with shorter dry periods (9). Hence, the water balance should at least demonstrate that drying will never extend longer than 2 months.

Brodie (8) and Mitsch (10) have discussed positioning constructed wetlands in watersheds. Brodie (8) listed advantages and disadvantages of locating wetlands in upper reaches, on slopes, and in lowlands. No single setting is clearly optimal; thus, location from this standpoint depends on project objectives and the relative importance of the advantages and disadvantages at the specific site under consideration. Some possibilities for locating constructed wetlands in the overall landscape include:

- Just off stream channels, for baseflow supply by diversion.
- In stream floodplains, separated from the low-flow channel by a natural levee, with periodic water supplied to the wetland when the levee is topped.
- Several small wetlands in upper reaches of the watershed.
- One large wetland in lower reaches.
- Several small wetlands in lower reaches.
- Terracing into the landscape in steep terrain.

Constructing several small wetlands in the upper watershed provides some advantages relative to locating one large wetland in the lower reaches, such as better survival of extreme events, closer proximity to pollutant sources, and local flood protection. In contrast, the single large lowland wetland can provide overall greater flood reduction capability, if that is an objective. An alternative is the multiple lowland wetland plan, under which each can take a portion of high flows with less vulnerability to any one.

Sizing Constructed Wetlands

Establishing Volume

Possible arrangements of a constructed wetland in relation to runoff quantity and quality control requirements are:

- Place a runoff quantity control device "on line" and a constructed wetland "off line" to treat all runoff up to a certain volume.
- Construct a wetland with a permanent pool ("dead storage") zone for treatment and a "live storage" zone and discharge control sized for peak runoff rate control.
- Construct a wetland only for treatment (for situations where quantity control is not required).

The first arrangement takes advantage of the fact that most of the pollutant mass loading over time is transported by runoff from the more frequent, smaller storms and the "first flush" from the less frequent, larger storms. This is the recommended arrangement where runoff quantity control is required because 1) the relatively shallow depths needed to maintain wetlands are somewhat inconsistent with the large storage volume needed for quantity control and 2) large surges of water can damage the wetland.

Basic sizing decisions involve the dead storage volume, surface area, depth contouring, and live storage volume, if runoff quantity control will be provided. There are three fundamental ways to calculate the treatment volume of a constructed wetland:

- Compute the volume needed to provide the required HRT for achieving a desired effluent concentration of the limiting pollutant (the hardest to remove), given a certain influent concentration, by using a mechanistic equation.
- Compute according to maximum allowable loading rates of water or specific pollutants established empirically from measurements on operating systems.
- Compute on the basis of a hydrologic criterion.

The first two approaches are employed in municipal and mining industry wastewater applications, where parameterized mechanistic equations or allowable loading rates exist for BOD and nitrogen in sewage and iron and manganese in mining effluents (6). Similar relationships do not exist for stormwater and will be difficult to develop, given the variability of flows and pollutant concentrations.

Therefore, stormwater wetland sizing must be determined using some form of the third approach. One version calls for choosing a volume sufficient to hold all runoff from a set percentage of the annual storms (e.g., 90 percent) or to hold a set depth of runoff generated by the contributing catchment (e.g., the first 2.5 cm = 1 in.). Schueler (4) presents several sizing rules of this type. Equivalent to this version is an approach for using a "water quality design storm" of a selected recurrence frequency and duration. The Washington State Department of Ecology (11) has taken this approach, selecting the 6-month, 24-hour rainfall event, which in Seattle is approximately equivalent to the first 3 cm of runoff, for stormwater treatment design in the Puget Sound basin.

A third version of the hydrologic basis is the method developed from wet pond performance data collected during the Nationwide Urban Runoff Program by the U.S. Environmental Protection Agency (EPA) (12). Using this method implicitly assumes that constructed wetlands will perform at least as well as wet ponds of equivalent treatment volume, which seems to be a safe assumption given the treatment advantages offered by a more structurally complex, vegetated system. The data exhibited an association between treatment efficiency and the ratio of permanent pool volume to runoff volume associated with the mean storm, termed the "volume ratio." The mean storm is the average rainfall quantity over all storms in a long-term record at a gaging station. TSS loading reduction is typically around 75 percent at a volume ratio of 2.5, which is a common design basis. Obtaining increasingly better performance levels requires exponentially increasing basin size because the contaminants hardest to capture are those still in suspension or solution.

With this means of sizing constructed wetlands, the task almost entirely involves hydrologic analysis. This is another point at which hydrologic expertise is important to the design effort. Unless actual data are available from gaging the catchment that will contribute to the constructed wetland, the hydrologic analysis must be performed using a model. Modeling options include, in order of preference, a well-calibrated continuous simulation computer model, such as EPA's SWMM and HSPF, an event-based model such as the Soil Conservation Service's curve number method, and, where adequate data exist, a locally derived empirical model of the rational method type.

Once the hydrologic analysis is complete, the permanent pool volume (VP) calculation can be made very simply by using the equation:

$$VP = C * VR * AC$$

where

C = unit conversion factor
VR = runoff volume from hydrologic analysis
AC = contributing catchment area

Schueler (4) recommended a minimum VP of 1.6 cm/ha of contributing catchment area, which will increase the wetland size over that calculated by the equation in small catchments.

This procedure is used for general runoff pollution control purposes. Knowledge is inadequate at present to perform detailed sizing calculations for such specific purposes as control of metals and nutrients. These special objectives can be advanced in part by installing appropriate design features (addressed later in this paper). It is known that the maximum potential to remove dissolved pollutants, which include certain nitrogen and phosphorus forms and some metals, is reached with a long HRT in the dead storage (2 to 3 weeks) (13, 14). The average residence time can be checked as follows: 1) perform the hydrologic analysis to determine the rate of flow to the wetland associated with the mean storm (Q), and 2) calculate HRT = VP/Q. If HRT is less than 2 to 3 weeks and dissolved pollutant removal is an objective, increase VP to obtain HRT in that range.

If the wetland has live storage for peak runoff rate control, the volume of that zone and the discharge orifice size will also have to be calculated. These calculations require hydrograph simulation and routing analysis and are beyond the scope of this paper. They should be performed by a qualified hydrologist.

Permanent Pool Surface Area and Depth Contouring

A larger surface area for the same volume provides better treatment by allowing more light penetration for photosynthetic activity by plants and algae, more aeration for aerobic chemical and biological processes, and a shorter settling distance for particles. A straightforward way of establishing the wetland surface area (AW) is to start by selecting a trial mean depth (D) from the following approximate ranges (after Schueler [4]):

Shallow marsh:	0.30 to 0.45 m
Pond/marsh:	0.60 to 0.85 m
Extended-detention wetland:	0.25 to 0.30 m (permanent pool) 1.0 m (extended-detention zone)
Pocket wetland:	0.15 to 0.40 m

Using the trial mean depth, calculate surface area by AW = VP/D. Determine the wetland to contributing catchment area ratio (AW/AC), and compare it with the guidelines in Table 3.

Once satisfactory basic dimensions are determined, allocate depths to the different wetland zones according to the design concept. Schueler (4) recommended the following zones to obtain diversity in structure and treatment capabilities:

- Deep areas (30 to 180 cm deep, no emergent vegetation)—forebay, micropools, deep water pools, and channels.
- Low marsh (15 to 30 cm below normal pool).
- High marsh (0 to 15 cm below normal pool).
- Irregularly inundated zone (above normal pool).

Schueler went on to supply approximate depth allocations for the various zones and design concepts, and the reader is referred to his guidelines for these details. For example, he recommended allocating 40 percent of the surface area to the high marsh and 40 percent to the low marsh in the shallow marsh design, with 5 percent each given to the forebay, micropools, deep water, and irregularly inundated zones.

Recommended Constructed Wetland Design Features

Adequate size is a necessary but not sufficient condition for good treatment performance. The theoretical HRT provided by the volume will not be achieved in practice if the layout permits water to traverse the wetland faster. Many of the features presented in this section are recommended to reduce the tendency of flow to short-circuit the wetland and fail to achieve an actual HRT as long as the theoretical HRT. Given that natural wetlands generally exhibit the recommended features, the selected reference system(s) should be employed as a model for designing these features. The recommendations are presented here in an abbreviated list format; consult the comprehensive sources referenced earlier for more detail.

Shaping the Wetland

Create a complex microtopography to lengthen the edge and flow path by using high marsh peninsulas and islands. Create at least two distinct cells by restricting the flow to a narrow passageway using the following features:

- Make the wetland relatively wide at the inlet to facilitate distribution of the flow well.
- Maximize the distance between the inlet and outlet.

The effective length to width ratio should be 5:1, preferably, and at least 3:1.

Slopes

The longitudinal slope (parallel to the flow path) should be less than 1 percent.

The wetland should be carefully constructed to have no lateral slope (perpendicular to the flow path) to avoid concentration of the flow in preferred channels, which reduces actual HRT and risks erosion.

Side slopes should be gradual (e.g., 5:1 to 12:1 horizontal to vertical), as in natural wetlands. Nowhere should the side slope be greater than 3:1.

Forebay

A forebay is a relatively deep zone placed where influent water discharges. It traps coarse sediments, reduces incoming velocity, and helps to distribute runoff evenly over the marsh.

Install a forebay in shallow marsh and extended-detention wetlands. In the case of a pond/marsh system, the pond serves this purpose. The restricted size of pocket wetlands generally does not allow for a forebay. Make the forebay 1.2 to 1.8 m deep. The forebay should be a separate cell set aside by high marsh features.

Provide maintenance access for heavy equipment (4.5 m wide and a maximum 5:1 slope) directly to the forebay. The forebay bed should be hardened to prevent disturbance during cleanout.

Flow Channeling

Create sheet flow to the maximum extent possible. Where flow must be channeled, use multiple, meandering channels rather than a single straight one. Intersperse open water areas with marsh, rather than connecting along the flow path. Minimize velocity in channels to prevent erosion and expand habitat opportunities.

Outlet Design

Place a micropool 1.2 to 1.8 m deep at the outlet. Install a reverse-sloped pipe 30 cm below the permanent pool elevation. This outlet design has been found to avoid clogging, to which constructed wetland outlets are prone (4).

Install a drain capable of dewatering the wetland in 24 hours to allow for maintenance. Control the drain with a lockable, adjustable gate valve. Place an upward-facing, inverted elbow on the end of the drain to extend above the bottom sediments.

Soils

Medium-fine textures, such as loams and silt loams, are optimal for establishing plants, capturing pollutants, retaining surface water, and permitting ground-water discharge. Circumneutral pH (approximately 6 to 8) is best for supporting microorganisms, insects, and other aquatic animals.

A relatively high content of highly decomposed organics ("muck") is favorable for plant and microorganism growth and the adsorption of metals and organic pollutants. Muck soils are preferred to peats (less decomposed organics), which tend to produce somewhat acidic conditions, to be low in plant nutrients, and to offer relatively poor anchoring support to plants.

Vegetation becomes established more quickly and effectively in constructed wetlands when soils contain seed banks or rhizomes of obligate and facultative wetland plants. Attempt to obtain any available soils that offer these resources.

Soil characteristics recommended for specific pollution control objectives are:

- High cation exchange capacity—for control of metals.
- High exchangeable aluminum and/or iron—for control of phosphorus.

Liner

An impermeable liner is required when infiltration is too rapid to sustain permanent soil saturation, when there is a substantial potential of ground water being contaminated by percolating stormwater, or both. Infiltration losses are insignificant at most sites with Soil Conservation Service Class B, C, and D soils. Also, sediment deposition is likely to seal the bottoms of constructed wetlands. Generally, therefore, a liner is likely to be needed only in Class A soils.

Emergency Spillway

An emergency spillway is required when the wetland will be used for runoff quantity control (and any other situation in which it would be possible for runoff to enter from a larger storm than the largest storm the facility is sized to handle).

Buffer

A buffer should be provided around the wetland both to separate the treatment area from the human community and, if development habitat is an objective, to reduce the exposure of animals to light, humans, and pets. The buffer requirement can be waived for pocket wetlands without wildlife habitat objectives and adjacent structures. The minimum buffer width should be 8 m, measured from the maximum water surface elevation, plus 5 m to the nearest structure. The buffer should be increased to at least 16 m when developing wildlife habitat is an objective. It should be sloped no more than 5:1 (horizontal to vertical).

Preserve existing forest in the buffer area if at all possible. At least 75 percent of the buffer should be forested to avoid attracting geese and to provide better protection and habitat for other wildlife.

Pretreatment

The constructed wetland is expected to serve as the primary treatment device. Nevertheless, some pretreatment can prevent problems in the wetland, produce a more self-sustaining system, and increase the potential for ancillary benefits. Pretreatment mechanisms that should be considered include:

- Catch basins, for trapping the largest solids.
- A presettling basin or biofilter, when the watershed produces relatively high solids loadings.
- Oil-water separators.

Designing for Ancillary Benefits and Avoidance of Problems

Ancillary Benefits

Potential ancillary benefits of constructed wetlands include:

- Wildlife habitat.
- Aquaculture for harvest.
- Primary production for food-chain support.

- Biological diversity.
- Open space for recreational, educational, and other human uses.

This paper focuses on creating wildlife habitat, which also helps achieve the latter three benefits. The preceding recommendations on configuring the wetland were also designed in part to contribute to these benefits.

An issue, of course, is the attraction of wildlife to a wastewater treatment area that might be contaminated. It is thought, but not proven, that levels of contamination hazardous to wildlife are a relatively rare problem restricted to watersheds with very high vehicle traffic, proportions of impervious surface, and/or population densities. It is also thought that such problems can be addressed at least partially by reversing the recommendations to attract wildlife; that is, install features that discourage wildlife colonization. In either case, a qualified wildlife biologist is needed to design the features. For now, the best course seems to be using and studying constructed wetlands for many applications, but avoiding their use in areas with a high potential for toxic contamination.

The main factor in designing for wildlife habitat is complex structure that provides a variety of possible niches to support feeding, nesting, breeding, and refuge requirements of desired species. Fortunately, many features that promote pollution control also enhance wildlife habitat. Figure 3 illustrates several suggested features for habitat development, and the comprehensive references provide other illustrations.

Following is a summary of features that enhance wildlife habitat drawn from Figure 3 and the references:

- Irregular shorelines.
- A wide range of depth zones—deep zones provide habitat for invertebrates, amphibians, and possibly fish; higher marsh areas offer feeding grounds to birds; and various nesting opportunities are provided in the different zones.
- Perimeter forest buffer at least 16 m wide.
- Connect wetland to corridors (e.g., streams and passages to forests and other wetlands) that allow wildlife movement.
- Increase wetland size if very small—research has shown that wildlife use is not strongly correlated to the size of natural wetlands of 0.5 to several hectares in area (15), but is low in very small natural and constructed wetlands (less than 0.1 hectares).
- Select plants that offer refuge, nesting, feeding, and breeding habitat.
- Install other features providing for nesting and refuge, such as:
  - Islands (protection for ground-nesters) (minimum 3 m^2 for a waterfowl pair, above maximum water surface elevation, densely vegetated, positively drained).

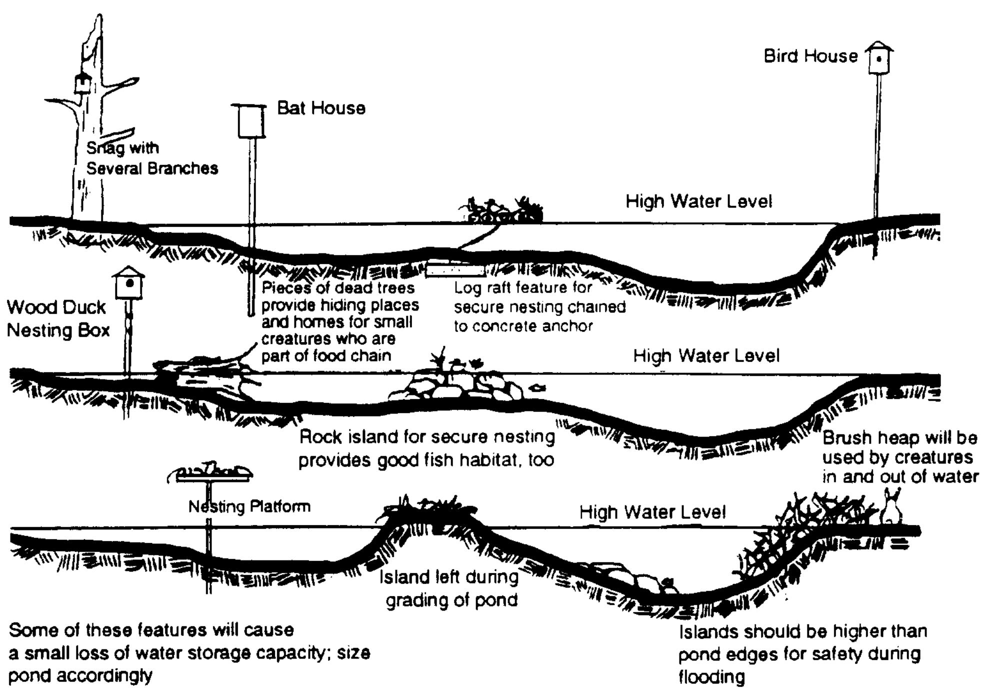

Figure 3. Suggested constructed wetland habitat features (11).

- Snags (dead tree trunks installed for cavity-nesters).
- Nest boxes and platforms (unique designs for cavity-nesters).
- Buffer trees (for foliage-nesters).
- Logs, stumps, and brush (for bird perches and small-mammal refuge).

• Avoiding significant water level fluctuations—this is an inherent disadvantage of stormwater wetlands relative to wildlife. The best remedy is to precede the wetland with runoff quantity control. Otherwise, the configuring recommendations stated earlier provide the best situation obtainable in stormwater applications.

Avoidance of Problems

Potential problems associated with constructed wetlands include:

- Mosquito breeding.
- Aesthetic drawbacks.
- Safety concerns.
- Attraction of geese and ducks, which can constitute a nuisance.
- Development of a monoculture of undesirable vegetation.
- Accumulation of toxicants.

The extent of actual occurrence of these problems and managing to avoid or minimize them is addressed briefly in this paper.

Mosquitoes are actually rarely a problem in well-designed and operated constructed wetlands; thus, education of the concerned public is part of the solution. A problem with mosquitoes can best be prevented by providing diverse habitats that support predatory insects. Mosquito fish *(Gambusia)* have been used successfully to control mosquitoes in permanent ponds, but the introduction of the fish in areas to which they are not native must be carefully assessed.

Aesthetic problems can be avoided with careful attention to construction and vegetation establishment. The buffer and tall emergent vegetation can be used to conceal such wetland characteristics as water level fluctuation and films on the water.

Constructed wetlands are inherently safer than deeper ponds, but some degree of potential hazard to children is associated with deep zones. Hazards can be avoided by establishing gradual side slopes and a shallow marsh safety bench (5 m wide) where the toe of the side slope meets any deep pool, by concealing outlet piping, and by providing lockable access. In general, fencing should only be needed on the embankment above large outfalls, where they exist.

Nuisance waterfowl can be discouraged in several ways. Maintain the buffer largely with forestland (at least 75 percent), and avoid the growth of turf grass around the wetland. Also, maintain a variety of depths, especially high marsh not favored by geese and mallards. Another important measure is to educate citizens and place signs to discourage feeding.

The tendency for wetlands to develop undesirable plant monocultures can be limited by maintaining structural diversity and a range of depths, especially shallower areas. A diverse selection of native flora should be planted shortly after the wetland is constructed.

Regarding toxicant accumulations, evidence suggests that metals and organics are tightly bound in sediments and do not tend to become mobilized over long periods. When maintenance is performed, disposal of spoils becomes an issue. Current knowledge indicates that spoils pass hazardous waste tests and can be safely land applied or landfilled (4). Plan an onsite application area if possible to save costs of disposal.

Vegetation Selection and Establishment

As experience with wetland creation, restoration, and construction projects accumulates, it is becoming increasingly clear that the plant community develops best when the soils harbor substantial vegetative roots, rhizomes, and seed banks. Its development is also enhanced by the opportunity for volunteer species to enter from nearby donor sites; however, volunteers cannot be relied on for vegetation establishment. Transplants may be supplanted by more vigorous resident and volunteer stock under these circumstances and may actually constitute a minor component of the eventual community. Nevertheless, transplanting is generally a wise strategy, and most of the specific guidance available for establishing wetlands concerns this source; thus, it is fully covered below.

Hydric soils containing vegetative plant material collected for establishing new wetlands are becoming known as "wetland mulch." It appears that ample use of this mulch enhances diversity and the speed of vegetation establishment, but the mulch content is somewhat unpredictable and donor sites are limited. Also, guidelines for extracting, handling, and storing the material are limited. A danger with the use of mulch is the possible presence of exotic, opportunistic species that will out-compete more desirable natives. Therefore, at least the donor sites that obviously support such plant species should be avoided in obtaining material. Preferred donor material includes wetland soils removed during maintenance of highway ditches, swales, sedimentation ponds, retention/detention ponds, and clogged infiltration basins and during dredging, or from natural wetlands that are going to be filled under permit (although these soils are best used for mitigating the loss). It is recommended that the upper 15 cm of donor soils be obtained at the end of the growing season, if possible. The best way to hold soils until installation is somewhat uncertain but must include keeping soils moist in conditions that will maintain vital dormancy. Efforts are under way to establish repositories for mulch reclaimed in maintenance operations.

The reliability of transplanting and the instant partial cover it provides make it necessary regardless of the potentials offered by wetland mulch and volunteer species recruitment. Commercial wetland plant nurseries now operate in many places in the nation to provide material. The following list of general vegetation selection principles was compiled from Garbisch's (16) recommendations for creating wetlands and from the comprehensive constructed wetland works:

- Base selections more on the prospects for successful establishment than on specific pollutant uptake capabilities (plant uptake is a highly important mechanism only for nutrients, much of which are released upon the plant's death; nutrient removal is more the result of chemical and microbial processes than of plant uptake).
- Select native species, and generally avoid natives that invade vigorously.
- Use a minimum of species adaptable to the various elevation zones; diversification will occur naturally.
- Select mostly perennial species, and give priority to those that establish rapidly.
- Select species that are adaptable to the broadest ranges of depth, frequency, and duration of inundation (hydroperiod).
- Match the environmental requirements of plant selections to the conditions to be offered by the site. Consider especially hydroperiod and light requirements.
- Give priority to species that have been used successfully in constructed wetlands in the past and to commercially available species.
- Avoid specifying only species that are foraged by wildlife expected to utilize the site.
- Phase the establishment of woody species to follow herbaceous ones.
- Consider planting needs to achieve designated objectives other than pollution control.

Although excessive emphasis on vegetation selection based on pollution control capabilities should be avoided, considerable information on that subject has been compiled. Kulzer (17) prepared a summary of the demonstrated capabilities of plants for the various common classes of pollutants. The most versatile genera that have species representatives in most parts of the nation are *Carex, Scirpus, Juncus, Lemna,* and *Typha.*

Schueler (4) and Garbisch (16) have assembled a considerable amount of specific guidance on the construction and vegetation establishment process for constructed wetlands and created wetlands, respectively. The course manual by Horner (5) also incorporates this guidance. Given the available literature, these topics are not addressed in this paper.

Operating Constructed Wetlands

Relative to retention/detention ponds, constructed wetlands pose a relatively significant routine operating burden. Operated properly, however, they should not require periodic expensive sediment cleanouts. From the outset, the project should include a formal operation and maintenance plan that covers the following elements: 1) inspection, 2) sediment management, 3) water management, and 4) vegetation management.

There are two levels of inspection: routine and comprehensive. Rapid, routine inspections should be made by a qualified observer to identify and take action on any problems that would damage the wetland's function. Recommended scheduling for these inspections is monthly and after each storm totaling more than 1.25 cm (0.5 in.) of precipitation. Comprehensive inspections should take place twice yearly the first 3 years, once in the growing season and again in the nongrowing season. Conditions that should be noted during these inspections include:

- Dominant plants and their distributions in each zone.
- Relative presence of intentionally planted and volunteer invasive and noninvasive species.
- Plant condition—look for signs of disease (yellowing, browning, wilting), pest infestations, and stunted growth.
- Depth zones and microtopographic features compared with the original plan.
- Normal pool elevation compared with the original plan.
- Sediment accumulations (locations and approximate quantities).
- Outlet clogging.
- Buffer condition.

The objective of sediment management is to trap—and when necessary remove—sediments before they reach the shallow zones. Forebays will probably have to be drained and dredged every 2 to 5 years. The pond in a pond/marsh system is, in part, a large forebay and should not need dredging as frequently.

If water levels do no conform to plans, or there is another reason to change them, regulation can be accomplished by installing a flash board at the desired height at the outlet weir or by adjusting the gate valves (if provided). Remove clogging debris from around the outlet as necessary.

In vegetation management, provide extra care during the first 3 years to plantings, especially trees, including watering, supporting, mulching, and removing weeds. Reinforcement plantings will probably be required after 1 or 2 years and should be added as necessary. Manually remove undesirable species with a high potential to invade and dominate, if they will subvert achievement of the designated objectives. Cut or dig out woody, unwanted species in marsh zones before they cause damage and become too difficult to remove.

Harvesting the wetland for nutrient control can be performed but has many drawbacks, including cost, disposal, and damage to the system. It is generally only possible to cut aboveground biomass, which will not adequately control the release of nutrients.

References

1. Hammer, D.A., ed. 1989. Constructed wetlands for wastewater treatment. Chelsea, MI: Lewis Publishers.
2. Strecker, E.W., J.M. Kersnar, E.D. Driscoll, and R.R. Horner. 1992. The use of wetlands for controlling stormwater pollution. Chicago, IL: U.S. EPA.
3. Olson, R.K., ed. 1992. Created and natural wetlands for controlling nonpoint source water pollution. Boca Raton, FL: Lewis Publishers.
4. Schueler, T.R. 1992. Design of stormwater wetland systems. Washington, DC: Metropolitan Washington Council of Governments.
5. Horner, R.R. 1992. Constructed wetlands for storm runoff water quality control. Seattle, WA: University of Washington, Engineering Continuing Education.
6. Water Pollution Control Federation. 1990. Natural systems for wastewater treatment. Alexandria, VA: Water Pollution Control Federation.
7. Richardson, C.J. 1985. Mechanisms controlling phosphorus retention capacity in freshwater wetlands. Science 228:1,424-1,427.
8. Brodie, G.A. 1989. Selection and evaluation of sites for constructed wastewater treatment wetlands. In: Hammer, D.A., ed. Constructed wetlands for wastewater treatment. Chelsea, MI: Lewis Publishers. pp. 307-318.
9. Azous, A. 1991. An analysis of urbanization effects on wetland biological communities. M.S. thesis. Seattle, WA: University of Washington, Department of Civil Engineering.
10. Mitsch, W.J. 1992. Landscape design and the role of created, restored, and natural riparian wetlands in controlling nonpoint source pollution. In: Olson, R.K., ed. Created and natural wetlands for controlling nonpoint source water pollution. Boca Raton, FL: Lewis Publishers. pp. 27-48.
11. Washington State Department of Ecology. 1992. Stormwater management manual for the Puget Sound basin. Olympia, WA: Washington Department of Ecology.
12. U.S. EPA. 1986. Methodology for analysis of detention basins for control of urban runoff quality. EPA/440/5-87/001. Washington, DC.
13. Walker, W.W. 1987. Phosphorus removal by urban runoff detention basins. Lake and Reservoir Management 3:314-326.
14. Hartigan, J.P. 1989. Basis of design of wet detention BMPs. In: Roesner, L.A., B. Urbonas, and M.B. Sonnen, eds. Design of urban runoff quality controls. New York, NY: American Society of Civil Engineers. pp. 122-144.
15. Martin-Yanny, E. 1992. The impacts of urbanization on wetland bird communities. M.S. thesis. Seattle, WA: University of Washington, College of Forest Resources.
16. Garbisch, E.W. 1986. Highways and wetlands: Compensating wetland losses. FHWA-IP-86-22. McLean, VA: Federal Highway Administration.
17. Kulzer, L. 1990. Water pollution control aspects of aquatic plants: Implications for stormwater quality management. Seattle, WA: Municipality of Metropolitan Seattle.

Stormwater Pond and Wetland Options for Stormwater Quality Control

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Abstract

In this paper, 10 designs for stormwater wetland and pond systems used for effective urban runoff quality control are surveyed. Each design is based on a different allocation of deep-pool, marsh, and extended detention storage. The comparative pollutant removal capability of the 10 designs are reviewed based on a national survey of 58 performance monitoring studies. In addition, the reported longevity, maintenance requirements, and environmental constraints of each design is assessed.

A team approach for selecting the most appropriate design at the individual development site is strongly recommended. Key selection factors, such as space, drainage area, and permitability, are discussed. A seven-stage design/construction process is outlined to ensure the team selects and builds the most appropriate and effective design.

The paper points out that the uncertain regulatory status of pond/wetland systems should be resolved so that this effective runoff control technology can be appropriately used.

Introduction

The use of stormwater ponds to control the quality of urban stormwater runoff has become more widespread in recent years. At the same time, designs have become more sophisticated to meet many environmental objectives at the development site. Today, the term stormwater pond can refer to any design alternatives in a continuum that allocates different portions of runoff treatment volume to deep pools, shallow wetland areas, and temporary extended detention storage. This paper provides a broad review of the comparative capabilities of pond and wetland systems.

In an operational sense, these systems can be classified into one of ten categories:

1. Conventional dry ponds (quantity control only)
2. Dry extended detention (ED) ponds
3. Micropool dry ED ponds
4. Wet ponds
5. Wet ED ponds
6. Shallow marsh systems
7. ED wetlands
8. Pocket wetlands
9. Pocket ponds
10. Pond/marsh systems

Table 1. Comparative Storage Allocations for the 10 Stormwater Pond/Wetland Options (% of Total Treatment Volume)

Pond/Wetland Alternative	Deep Pool	Marsh	ED
1. Conventional dry ponds (quantity control only)	0	0	0
2. Dry ED ponds	0	10 (ls)	90
3. Micropool dry ED ponds	30 (f, m)	0	70
4. Wet ponds	80	20 (b)	0
5. Wet ED ponds	50	10 (b)	40
6. Shallow marsh systems	40 (f, m, c)	60	0
7. ED wetlands	20 (f, m)	30	50
8. Pocket wetlands	20 (f)	80	0
9. Pocket ponds	80	20 (b)	0
10. Pond/marsh systems	70	30 (b, m)	0

Note: The storage allocations shown are approximate targets only.
ls = lower stage of ED pond often assumes marsh characteristics
f = forebay
m = micropool
c = channels
b = aquatic bench

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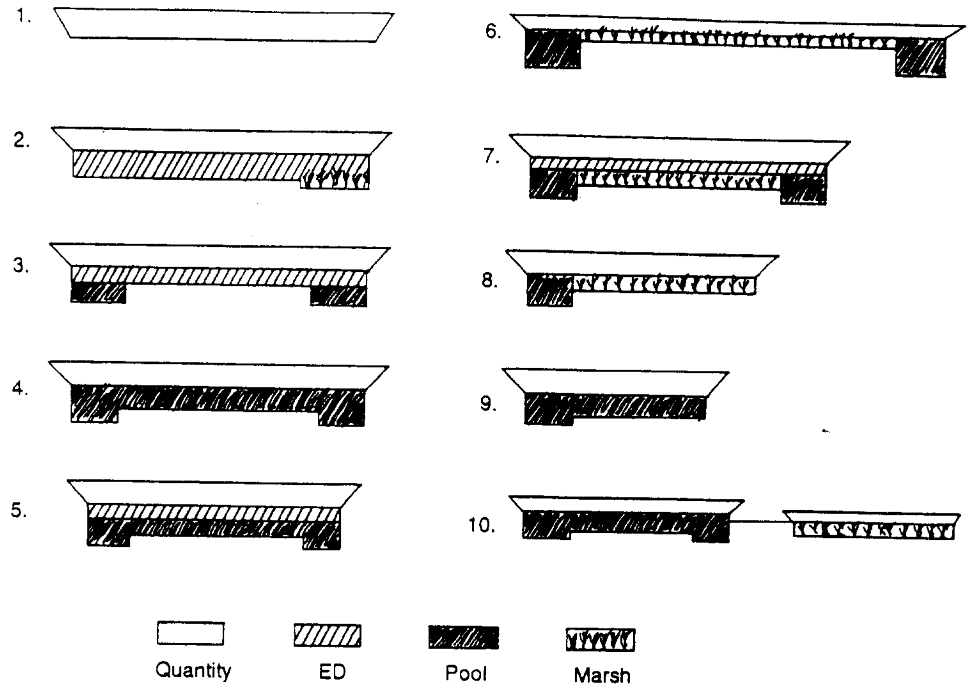

Figure 1. Stormwater pond options.

Each of these designs (shown in cross-sectional view in Figure 1) can be distinguished by how it allocates the total treatment volume to deep pools, shallow wetlands, and temporary extended detention storage. As can be seen, most designs incorporate two and sometimes three runoff treatment pathways. Comparative storage allocations are shown in quantitative terms in Table 1. It is important to note that these allocation targets are approximate and relative, and individual systems may not always conform to the target.

Stormwater pond systems can also be configured in many different ways, as shown in Figure 2. Ponds can be located "on-line" or "off-line" and can be arranged in multiple cells. On-line ponds are located directly on streams or drainage channels. Off-line ponds are constructed away from the stream corridor. Runoff flow is split from the stream and diverted into off-line ponds by a flow splitter or smart box.

The total treatment volume need not be provided within only one cell. Stormwater ponds can contain multiple storage cells, and these often enhance the performance, longevity, and redundancy of the entire system.

All pond designs provide additional storage to control the increased quantity of stormwater produced as a consequence of urban development. This "quantity control" storage is usually defined as the storage needed to keep postdevelopment peak discharge rates equivalent to predevelopment levels for the 2-year storm. The quantity control storage is in addition to, and literally on top of, the quality control runoff storage.

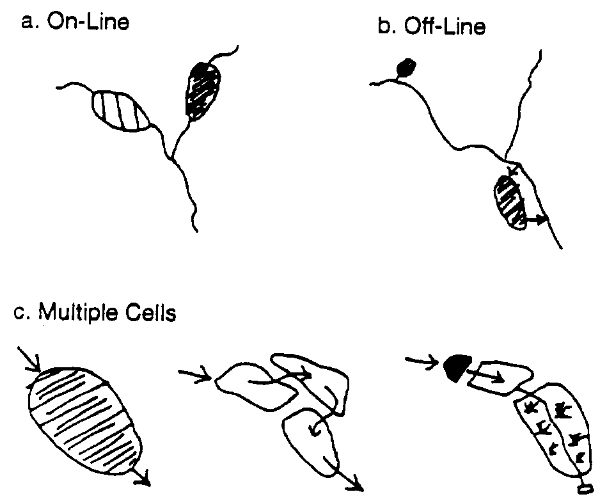

Figure 2. Stormwater pond configurations.

Comparative Pollutant Removal of Stormwater Pond Designs

Each of the three basic treatment volume allocations (pool, marsh, and ED) use different pollutant removal pathways. Therefore, it is not surprising to find considerable variability in the projected removal rates for each of the 10 stormwater pond designs (Table 2). The table is based

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Table 2. Comparative Pollutant Removal Capability of Stormwater Pond/Wetland Alternatives

	Pollutant Removal Rate			
Pond/Wetland Alternative	**TSS**	**TP**	**TN**	**Reliability**
1. Conventional dry ponds	10	0	0	Moderate
2. Dry ED ponds	30	10	10	Low
3. Micropool dry ED ponds	70	30	15	Moderate (projected)
4. Wet ponds	70	60	40	High
5. Wet ED ponds	75	65	40	High
6. Shallow marsh systems	75	45	25	High
7. ED wetlands	70	40	20	Moderate
8. Pocket wetlands	60	25	15	Moderate (projected)
9. Pocket ponds	60	30	20	Moderate (projected)
10. Pond/marsh systems	80	70	45	High

TSS = total suspended solids
TP = total phosphorus
TN = total nitrogen

on a review of 58 pond and wetland performance studies conducted across the United States and Canada (1).

While seven of the ten pond designs have been monitored in the field, the performance of three designs (pocket ponds, pocket wetlands, and micropool dry ED ponds) can only be projected based on design inferences and field experience.

Two of the pond designs possess limited capability to remove pollutants—the conventional dry pond and the dry ED pond. These pond systems seldom have been observed to reliably remove sediment and have shown virtually no capability to remove nutrients. The performance of dry ED ponds is expected to improve if micropools are added at the inlet and the outlet. Micropools help to pretreat incoming runoff, prevent resuspension, and reduce clogging.

When properly sized and designed, wet ponds can reliably remove sediments and nutrients at relatively high rates. The deep pool of the wet pond allows for gravitational settling. Removal rates for wet ponds can be incrementally improved if the deep pool is combined with extended detention, as in the wet ED pond system.

The removal capability of wetland systems (designs 6, 7, and 8) is generally comparable to that of wet ponds of similar size. Sediment removal often is slightly higher in wetland systems, but nutrient removal appears to be somewhat lower and less reliable. Shallow marsh systems exhibit slightly higher removal rates than either the ED wetland or the pocket wetland systems, which may be explained by the greater surface area and complexity of shallow marsh systems (2).

Ponds and wetlands that do not have a reliable source of base flow, and that have a water level that frequently fluctuates, are termed pocket ponds and wetlands. These systems typically serve very small drainage areas and are excavated to the local water table. Consequently, pocket facilities are often less than a quarter acre in size and possess few of the design features of their larger counterparts. Therefore, pocket wetlands are thought to have lower pollutant removal capability, especially for nutrients.

Pond-marsh systems appear to possess the greatest overall pollutant removal capability of all the designs monitored. The permanent pool and the shallow wetland provide complementary and redundant removal pathways, and reduce remobilization of pollutants.

It should be noted that while differences in removal capability do exist among the 10 designs, other key design factors also must be present if these rates are to be achieved. First, the system must be capable of capturing at least 90 percent of the annual runoff volume delivered. Second, incoming runoff must be pretreated in a forebay or deep pool. Third, the system must meet minimum criteria for internal geometry (flow path, microtopography, surface-area-to-volume ratio). Clearly, a poorly conceived or designed pond system will not achieve the rates shown in Table 2.

Comparative Ability To Protect Downstream Channels

Pond systems that combine ED storage with stormwater quantity storage appear to provide the best measure of protection for downstream channels exposed to the erosive potential of bankfull and subbankfull floods. Recent field research has demonstrated that control of the 2-year storm quantity exacerbates, rather than reduces, downstream channel erosion problems. Modeling studies suggest that extended detention (e.g., 6 to 24 hours) of relatively small treatment volumes may have some potential to alleviate downstream channel erosion problems. Additional field research is needed to confirm the value of ED in protecting channels.

Comparative Physical, Environmental, and Maintenance Constraints

Each of the 10 pond systems are subject to many different constraints that may limit their use at a particular site. Some of the more common constraints are outlined in Table 3.

Physical constraints include available space, climate, dry weather base flow, and contributing drainage area. Maintenance constraints may involve susceptibility to clogging and the frequency and difficulty of sediment cleanout.

Table 3. Comparative Capability of 10 Pond/Wetland Alternatives—Physical, Environmental, and Maintenance Constraints

Pond/Wetland Alternative	Minimum Drainage Area[a]	Space Index[b]	Water Balance	Clogging Risk	Sediment Cleanout	Waters of U.S. (404)	Stream Warming	Safety Risk
1. Conventional dry ponds	5	0.5	No restrictions	Moderate	Basin (10-20 yr)	?	Low	Low
2. Dry ED ponds	10	1.0	No restrictions	High	Basin (10-20 yr)	Yes	Moderate	Low
3. Micropool dry ED ponds	15	1.0	May require base flow	Low	Forebay (2-5 yr)	Yes	Moderate	Low
4. Wet ponds	25+	1.0	Climate	Low	Forebay (2-5 yr)	Yes	High	High
5. Wet ED ponds	25+	1.0	Climate	Low	Forebay (2-5 yr)	Yes	High	High
6. Shallow marsh systems	25+	2.5	Climate, base flow	Low	Forebay (2-5 yr)	Yes	High	Moderate
7. ED wetlands	10+	1.5	Climate, base flow	Low	Forebay (2-5 yr)	?	High	Moderate
8. Pocket wetlands	1-5	2.0	Climate, ground water	Moderate	Basin (5-10 yr)	No	Moderate	Moderate
9. Pocket ponds	1-5	1.0	Climate, ground water	Moderate	Basin (5-10 yr)	No	Moderate	Moderate
10. Pond/marsh systems	25+	1.5	Climate, base flow	Low	Pool (10-15 yr)	Yes	High	High

[a]Maximum of 400 acres in most cases.
[b]Space consumption index (1 = space required for wet pond).

Perhaps the most restrictive constraints, however, are of an environmental nature. Recent research has indicated that on-line pond and wetland systems can have serious impacts on the local and downstream environment, if they are not properly located and designed (2). The most serious include the modification or destruction of high-quality forests and wetlands as a consequence of construction, and downstream warming. Consequently, the siting of ponds and wetlands in the mid-Atlantic region has become a major focus of federal and state regulatory agencies. Presently, both a Section 404 (wetlands) and a Section 401 water quality certification permit must be obtained for the construction of any on-line stormwater pond or wetland.

A Team Approach for Selecting the Most Appropriate System

Selecting and designing a pond system has become a complex and lengthy process. An effective approach is to assemble a design team consisting of a stormwater engineer, landscape architect, environmental consultant, and the construction contractor. The combined expertise of the design team, along with early and frequent coordination with local plan reviewers, is an essential ingredient for implementing the most appropriate system for the development site and the downstream community.

The design team works together throughout the planning, design, approval, and construction process, which can take as long as 2 years. Building an effective and appropriate pond system consists of seven general steps, as outlined below:

1. Evaluation of the Feasibility of the Site

The design team has two major tasks. The first task is to define, in consultation with local planning and resource protection agencies, the primary watershed protection objectives for the particular site and stream. The objectives may include specific targets for pollutant reduction, flood control, channel protection, wetland creation, habitat protection, protection of indicator species (e.g., trout), or preservation of stream corridors. Careful identification of realistic and achievable objectives early in the process is critical for allowing the design team to incorporate them into the design and construction process.

The second task is to analyze the physical and environmental features of the development site to determine if a pond system is feasible, appropriate, and can meet the primary watershed protection objectives. This typically involves a thorough delineation of the wetlands, forests, and catchments within the development, as well as the collection of geotechnical data to define soil properties and water balances. The design team also

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should assess both the site and downstream aquatic conditions during a site visit.

2. Development of the Initial Concept Plan

The task for the design team in this stage is threefold: 1) select the most appropriate pond design option, 2) identify the most environmentally suitable location for it, and 3) compute the size and geometry of the facility. The design team assembles a concept plan and then submits it to the local stormwater review agency and other regulatory agencies for preliminary review and approval. Early input from the permitting agencies is essential, and a joint field visit is often a useful means of securing it.

3. Development of the Final Design

In final design stage, the team adds engineering details to the concept plan and responds to the comments made by the local permitting authorities. The team works together to ensure that all standard pond design features are incorporated into the final design plans (e.g., benches, forebays, buffers, gate valves). (See Schueler [2] for a full list.) In addition, the plan should be thoroughly analyzed to reduce safety risks, allow for easy maintenance access, provide safe and environmentally sensitive conveyance to the pond, and reduce the future maintenance burden. The final plan is then submitted for review and approval by the appropriate local and state regulatory agencies.

4. Preparation of a Pondscaping Plan

This stage of the design process is critical but frequently overlooked. The design team jointly prepares an aquatic and terrestrial landscaping plan for the pond or wetland, known as a pondscape. It specifies the trees, shrubs, ground cover, and wetland plants that will be established to meet specific functional objectives within different moisture zones in and around the pond.

The pondscaping plan is more than a landscaping materials list, it also specifies necessary soil amendments, planting techniques, maintenance schedules, reinforcement plantings, and wildlife habitat elements needed to establish a dense and diverse pondscape over several growing seasons. Although landscape architects take the lead in the development of the pondscape, other members of the team can provide important contributions. For example, the engineer projects soil moisture zones, the contractor provides practical guidance on tree protection during construction and temporary stabilization, and the environmental consultant provides input on native wetland plants and propagation techniques.

5. Construction of the Pond

Appropriate designs only work when they are constructed properly. Therefore, it is essential to conduct a field meeting with the entire construction crew prior to construction. The design team outlines the purpose of the project, the sequence of construction activities, and walks through the no-disturbance limits. Short but regular meetings to inspect progress are helpful during the construction process, especially to modify decisions in the field. After construction is complete and the pond site is stabilized, the engineer performs an as-built survey for submission to local government authorities that verifies that the pond was constructed in accordance with the approved plans.

6. Establishment of the Pondscape

Establishing a functional pondscape requires frequent adjustment of the original pondscaping plan. Initially, the design team modifies the plan to account for actual moisture conditions and water elevations that exist after construction. The design team then reexamines the pondscape after the first growing season to determine if reinforcement plantings are needed.

7. Inspection and Operation of the Pond

The final stage of the process involves the final inspection of the facility, development of the maintenance practices and schedules, and the transfer of maintenance responsibilities to the responsible party.

Resolving the Regulatory Status of Stormwater Ponds

Although pond and wetland systems are attractive options for urban nonpoint source control, their regulatory status has recently become very confused. This is due to the fact the these systems fall under the scope of three often conflicting sections of the Clean Water Act—Section 401 (water quality certification permits), Section 402 (stormwater National Pollutant Discharge Elimination System [NPDES] permits), and Section 404 (wetland permits). Confusion about these systems also stems from a number of particular factors:

First, pond systems often acquire wetland characteristics over time, whether by design or simply with age. At some point, they may become delineated wetlands, subject to the same protection and restrictions as natural wetlands. If a stormwater pond system does evolve into wetland status, then Section 404 wetland permits may be required and all future maintenance activities conducted on the stormwater pond system would likely require a permit. Conversely, it also is possible that a well-designed stormwater wetland would be eligible for a partial mitigation "credit" when it "evolves" into wetland status.

Second, most pond systems are located on waters of the United States (i.e., intermittent or perennial streams or drainage channels) and are thus subject to the Section 404 permit process, even when the system is not located within a delineated wetland. Some regulators have advocated that the prohibition against "instream treatment" should apply to stormwater pond systems, while others have required that an extensive alternatives analysis be undertaken before a permit is issued. In the former interpretation, the use of stormwater pond systems would be limited to off-line or pocket applications. Under the latter interpretation, the design team might have to demonstrate that all upland best management practice (BMP) alternatives are exhausted before a pond system can be constructed. While upland BMPs are an alternative, they do not possess the performance or longevity of pond and wetland systems and may not be adequate to protect streams or meet pollutant reduction targets.

Third, construction of stormwater ponds and wetlands within or adjacent to delineated natural wetlands can radically alter the characteristics of that wetland, either through excavation, fill, pooling, or inundation. In most cases, construction of stormwater ponds in natural wetland areas is strongly discouraged. In other cases, however, it may actually be desirable to convert degraded natural wetlands into stormwater wetlands. The conditions, if any, where these conversions might take place are the subject of considerable controversy. The influence of stormwater ponds on wetlands need not always be negative, however. In many cases, stormwater ponds can help protect downstream wetlands from degradation caused by uncontrolled stormwater flows and construction-stage sediment deposition.

Fourth, stormwater ponds have a dual nature: They can help to meet water quality standards in receiving waters, while at the same time contributing to possible violations of other standards. For example, ponds can help meet sediment, turbidity, nutrient, and toxics limits. At the same time, they may amplify the stream warming associated with urban development and thus lead to violations of temperature standards in some sensitive streams. This creates a great dilemma for regulators that must perform water quality certification on stormwater ponds.

The resolution of the uncertain and confusing regulatory issues relating to stormwater ponds is critical if application of this effective technology is to continue on a widespread basis. The challenge for designers will be to acknowledge and avoid the potential for negative environmental impact, whereas the challenge for the regulatory community will be to recognize the benefits of stormwater ponds and craft a regulatory policy that is practical rather than merely legal. Otherwise, the fifth member of the pond design team may have to be a lawyer. Hopefully, a workable policy can be developed in the near future that sets guidelines on the appropriate use of this effective nonpoint source control technology.

References

1. Schueler, T. 1993. Performance of stormwater pond and wetland systems. Submitted to ASCE International Symposium on Engineering Hydrology, San Francisco, CA (July).
2. Schueler, T. 1992. Design of stormwater wetland systems. Washington, DC: Metropolitan Washington Council of Governments.

Additional Reading

1. Galli, J. 1992. Analysis of urban BMP performance and longevity in Prince Georges County, Maryland. Prepared for Prince Georges Watershed Protection Branch. Washington, DC: Metropolitan Washington Council of Governments.
2. Schueler, T., and J. Galli. 1992. The environmental impacts of stormwater ponds. In: Kumble, P., and T. Schueler, eds. Watershed restoration sourcebook. Washington, DC: Metropolitan Washington Council of Governments. pp. 161-180.
3. Schueler, T., M. Heraty, and P. Kumble. 1992. A current assessment of urban best management: Techniques for reducing nonpoint source pollution in the coastal zone. Prepared for U.S. EPA by Metropolitan Washington Council of Governments.

Practical Aspects of Stormwater Pond Design in Sensitive Areas

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Abstract

This paper's purpose is to provoke thought in establishing some considerations and techniques for the design of stormwater management ponds in sensitive areas, not to describe a step-by-step process for designing stormwater management ponds. The reader should have a basic understanding of the principles of small pond design, urban hydrology, water quality control, and best management practices.

First, practical design requires an inventory of the sensitive resources that need protection and an estimate of the project goals and potential environmental benefits. The next step is to develop a concept plan, which initiates the design process and ensures agency and public involvement in early stages of the project. Several techniques can be used to avoid or minimize negative impacts on sensitive areas, which this paper groups into techniques for either warm water or cool water environments. In addition, the paper covers three new theoretical techniques that combine warm water design practices with cool water mitigation approaches. Maintenance and monitoring issues are also discussed. Coupling a common sense approach with the need for innovative thinking should be a primary goal, and designers must factor into this challenge the goal of reaching a consensus with different interest groups.

Goals and Expectations

Stormwater management ponds are often installed or constructed to fulfill regulations for the control of urban runoff. Controlling urban runoff usually means providing some kind of detention facility that controls the increased runoff frequency and volume in developing areas.

Good, practical stormwater management requires an assessment of what the pond needs to protect and an estimate of how well pond is likely to work. This involves conducting an inventory of existing natural and constructed features, which then becomes a basis for design considerations. For example, stormwater ponds often need to be located in the lower portion of a site to maximize the area and runoff draining toward them. This can create a conflict with existing, sensitive natural features, such as wetlands, seeps, springs, or even intermittent or perennial streams.

A natural resources inventory, which is essential for design, should at a minimum incorporate the following features:

- Topography
- Wetlands (including springs and seeps)
- Soils
- Floodplains
- Forest lands (vegetation)
- Watercourses
- Specimen trees
- Steep slopes, rock outcroppings, etc.
- Historical or archeological features
- Habitat

After a reasonably detailed natural resources inventory has been conducted, design should continue with an analysis of the receiving stream or ground-water aquifers. This may be very detailed and use various habitat analyses or biological indicators, or it can be a general overview. To pursue a sensitive design approach, however, establishing the type of aquatic resource fisheries (cold water versus warm water) is important.

After establishing the natural resources inventory and assessing what level of aquatic resource protection is warranted, a concept plan should be developed.

Concept Plan Development

One of the most important elements in implementing a successful stormwater management plan is the development of a good concept plan. A concept plan allows various agencies and interest groups the opportunity to offer input at a time when change is reasonably inexpensive. Later in a program, change becomes much more difficult. Many resource protection agencies and special interest groups have conflicting goals, which should be resolved as much as possible in the early stages of the concept plan process so that meaningful projects ultimately become a reality.

One of the key elements of working in an environmentally sensitive area is compromise, but ingenuity is equally important. To advance technology and find different and possibly more successful methods of stormwater management pond design, new techniques should be proposed and implemented, even if unproven.

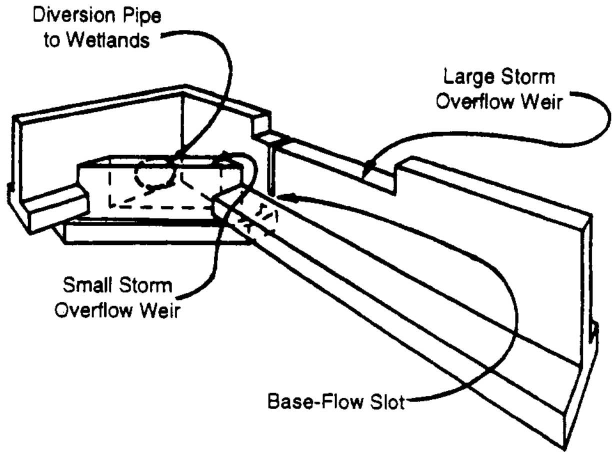

Figure 1. Diversion structure or "flow splitter."

Techniques for Avoiding or Minimizing Impacts to Sensitive Areas

Warm Water Environments

For warm water fisheries, where thermal impacts are not a major consideration, wet ponds (permanent pools of water) represent the most reliable and maintenance-free option for stormwater runoff quality control (1). Several techniques can enhance the pollutant removal efficiency of wet ponds and simultaneously minimize the impact that a large body of water has on surrounding sensitive areas. Some of these techniques are:

- Location of a pond "off-line" from active flowing streams reduces the impact to existing aquatic environment and does not necessarily inhibit fish migration.
- Diversion structures or "flow splitters" provide a technique for conveying both base flow and storm flow away from sensitive areas (see Figure 1).
- Pond grading techniques that provide storage volumes direct impacts away from sensitive areas.
- Pond grading techniques that give curvilinear geometry to the pond can increase flow lengths and decrease ineffective storage areas.
- Pond grading techniques that use shallow aquatic zones, peninsulas and/or islands, and low-lying areas for riparian vegetation provide varied water regimes.
- Incorporating vegetative practices into the design, such as shallow marsh emergent wetlands, submerged aquatic vegetation, and riparian fringe plantings, can create additional wildlife habitats.

Figure 2 depicts a wet pond concept for a warm water environment.

Cool Water Environments

For cool water fisheries, where thermal impacts are a major consideration, a design must attempt to maximize pollutant removal efficiencies but also to reduce and/or offset thermal impacts.

The following are some of the techniques that incorporate these goals:

- The facility should avoid open bodies of water where solar radiation would heat up the water column. Examples in descending order of preference would be infiltration facilities, filtration facilities, dry extended detention ponds, and shallow stormwater wetland ponds (2).
- The location and orientation of the facility should account for the hours of potential solar radiation, such as a north/south dominant orientation.
- Shading of the pool area by maximizing tree canopy can minimize solar penetration.
- Incorporating underdrain and toe drain groundwater collection systems can provide an additional source of cool water release, where available, while implementing an earthen embankment safety consideration.
- Shading and covering a pond's outlet channel helps prevent thermal impacts associated with water running over heated rocks.
- Watershedwide landscaping, including shading of impervious asphalt surfaces, helps reduce thermal loading at the source.

Figure 3 depicts a dry pond concept for a cool water environment.

New Theorized Techniques

New approaches may afford the opportunity to combine the pollutant removal efficiencies of wet ponds with temperature mitigation measures. Three approaches are to:

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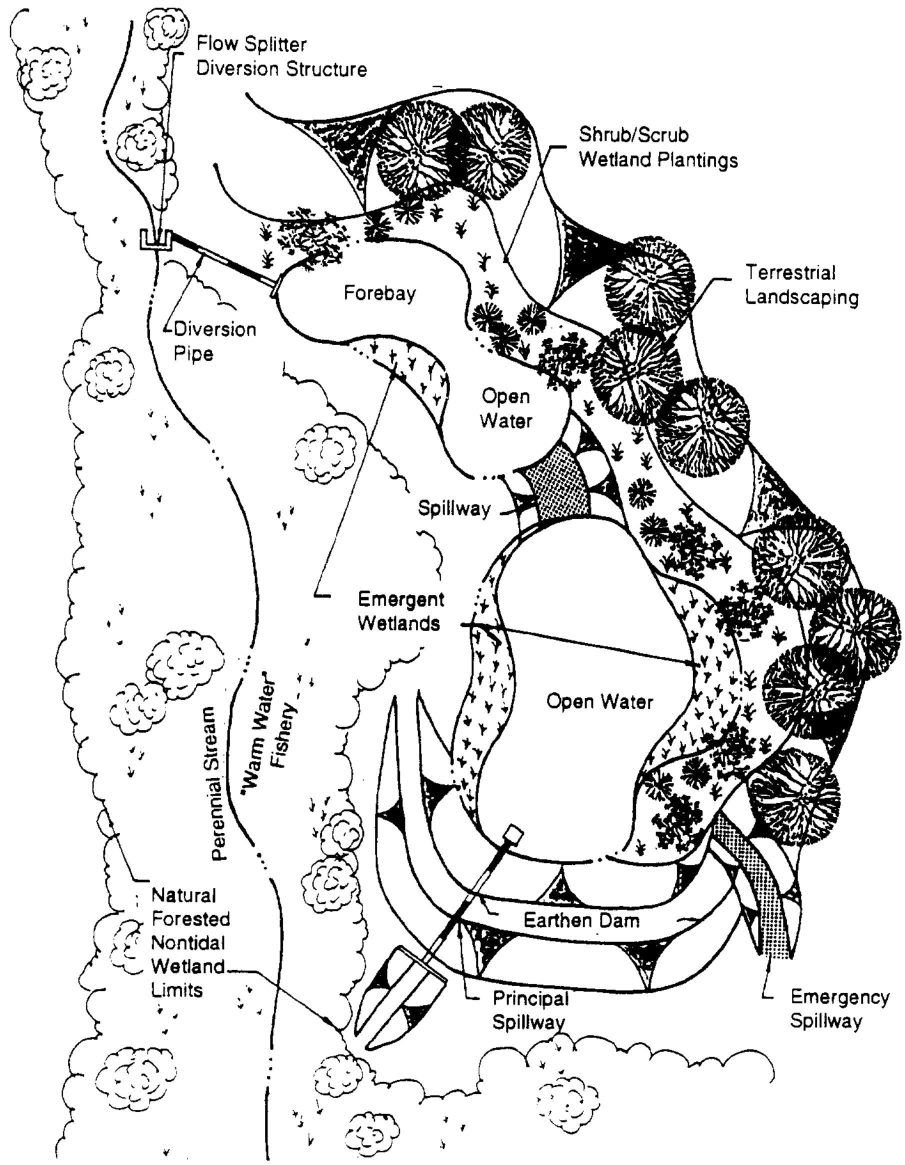

Figure 2. Wet pond concept with diversion structure for warm water environment.

- Incorporate "cooling tower" design practices into the outlet structure of the spillway system (Figure 4) (3).
- Investigate vegetative practices that cover the open water surface of ponds to minimize solar radiation of the water column (4).
- Incorporate a ground-water siphon system into the design of the release structures to siphon ground water as the low flow release (Figure 5) (5).

Maintenance and Monitoring

An effective design cannot become a practical application without a good implementation program, an effective monitoring program, and a maintenance program that keeps a facility functioning at its best. Many of the techniques and considerations previously discussed are new and may not meet expectations. These techniques require short- and long-term monitoring to ensure that they are meeting the expectations of the designer and agency.

In addition, many of the more innovative design approaches require periodic maintenance. It is not practical to assume that these approaches will function without the necessary observations and periodic maintenance. Some of the approaches (e.g., flow splitters) require only periodic trash removal to keep them functioning as designed, while others (e.g., filters and infiltration basins) require a more intensive maintenance program.

Conclusion

In sensitive areas, design approaches need to combine innovative alternatives, common sense, and compromise. Everyone agrees that our sensitive resources

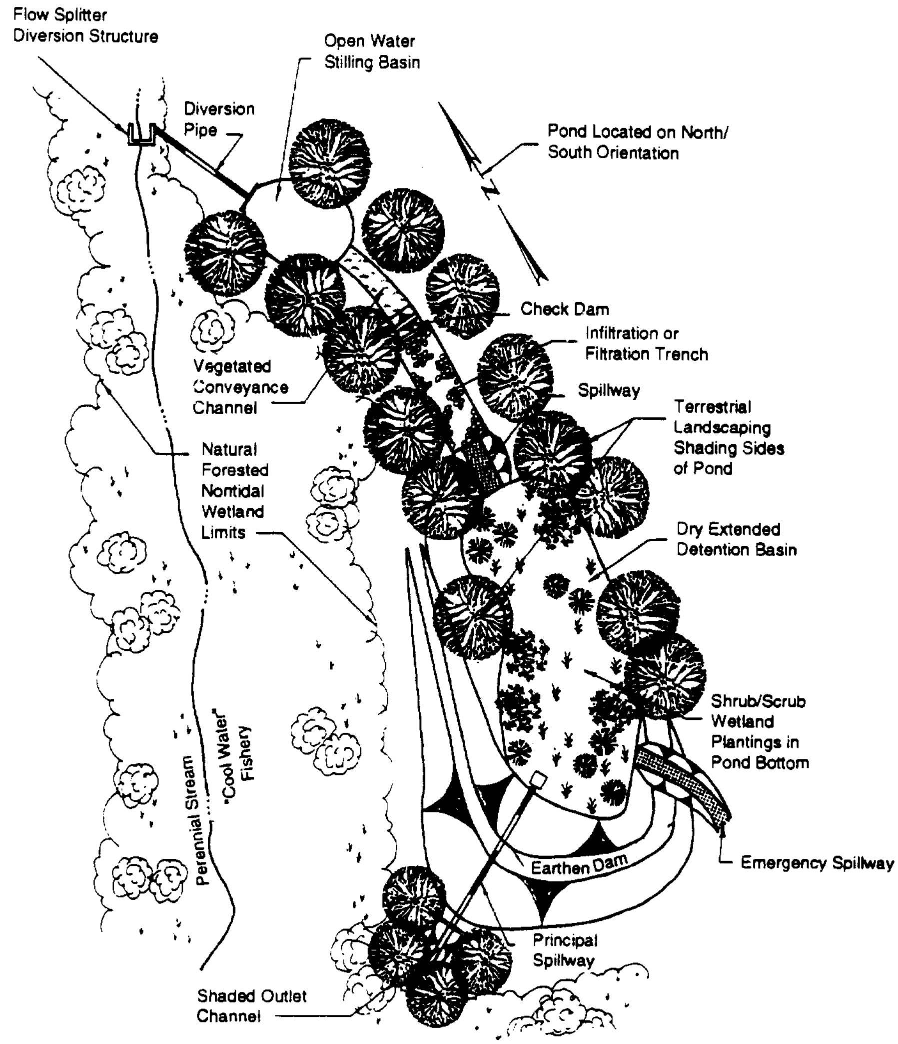

Figure 3. Dry pond concept with diversion structure for cool water environment.

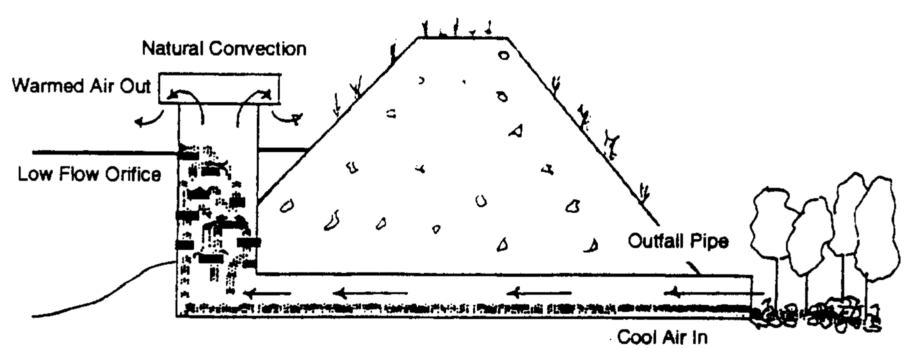

Figure 4. Combination atmospheric and natural draft cooling tower to cool water discharged from a wet pond system (3).

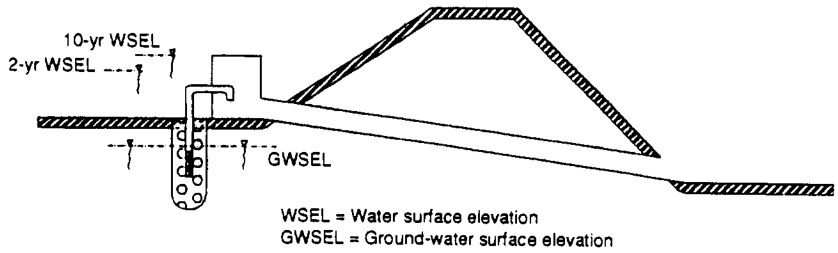

Figure 5. Siphon thermal cooler concept for stormwater management ponds (5).

need special protection and require the utmost care if a disturbance occurs. There is not agreement, however, on the best approaches and on what resources are the most important. Therefore, it is vital to document the existing conditions carefully, prepare flexible concepts and designs, and be prepared to revise plans and design approaches as new information and monitoring results emerge. Practical aspects of stormwater pond design will not remain static but will continue to change as new technologies and techniques advance and older considerations become obsolete.

Acknowledgments

The author would like to acknowledge the following individuals who have played a key role in the development of some of the techniques and considerations contained herein: John Galli, Carter McCamy, Daniel O'Leary, Mary Jo Garreis, Tom Schueler, Tim Schueler, and Andrew Der.

References

1. Schueler, T. 1987. Controlling urban runoff: A practical manual for planning and designing urban BMP. Metropolitan Washington Council of Governments (July).
2. Galli, J. 1990. Thermal impacts associated with urbanization and stormwater management best management practices. Metropolitan Washington Council of Governments for the Sediment and Stormwater Administration, Maryland Department of the Environment (December).
3. McCamy, C. 1992. Combination atmosphere and natural draft cooling tower. EQR report (October 12). Environmental Quality Resources, Inc., 1738 Elton Rd., Suite 310, Silver Spring, MD 20903.
4. McCamy, C. 1992. The use of water hyacinth to control thermal loading in wet pond systems. EQR report (October 12). Environmental Quality Resources, Inc., 1738 Elton Rd., Suite 310, Silver Spring, MD 20903.
5. O'Leary, D. Syphon thermal cooler concept for stormwater management ponds. Water Management Administration, Maryland Department of the Environment, 2500 Broening Highway, Baltimore, MD 21224.

Infiltration Practices: The Good, the Bad, and the Ugly

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Abstract

Of all the best management practices (BMPs) in the stormwater treatment tool box, infiltration practices are the most effective in removing stormwater pollutants and, equally important, in reducing both stormwater volume and peak discharge rate. This paper explains the concept of on-line and off-line systems, and discusses factors that influence their treatment effectiveness. Design guidelines for infiltration systems, including the importance of the BMP treatment train approach, will be reviewed, focusing on soil types, water table elevation, geology, vegetation, and determination of infiltration rates. Construction considerations will be reviewed. Because of their likelihood for clogging, the importance of regular inspection and maintenance programs is stressed.

Infiltration practices that the paper covers include roadside swales, retention basins, landscape retention, exfiltration systems, infiltration trenches, and porous pavement. For each type of system, information on treatment effectiveness, design criteria, advantages, and disadvantages is presented, along with discussion of the good, the bad, and the ugly. The paper reviews the effect of infiltration practices on ground-water quality and presents recommendations to limit adverse impacts. Special design guidelines for infiltration practices in areas with karst geology, which is characterized by sinkholes, will also be reviewed.

Introduction

To achieve the desired objectives of flood and water quality protection, erosion control, improved aesthetics, and recreation, a stormwater management system must be an integral part of the site planning for every site. Although the basic principles of stormwater management remain the same, each individual site and each specific project presents unique challenges, obstacles, and opportunities. The many variations in climate, soils, geology, ground water, topography, vegetation, and planned land use require site-specific design. Each site contains natural attributes that will influence the type and configuration of the stormwater system.

The variety of features contained on a site suggest which particular combination of best management practices (BMPs) can be successfully integrated into an effective system. Whenever site conditions allow, the stormwater management system should be designed to achieve maximum onsite storage (and even reuse) of stormwater by incorporating infiltration practices throughout the remaining natural and landscaped areas of a site. A stormwater management system should be viewed as a "treatment train" in which the BMPs are the individual cars. Generally, the more BMPs that are incorporated into the system, the better the performance of the treatment train. Inclusion of infiltrative practices as one of the cars should be a primary goal of stormwater system designers.

Infiltration practices are one of the few BMPs that can help to ensure that all four stormwater characteristics (the volume, rate, timing, and pollutant load) after development closely approximate the conditions that occurred before development. This is because infiltration practices help to maintain predevelopment site perviousness and vegetative cover, thereby reducing stormwater volume and discharge rate, which further promotes infiltration and filtering of the runoff.

The benefits of infiltration include:

- Reducing stormwater volume and peak runoff rate.
- Recharging ground water, which helps to replenish wetlands, creeks, rivers, lakes, and estuaries.
- Augmenting base flow in streams, especially during low flow times.
- Aiding in the settling of pollutants.
- Lowering the probability of downstream flooding, stream erosion, and sedimentation.
- Providing water for other beneficial uses.

Another benefit of infiltration practices is their ability to serve multiple uses because they are temporary storage basins. Recreational areas (e.g., ballfields, tennis courts, volleyball courts), greenbelt areas, neighborhood parks, and even parking facilities provide excellent settings for the temporary storage of stormwater. Such areas are not usually in use during periods of precipitation, and the ponding of stormwater for short durations does not seriously impede their primary functions.

Determining Treatment Effectiveness

To design a BMP for water quality enhancement, a pollutant reduction goal must first be established. Stormwater treatment regulatory programs in Florida and Delaware are based on a performance standard of reducing the annual average total suspended solids (pollutant) load by 80 percent for stormwater systems discharging to waters classified as fishable and swimmable. In Florida, stormwater systems discharging to potable supply waters, pristine waters, or highly polluted waters may be required to remove up to 95 percent of the average annual pollutant load. Technology-based performance standards such as these provide water quality goals for nonpoint sources that create equity with the minimum treatment requirements for domestic wastewater point sources (1). Design criteria for various types of stormwater management systems that achieve the desired performance standard (treatment efficiency) are then adopted, thereby providing guidance to the design community and making it relatively easy to obtain a stormwater permit.

The average annual pollutant removal efficiency is calculated by considering the annual mass of pollutants available for discharge and the annual mass removed. The primary removal mechanism for infiltration practices is the volume of stormwater that is infiltrated, because this eliminates the discharge of stormwater and its associated pollutants. As with any type of stormwater management practice, its actual field efficiency depends on many factors. For infiltration practices, these factors include:

- Long-term precipitation characteristics such as mean number of storms per year along with their intensity and volume; average interevent time.
- The occurrence of first flush, which is related to the amount of directly connected impervious area, type of stormwater conveyance system, and the pollutant of interest.
- "On-line" or "off-line" design.

Cumulatively, the above three factors determine the minimum treatment volume and maximum storage recovery time.

The National Weather Service (within the National Oceanic and Atmospheric Administration) has measured weather statistics at many locations around the country. Long-term precipitation records, including information such as day and duration of event, intensity, and volume, are available from either the federal government or private vendors. Statistical analysis of these records can develop probability frequencies for storm characteristics such as the mean storm volume and the mean interevent period between storms.

"First flush" describes the washing action that stormwater has on accumulated pollutants in the watershed. In the early stages of runoff, the land surfaces, especially impervious ones such as streets and parking areas, are flushed clean by the stormwater. This flushing creates a shock loading of pollutants. The occurrence and prevalence of first flush, however, depends largely on precipitation patterns. Studies in Florida have determined that for urban land uses there is a first flush for many pollutants, especially particulates (2, 3). In areas such as Oregon and Washington, however, where rainfall consists of low intensity, long-duration "events," the first flush is not very prevalent. Where it exists, the first-flush effect generally diminishes as the size of the drainage basin increases and the amount of impervious area decreases.

On-line stormwater practices store runoff temporarily before most of the volume is discharged to surface waters. These systems capture all of the runoff from a design storm. This mixes all stormwater within the system, thereby masking first flush and reducing pollutant removal. They primarily provide flood control benefits, with water quality benefits usually secondary, although on-line wet detention systems do provide both benefits.

Off-line practices are designed to divert the more polluted stormwater first flush for water quality treatment, isolating it from the remaining stormwater that is managed for flood control. The diverted first flush is not discharged to surface waters but is stored until it is gradually removed by infiltration, evaporation, and evapotranspiration. Vegetation, such as grass in the bottom and sides of infiltration areas, helps to trap stormwater pollutants and reduce the potential for transfer of these pollutants to ground waters. Off-line retention practices are the most effective for water quality enhancement of stormwater.

Because an off-line retention area primarily provides for stormwater treatment, it must be combined with other BMPs for flood protection to form a comprehensive stormwater management system. Figure 1 is a schematic of an off-line system, commonly referred to as a "dual pond system," in which a smart weir directs the first flush stormwater into the infiltration area until it is filled, with the remaining runoff routed to the detention facility for flood control.

Using the three factors above, design criteria have been developed and implemented in Florida to achieve the

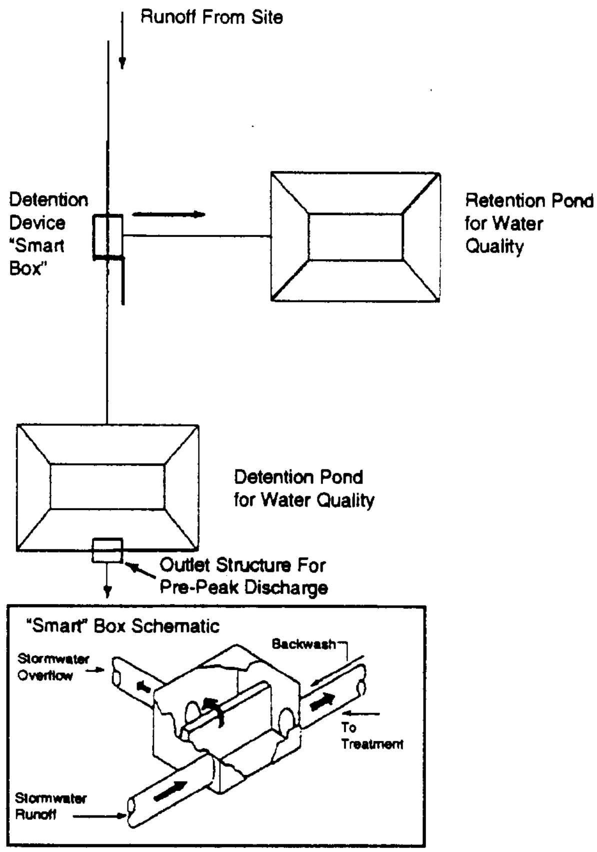

Figure 1. Schematic of an off-line system (4).

desired 80 or 95 percent treatment performance standard (5). The pollutant removal efficiency of an off-line system depends on the annual volume of stormwater that is diverted and infiltrated. For each storm, pollutant removal efficiencies will vary from 100 percent for storms producing less runoff than the diversion design volume to lower efficiencies for much larger storms. If the time between storms is less than the design interevent period, then the design treatment volume will not be available, and more runoff will not be captured and treated. Wanielista (6) developed cumulative frequency distributions for storm-related efficiencies using a simulation model dependent on 20 years of rainfall data and 16 measured storm event runoff quantities and qualities. The results shown in Table 1 are based on Florida rainfall characteristics (90 percent of all annual rainfall events are less than 2.54 cm) and a distinct first flush (up to 90 percent of the pollution load carried in the first 2.54 cm of runoff). An off-line retention system designed to accept at least the first 1.25 cm of runoff (or the volume calculated by 1.25 times the percent imperviousness of the site) will remove more than 80 percent of the average annual pollutant load.

A more recent investigation of the influence of long-term rainfall characteristics on the efficiency of retention practices led to the development of diversion volume curves for interevent dry periods of varying length (7). Figure 2 shows an example diversion volume curve for the Orlando area. It is important to note that first flush is not considered in these curves. If a first-flush effect does exist, the design curves would be conservative in that the percent treatment efficiency of the infiltration system would increase. Furthermore, these curves are based on precipitation interevent frequency (PIF) curves, which also include consideration of the probability that a storm greater than the design storm will occur. The PIF analysis looked at exceedance probabilities for storms with a return period of 2, 3, 4, or 6 months, representing a chance that the storm will exceed the design volume six, four, three, or two times a year.

Table 1. Cumulative Frequency Distributions on Efficiencies per Storm Event as a Function of Storage Volume (Area = 4.6 Ac, 85 percent Impervious, Tc = 20 min)

Average[a] Efficiency	Volume of Storage, centimeters (inches) 0.25 (0.1)	0.64 (0.25)	1.27 (0.50)	2.54 (1.0)
100	35.4	66.4	92.9	99.0
>96	42.5	74.3	97.3	100.0
>92	46.0	77.9	97.4	
>88	47.8	81.4	98.2	
>84	50.4	90.3	100.0	
>80	65.6	92.9		
>76	61.1	96.3		
>72	66.4	97.3		
>68	72.6	98.2		
>64	82.3	100.0		

[a] Average efficiency is the average removal of BOD_5, suspended solids, nitrogen, and phosphorus over a 20-year period. Average number of rainfall events producing runoff per year is 116.

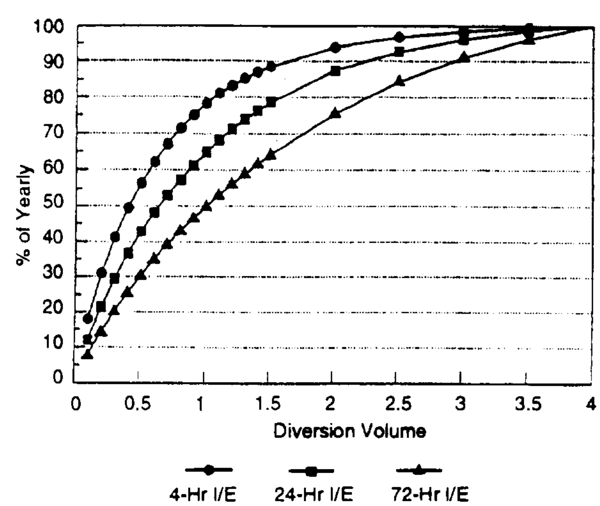

Figure 2. Diversion volume curve for Orlando, Florida.

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Design of Infiltration (Retention) Practices

Infiltration practices also are commonly called retention practices because they retain the runoff on site. They are designed to infiltrate a design volume (treatment volume) of stormwater, and the tool box includes on-line and off-line percolation ponds and trenches, infiltration areas, exfiltration systems, and vegetated swales. Design factors that influence the treatment effectiveness and feasibility of infiltration practices include choice of on-line or off-line system, use of the BMP treatment train concept, and soil type, geology, water table elevation, topography, and vegetation.

Infiltration areas, especially off-line ones, can be incorporated easily into landscaping or open space areas of a site. These can include natural or excavated grassed depressions, recreational areas, and even parking lot landscape islands. If site conditions prevent the exclusive use of infiltration, then off-line retention areas should be used as pretreatment practices in a stormwater treatment train. This is especially true if detention lakes are the primary component of the stormwater system and the lakes are intended to serve as a focal point of the development. Parking lots with their landscape islands offer an excellent opportunity for the use of this concept because even the infiltration of a quarter inch of runoff will greatly reduce sediments, metals, and oils and greases. Placing storm sewer inlets within recessed parking lot landscape areas, raising the inlet a few inches above the bottom, and using curb cuts to allow runoff to enter this area represent a highly effective treatment train.

Siting, Design, and Planning Considerations for Infiltration Practices

The suitability of a site for certain infiltration practices depends on a careful evaluation of the site's natural attributes. Proposed infiltration areas should be evaluated for feasibility on any particular site or project by examining the following.

Soils

Soils must have permeability rates that allow the diverted volume to infiltrate within 72 hours, or within 24 to 36 hours for infiltration areas that are planted with grasses. Soil textures with minimum infiltration rates of 0.43 cm/hr or less are not suitable for infiltration practices (8). These unsuitable soils include soil textures that have at least 30 percent clay content.

Infiltration Rates

One of the most difficult aspects of designing infiltration practices is obtaining reliable information about the actual infiltration rate of the soil where the practice will be constructed. Unfortunately, such information is not easily obtainable. Avellaneda (9) conducted 20 hydrologic studies of vegetated swales constructed on sandy soils with a water table at least 1 ft below the bottom during dry conditions. Infiltration rates were measured using laboratory permeability tests, double-ring infiltrometers, and field mass balance experiments. The field mass balance method measured a minimum infiltration rate of 5 to 7.5 cm/hr. This measured rate was much less than lab permeabilities, rates measured by double-ring infiltrometer tests (12.5 to 51 cm/hr), or rates published in the detailed soil survey. Recommendations for determining the infiltration rate for retention practices include the following:

- Because the infiltration rate is the key to designing any retention practices, conservative estimates should be used and safety factors incorporated into the design to ensure that the design volume will actually be percolated into the soil and not discharged downstream.
- Onsite infiltration measurements must be taken at the locations where retention practices will be located. More importantly, because soil characteristics and infiltration rate change with depth, it is crucial that the measurements be made at the depth of the design elevation of the bottom of the retention practice.
- Infiltration rates should be determined by mass balance field tests if possible. These provide the most realistic estimate of the percolation rate. If field tests are not possible, then infiltrometer tests should be used, with lab permeability tests a third option. In either of these two tests, the design infiltration rate should be half of the lowest measured rate. As a last resort, information from detailed soil surveys can be used to estimated the infiltration rate. The lowest rate should be used, however, as should a safety factor of two.

Water Table

The seasonal high water table should be at least 1 m beneath the bottom of the infiltration area to ensure that stormwater pollutants are removed by the vegetation, soil, and microbes before contacting the ground water. When considering the ground-water elevation, it is important to remember that the retention area can cause a mounding effect on the water table, thereby raising it above the predevelopment level.

Geology

Bedrock should be at least 1 m beneath the bottom of the infiltration area. In those parts of the country where limestone is at or near the land surface, special precautions must be taken when using infiltration practices. The potential for ground-water contamination in such areas is quite high, especially in "karst sensitive areas" (KSAs), where sinkhole formation is common. In KSAs, solution pipe sinkholes may form in the bottom of infiltration areas, creating a direct conduit for stormwater pollutants to enter the ground water. Solution pipes often open in the bottom of retention areas because the natural soil plug capping the solution pipe is thinned by partial excavation to create the retention area and because the stormwater creates hydraulic pressure that can wash out the plug.

In KSAs, a site-specific hydrogeologic investigation should be undertaken that includes geologic borings wherever infiltration areas are proposed and mapping limerock outcroppings and sinkholes on site. Infiltration systems in KSAs should:

- Include several small offsite areas.
- Use swale conveyances for pretreatment.
- Be as shallow as possible.
- Be vegetated with a permanent cover such as sodded grasses.
- Have flat bottoms to keep the stormwater spread out across the entire area.

Topography

Infiltration practices should not be located on areas with slopes over 20 percent to minimize the chance of downstream water seepage from the subgrade. Sloping sites often require extensive cut and fill operations. Infiltration practices should not be sited on fill material because fill areas are very susceptible to slope failure, especially when the interface of the fill/natural soil becomes saturated.

Vegetation

To reduce the potential for stormwater pollutants to enter ground waters and to help maintain the soil's capacity to absorb water, infiltration practices should be vegetated with appropriate native vegetation, especially grasses. This type of vegetation cannot tolerate long-term inundation, however, so the retention area must be capable of infiltrating all of its runoff within a relatively short period (i.e., 24 to 36 hours).

Set Backs

Infiltration areas should be located at least 33 m from any water supply well and at least 3.5 m downgradient from any building foundations. Additionally, they should be set back at least 15 m from onsite wastewater systems, especially drain fields.

Land-Use Restrictions

Certain infiltration practices can only be applied to particular land uses. Some sites are so small or intensively developed that space is insufficient for practices that require a large area (e.g., retention basin). Other practices (e.g., porous pavement) can only be used on sites with parking lots and limited truck traffic.

Sediment Input

Infiltration practices must be protected from large loads of sediment to prevent clogging and subsequent failure. Although sediment loads drop sharply after construction is complete, gradual clogging of infiltration practices can still occur. Pretreatment practices such as swale conveyances or vegetated buffer strips can help to filter out sediments and extend the life of retention practices.

Construction Considerations

To prevent clogging of infiltration areas, special precautions must be taken during the entire construction phase of a project. These are needed to prevent sedimentation during construction, compaction of the soil, and subsequent reduction in its infiltration capacity. Areas with suitable characteristics that are selected for infiltration use should be well marked during site surveying and protected during construction. Heavy equipment, vehicles, and sediment laden runoff should be kept out of infiltration areas to prevent compaction and loss of infiltration capacity.

- Before the development site is graded, the area planned for use as infiltration areas should be well marked during site surveying. Then, the area should be roped off to prevent heavy equipment from compacting the underlying soils.
- Diversion berms should be placed around the perimeter of the infiltration area during all phases of construction. Sediment and erosion control plans for the site should be oriented to keep sediment and runoff completely away from the area. Actual construction of the infiltration practice should not begin until after the site has been stabilized completely.
- Infiltration areas should never be used as a temporary sediment basin during the construction phase. It is somewhat common for infiltration areas, especially basins, to be used as a sediment trap, with initial excavation to within 2 ft of the final design elevation of the basin floor. Sediment that accumulates during the construction phase can then be removed when the basin undergoes final excavation after the development has been completed. Recent experience, however, indicates that even with this type of construction practice infiltration areas used as sediment traps tend to fail.
- Infiltration areas/basins should be excavated using light earth-moving equipment with tracks or oversized tires. Normal rubber tires should be avoided because they compact the subsoil and reduce its infiltration capabilities. For the same reason, the use of bulldozers or front-end loaders should be avoided. Because some

compaction of the underlying soils is still likely to occur during excavation, the floor of the basin should be deeply tilled with a rotary tiller or disc harrow.

- The basin should be stabilized with vegetation within a week after construction. Use of low maintenance, rapid-germinating grasses such as fescues are recommended. The condition of the newly established vegetation should be checked several times over the first 2 months and any necessary remedial actions taken (e.g., reseeding, fertilization, and irrigation).

Maintenance

All infiltration practices require regular and nonroutine maintenance to maintain their ability to infiltrate stormwater. The frequency and need for maintenance depends primarily on the loading of particulates and the use of pretreatment practices. Inspections should be conducted on a regular basis after storm events, and maintenance activities should be conducted whenever stormwater remains in the practice beyond the designed time. Specific maintenance needs are discussed for each of the different types of infiltration practices in the next section.

Discussion of Various Infiltration Practices

Infiltration Basins

An infiltration basin is made by constructing an embankment or by excavating in or down to relatively permeable soils. The basin temporarily stores stormwater until it infiltrates through the bottom and sides of the system. The infiltration "basin" can actually be a landscape depression within open spaces, even parking lot islands or a recreational area such as a soccer field. Infiltration areas generally serve drainage areas ranging from 2 to 20 hectares. Infiltration basins should be designed as off-line systems but they can be on-line, especially if predevelopment stormwater volume is being maintained.

Advantages of infiltration basins are that they preserve the natural water balance of a site, can serve larger developments, and can be integrated into a site's landscaping and open spaces. Disadvantages of infiltration basins can include their land area; fairly high rate of failure due to unsuitable soils, poor construction, or lack of maintenance; the need for frequent maintenance; and possible nuisances such as odors, mosquitos, or soggy ground (all signs of a failing system).

The function of infiltration basins can be improved if the following design tips are followed:

- *Basin floor and sides:* The rate and quantity of infiltration are enhanced by increasing the surface area of the bottom. Large, relatively shallow areas are preferable, especially in KSAs, so that the stormwater spreads evenly over the entire surface area. Therefore, it is very important that the bottom be evenly graded with a zero slope. If the bottom is uneven, these low spots will remain underwater for a longer time and may become chronically wet as the floor clogs and infiltration is reduced. Side slopes should be no steeper than 3:1 to allow for vegetative stabilization, easier mowing and access, and better public safety.
- *Vegetation:* The side slopes and bottoms of infiltration areas should be vegetated with a dense turf of water-tolerant grass immediately after construction. Not only does the vegetation stabilize these areas, but it also helps to filter stormwater pollutants, remove dissolved nutrients and metals, enhance aesthetic qualities, reduce maintenance needs, and even maintain or improve infiltration rates.
- *Reducing incoming water velocities:* Inlets to an infiltration area should be stabilized to prevent inflowing runoff velocities from reaching erosive levels and scouring the bottom. Riprapping inlet channels or pipe outfalls and using bubble-up inflow devices or perimeter swale and berms can address this problem. Because the stormwater should spread evenly over the entire infiltration area, riprap inlets should terminate in a broad apron that serves as a crude level spreader.
- *Construction requirements:* Proper construction and routine maintenance as discussed above are essential for successful infiltration basin implementation. In a recent survey, approximately 40 percent of the infiltration basins had partially or totally clogged within their first few years of operation (10). Many of the systems failed almost immediately after construction or never worked properly from the beginning.
- *Routine maintenance requirements:* Infiltration areas should be inspected following major storms, especially in the first few months after construction. If stormwater remains in the system beyond the design drawdown time (typically 24 to 36 hours if grassed, 48 to 72 hours if not grassed), either the infiltration capacity was overestimated or maintenance is needed. Factors responsible for clogging may include upland erosion and sedimentation, low spots, excessive compaction, or poor soils. Cleaning frequently depends on whether the basin is vegetated or nonvegetated and is a function of storage capacity, sediment and debris load, and land use. Litter, leaves, brush, and other debris should be removed regularly, perhaps during the mowing of vegetation. The buffer, side slopes and bottom of the retention area should be mowed as needed, with the grass clippings removed. Eroded or barren areas should be immediately revegetated. Nonvegetated basins can be tilled annually after accumulated sediments are removed. Sediments should be removed only after the basin is thoroughly dry, preferably to the point where the top

layer begins to crack. To reduce soil compaction, only light equipment should be used.

- *Nonroutine maintenance requirements:* Over time, the original infiltration capacity of the bottom will gradually decline. Deep tilling every 5 to 10 years can be used to break up clogged surface layers, followed by regrading, leveling, and revegetation. If the original infiltration rate was overestimated, underdrains may be installed beneath the bottom, or perhaps the system should be converted to a shallow marsh or wet detention system.

Infiltration Trenches

An infiltration trench generally consists of a long, narrow excavation, ranging from 1 to 3 m in depth, that is backfilled with stone aggregate, allowing for the temporary storage of the first-flush stormwater in the voids between the aggregate material. Stored runoff then infiltrates into the surrounding soil. To minimize clogging potential and maximize treatment effectiveness, infiltration trenches should always be designed as off-line systems. Infiltration trenches usually are designed to serve drainage areas of 2 to 4 hectares and are especially appropriate in urban areas where land costs are prohibitive. As with any infiltration practice, the treatment train concept must be employed to capture sediment before it enters the trench to minimize and reduce clogging.

Advantages of infiltration trenches include ground-water recharge, reduced stormwater volume, and the ability to fit into perimeters or other underused areas of a development, even beneath parking areas. Disadvantages include potential clogging, especially if sediment is not kept out during construction, the need for careful design and construction, and maintenance.

Infiltration trenches can be located on the surface or below the ground. Surface trenches receive sheet flow runoff directly from adjacent areas after it has been filtered by a grass buffer. Underground trenches can accept runoff from storm sewers but require use of special pretreatment inlets to prevent coarse sediment, soils, leaves, and greases from clogging the stone reservoir.

Surface trenches typically are used in residential areas where smaller loads of sediment and oil can be trapped by grass filter strips that are at least 6 m wide. While surface trenches may be more susceptible to sediment accumulations, their accessibility makes them easier to maintain. Surface trenches can be used in highway medians, parking lots, and narrow landscape areas.

Underground trenches can be applied in many development situations and are particularly suited to accept concentrated runoff; however, pretreatment is essential. Inlets to underground trenches should include trash racks, catch basins, and baffles to reduce sediment, leaves, debris, and oil and grease. Maintenance of underground trenches can be very difficult and expensive, especially if placed beneath parking areas or pavement.

The most commonly used underground trench is an exfiltration system, in which the stormwater treatment volume is diverted into an oversized perforated pipe placed within an aggregate envelope. The first-flush stormwater is stored in the pipe and exfiltrates out of the holes, through the gravel and filter fabric, and into the surrounding soil. The city of Orlando, Florida, has installed exfiltration systems using perforated corrugated metal pipe and slotted concrete pipe throughout the downtown area to reduce stormwater pollution of its lakes.

Dry wells are used extensively in Maryland to store and infiltrate runoff from rooftops. The downspout from the roof gutter is extended into an underground trench, which is constructed at least 3 m away from the building foundation. Rooftop gutter screens are used to trap particles, leaves, and other debris. Additional design information on dry wells is available from the Maryland Department of the Environment (11).

The following design and construction guidelines are provided for infiltration trenches.

Infiltration Rates

The actual rate at which water leaves the infiltration trench is determined by several factors. Whether infiltration primarily occurs through the trench bottom or sides depends on the elevation of the water table and soil properties. To prevent ground-water contamination, trench bottoms should be at least 4 ft above the seasonal high water table (remember to consider ground-water mounding). This will also ensure infiltration through the bottom. In addition to the infiltration rate of the parent soil, the permeability of the surrounding filter fabric (if used) is crucial and can become a limiting factor. A recent investigation of exfiltration systems (12) provides the following:

- Permeability of the parent soil is not the limiting exfiltration rate.
- The limiting exfiltration rate is set by the geotextile filter fabric, not the soil.
- A maximum rate of 1.27 cm/hr should be used, assuming infiltration through the sides and bottom.
- A maximum rate of 2.54 cm/hr should be used if the geotextile filter fabric is matched correctly to the soil type and only the trench side areas are assumed to exfiltrate.

Construction of Infiltration Trenches

Successful use of infiltration trenches requires thorough site planning and evaluation and proper construction. In addition to the construction recommendations for all infiltration practices discussed above, the construction of infiltration trenches should also include the following:

- Excellent erosion and sediment control should be maintained during construction to keep sediments away from the trench. Allowing even an inch or two of soil to get into the trench between the aggregate and the fabric will almost ensure clogging. If constructed before the drainage area is entirely stabilized, then the trench should be covered with heavy plastic to prevent any inflow until stabilization is completed.
- The trench should be excavated using a backhoe or trencher equipped with tracks or oversized tires. Normal rubber tires should be avoided because they compact the subsoil and may reduce infiltration capability. For the same reason, the use of bulldozers or front-end loaders should be avoided. Excavated material should be stored at least 3 m from the trench to avoid backsliding and cave-ins.
- Once the trench is excavated, the bottom and sides should be lined with a geotextile filter fabric to prevent upward piping of underlying soils. The fabric should be placed flush with the sides and bottom, with a generous overlap at the seams. Care should be taken in selecting the proper kind of filter fabric, as available brands differ significantly in their permeability and strength. The geotextile fabric must be handled carefully to prevent holes and tears that allow soil to get into the trench. As an alternative, a 15-cm deep filter of clean, washed sand may be substituted for filter fabric on the bottom of the trench.
- Clean, washed 2.5- to 7.5-cm stone aggregate should be placed in the excavated reservoir in lifts and lightly compacted with plate compactors to form the coarse base. Unwashed stone has enough associated sediment to pose a risk of clogging at the soil/filter cloth interface. Where possible, the use of limestone or bluestone aggregate should be avoided.
- A simple observation well should be installed in every trench. Wells can be made of secure foot plate, perforated polyvinyl chloride pipe, and locking cover. The observation well is needed to monitor the performance of the trench and is also useful in marking its location. The drain time for a trench can be measured by placing a graduated dipstick down the well immediately after a storm and again 24, 48, and 72 hours later.
- Postconstruction sediment control is critical. It is therefore important that 1) sediment and erosion controls be inspected to make sure they still work, 2) vegetated buffer strips are established immediately, preferably by sodding, and 3) if hydroseeding is used, reinforced silt fences are placed between the buffer and trench to prevent sediment entry before the buffer becomes fully established.

Maintenance of Infiltration Trenches

If properly constructed with pretreatment practices to prevent heavy sediment loading, infiltration trenches can provide stormwater benefits without tremendous maintenance needs. Because trenches are "out of sight, out of mind," getting property owners to maintain them can be difficult. Accordingly, a public commitment for regular inspection of privately owned trenches is essential, as is a legally binding maintenance agreement and education of owners about the function and maintenance needs of trenches.

Trenches should be inspected frequently within the first few months of operation and regularly thereafter. Inspections should be done after large storms to check for water ponding, with water levels in the observation well recorded over several days to check drawdown. Grass buffer strips should maintain a dense, vigorous growth of grass and receive regular mowing (with bagging of grass clippings) as needed. Pretreatment devices should be checked periodically and sediment removed when the sediment reduces available capacity by more than 10 percent.

Swales

Swales, or grassed waterways, are one of the oldest stormwater BMPs, having been used along streets and highways and by the farmer for many years. By definition, a swale is a shallow trench that:

- Has side slopes flatter than 3 ft horizontal to 1 ft vertical.
- Contains contiguous areas of standing or flowing water only following a rainfall.
- Is planted with or has stabilized vegetation suitable for soil stabilization, stormwater treatment, and nutrient uptake.
- Is designed to take into account the soil erodability, soil percolation, slope, slope length, and drainage areas so as to prevent erosion and reduce stormwater pollutants.

Traditionally, swales have been and are used primarily for stormwater conveyance; as such, they are considered an on-line practice. The removal of stormwater pollutants by swales can occur by either infiltration or vegetative filtration and uptake. Investigations in Florida (13, 14) have concluded that swale treatment efficiency largely depends on the volume of stormwater that can be infiltrated through the filtering vegetation and into the soil. To achieve Florida's performance standards, swales must be designed to infiltrate the runoff from a 3-yr/1-hr storm (about 7.5 cm) within 72 hours. Investigations in Washington state (15, 16), however, indicate that swales can also act as a biofilter, with removal of particulate pollutants without infiltration of stormwater.

Avellaneda (9) developed the following equation for a triangular shaped swale to estimate the length of swale necessary to infiltrate the design runoff volume:

$$L = \frac{KQ^{5/8} S^{3/16}}{n^{3/8} i} \qquad (1\text{–}1)$$

where:

L = swale length (m)
n = Mannings roughness coefficient
Q = average runoff flow rate (m^3/sec)
i = infiltration rate (cm/hr)
S = longitudinal slope (m/m)
K = constant that is a function of side slope (see Table 2)

For most residential, commercial, and highway projects, the length of swales necessary to percolate the stormwater needed to achieve the 80 percent performance standard was found to be excessive or at least twice the distance available. Thus, some type of swale block (berm) or on-line detention/retention may be more helpful. Swales make excellent pretreatment practices by providing for the infiltration of some stormwater and for some vegetative filtration. By using a raised stormsewer inlet, swales can provide water quality enhancement via retention and still serve as effective conveyances for flood protection. Swales can incorporate retention by using swale blocks, small check dams, or elevated driveway culverts to create storage, thereby reducing runoff velocity, reducing erosion, and promoting infiltration.

Using the runoff from 7.5 cm of rainfall as a design treatment volume, equations have been developed for swale block designs to store and infiltrate the runoff (17).

Table 2. Constant (K) for Design Equation for Triangular Shape

Z (Side Slope) $\left(\frac{\text{1 Vertical}}{\text{Z Horizontal}}\right)$	K (U.S. Units)	K (SI Units)
1	10,516	75,552
2	9,600	68,971
3	8,446	60,680
4	7,514	53,984
5	6,784	48,740
6	6,203	44,565
7	5,730	41,167
8	5,337	38,344
9	5,006	35,966
10	4,722	33,925

The swale block volume can be calculated for a fixed length of swale using:

Volume of runoff – volume infiltrated = swale block volume

$$Q(\Delta t) - Q_i(\Delta t) = \text{swale block volume}$$

$$Q(\Delta t) - \left[\frac{L n^{3/8} i}{K S^{3/16}}\right]^{8/5} (\Delta t) = \text{swale block volume} \qquad (1\text{–}2)$$

where

Q_i = average infiltration rate (m^3/sec)
Δt = runoff hydrograph time (sec)

Wanielista and Yousef (18) present the following example problem using Equations 1 and 2 for designing a swale with cross blocks to satisfy a specific water quality goal:

Given

n = 0.05
i = 7.5 cm/hr
S = 0.0279
z = 7
Q_i = 0.0023m^3/sec for Δt = 100 min

what swale length would be necessary to percolate all the runoff?

Using Equation 1,

$$L = \frac{41{,}167\,(0.0023)^{5/8}\,(0.0279)^{3/16}}{(0.05)^{3/8}\,7.5} = 193 \text{ meters.}$$

If only 76 m is available, how much storage volume is necessary?

Using Equation 2,

$$(0.0023)(60)(100) - \left[\frac{(76)(0.05)^{3/8}(7.5)}{41{,}167(0.0279)^{3/16}}\right]^{8/5} 60(100) = \text{volume,}$$

and the volume of storage is equal to 10.7 m^3.

In highway designs for high-speed situations, safety must be considered; thus, a maximum depth of water equal to 0.5 m (about 1.5 ft) and flow line slopes on the berms of 1 vertical/20 horizontal are recommended. Along lower speed highways or in some residential/commercial urban settings, steeper flow line berm slopes (1/6) are acceptable.

The studies of swales in Washington state resulted in the following recommendations to improve water quality benefits (15):

- Maximum design velocity should not exceed 27 cm/sec.
- A hydraulic residence time of at least 9 min is recommended for removal of about 80 percent of the total suspended solids. Longer residence times will provide higher removal effectiveness.
- Swale width should be limited to 2 to 2.5 m unless special measures are provided to ensure a level swale bottom, uniform flow spreading, and management of flows to prevent formation of low-flow channels.
- Swale slopes should be between 2 and 4 percent.
- Water depth should be limited to no greater than one half the height of the grass, up to a maximum of 7.5 cm.
- Swale length will be a function of the hydraulic residence time, swale width, and stormwater volume and velocity.

Porous Pavement

Local land development codes typically specify the type of material for a parking lot (i.e., paved, grass, gravel) and determine the number and size of parking spaces within a parking lot. These requirements should be reviewed carefully to ensure that they are necessary (Is paving really required in every case?) and that the number of spaces is related to actual traffic demands. After these requirements have been reviewed and verified, the use of porous pavement within a parking lot should be examined. Porous pavement materials include porous asphalt, porous concrete, turf blocks, and even Geoweb covered with sod.

Overall, experiences with porous pavements have not been very good. Porous pavements have been prone to clogging. Causes include poor erosion and sediment control during construction, unstabilized drainage areas after construction, improper mixing and finishing of the pavement, and poor maintenance. Field investigations of porous concrete that has been in use for up to 15 years in Florida, however, indicate that these parking lots can continue to infiltrate rainfall and runoff if they were installed and maintained properly (19). Recommendations to improve the utility of porous pavements include the following:

- Be sure that the installer is properly trained in the design, mixing, installation, and finishing of the porous pavement material. Both porous asphalt and concrete must be mixed and installed much differently than regular asphalt or concrete.
- Exemplary erosion and sediment control during construction and complete site stabilization after construction are essential to prevent clogging of the void spaces within the porous pavement.
- The porous pavement must receive regular, routine vacuuming to remove accumulating solids. At times, nonroutine maintenance may involve cleaning with high-pressure water.
- The entrance to any porous pavement area should have a large sign warning those about to enter that porous pavement is in use. Precautions should include prohibiting vehicles with large amounts of soil on their tires.

Problems Associated With Infiltration Practices

There have been several concerns regarding the use of infiltration practices, including their propensity to fail, their potential effects on ground-water quality, and their need for maintenance.

Infiltration systems seem to have a very high rate of failure. The author believes, however, that this high failure rate is a reflection of improperly estimated infiltration rates and improper erosion and sediment control during the construction process. A 1990 field survey of stormwater infiltration facilities constructed in Maryland replicated a 1986 field survey, thereby providing data on the performance of infiltration practices after they have been in operation for several years (20). Table 3 summarizes the information from this project.

From Table 3 it can be seen that the overall condition and functioning of infiltration systems declined over time. In 1986, about two-thirds of all facilities were functioning as designed, while in 1990 only about half were. Only 42 percent of the facilities were functioning as designed in both 1986 and 1990, while about 27 percent were not functioning as designed in both years. About 24 percent of the systems were functioning in 1986 but not in 1990, while only 7 percent of those not working in 1986 were working in 1990. Maintenance was needed at more facilities in 1990 (66 percent) than in 1986 (45 percent). Additionally, many facilities (38 percent) that needed maintenance in 1986 still needed maintenance in 1990, while 32 percent of the facilities that did not need maintenance in 1986 did need it in 1990. Only 10 percent of the systems that needed maintenance in 1986 did not need maintenance in 1990. These data indicate that little effort is expended on maintaining the operational capabilities of stormwater management systems.

A second concern about infiltration practices is whether they simply are transferring the stormwater pollution problem from surface waters to ground waters. Harper (14) has shown that stormwater pollutants, especially heavy metals, quickly bind to soil particles, while vegetation is effective in filtering pollutants, thereby minimizing the risk of ground-water contamination. Ground water beneath swales and retention areas located in

Table 3. Comparison of the Operation of Maryland Infiltration Practices

Type of BMP	1986 Number of Sites	1986 Number of Sites Working	1990 Number of Sites	1990 Number of Sites Working
Basins	63	30 (48%)	48	18 (38%)
Trenches	94	75 (80%)	88	47 (53%)
Dry wells	30	23 (77%)	25	18 (72%)
Porous pavement	14	7 (50%)	13	2 (15%)
Swales	6	3 (50%)	3	2 (67%)
Totals	207	138 (67%)	177	87 (49%)

highly sandy soils with low organic content and sparse vegetative cover, however, did show elevated levels of heavy metals down to depths of 20 ft (21).

References

1. Livingston, E.H. 1988. State perspectives on water quality criteria. In: Design of urban runoff controls, an Engineering Foundation conference. Potosi, MO.

2. Yousef, Y.A., M.P. Wanielista, and H.H. Harper. 1986. Fate of pollutants in retention/detention ponds. In: Stormwater management: An update. Publication 85-1. Orlando, FL: University of Central Florida (July). pp. 259-275.

3. Miller, R.A. 1985. Percentage entrainment of constituent loads in urban runoff, South Florida. U.S. Geological Survey Document No. WRI 84-4329.

4. Livingston, E.H., and E.M. McCarron. 1992. Stormwater management: A guide for Floridians. Fl. Tallahassee, FL: Department of Environmental Regulation.

5. St. Johns River Water Management District. 1992. Rule 40C-42 and associated applicant's handbook. Palatka, FL.

6. Wanielista, M.P. 1977. Quality considerations in the design of holding ponds. Presented at the Stormwater Retention/Detention Basins Seminar, University of Central Florida, Orlando, FL (August).

7. Wanielista, M.P., Y.A. Yousef, G.M. Harper, T.R. Lineback, and L. Dansereau. 1991. Precipitation, interevent dry periods, and reuse design curves for selected areas of Florida. Final report. Contract WM-346. Submitted to the Florida Department of Environmental Regulation, Tallahassee, FL.

8. Shaver, H.E. 1986. Infiltration as a stormwater management component. In: Proceedings of the Urban Runoff Technology Engineering Foundation Conference, Henniker, NH (June). pp. 270-280.

9. Avellaneda, E. 1985. Hydrologic design of swales. M.S. thesis. University of Central Florida, Orlando, FL (December).

10. Sediment and Stormwater Division. 1986. Maintenance of stormwater management structures: A departmental summary. Annapolis, MD: Department of Natural Resources, Water Resources Administration (July).

11. Sediment and Stormwater Administration. 1984. Standards and specifications for infiltration practices. Baltimore, MD: Maryland Department of the Environment.

12. Wanielista, M.P., M.J. Gauthier, and D.L. Evans. 1991. Design and performance of exfiltration systems. Final report. Contract C3331. Submitted to the Florida Department of Transportation, Tallahassee, FL.

13. Yousef, Y.A., M.P. Wanielista, H.H. Harper, D.B. Pearce, and R.D. Tolbert. 1985. Best management practices: Removal of highway contaminants by roadside swales. Final report. Contract 99700. Submitted to the Florida Department of Transportation, Tallahassee, FL.

14. Harper, H.H. 1985. Fate of heavy metals from highway runoff in stormwater management systems. Ph.D. dissertation. University of Central Florida, Orlando, FL.

15. Horner, R.R. 1988. Biofiltration systems for storm runoff water quality control. Final report. Submitted to City of Seattle, Washington.

16. Water Pollution Control Department. 1992. Biofiltration swale performance, recommendations, and design considerations. Publication 657. Seattle, WA.

17. Wanielista, M.P., Y.A. Yousef, L.M. Van DeGroaff, and S.H. Rehmann-Koo. 1986. Best management practices: Enhanced erosion and sediment control using swale blocks. Final report. FL-ER-35-87. Submitted to the Florida Department of Transportation, Tallahassee, FL (September).

18. Wanielista, M.P., and Y.A. Yousef. 1986. Best management practices overview. In: Proceedings of the Urban Runoff Technology Engineering Foundation Conference, Henniker, NH (June). pp. 314-322.

19. Florida Concrete Products Association. 1991. Pervious pavement manual and field performance tests. Orlando, FL.

20. Lindsey, G., L. Roberts, and W. Page. 1992. Inspection and maintenance of infiltration facilities. J. Soil Water Conserv. 47(6):481-186.

21. Harper, H.H. 1988. Effects of stormwater management systems on ground water quality. Final report. Contract WM-190. Submitted to the Florida Department of Environmental Regulation, Tallahassee, FL.

Stormwater Reuse: An Alternative Method of Infiltration

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Abstract

Runoff water stored in a wet detention pond can be an asset if it is used to recharge surficial aquifer levels. The recharge can occur directly from the pond by infiltrating the detained water, or the detained water can be irrigated over the watershed. Reuse in the watershed or infiltration at the pond lessens the quantity of water discharged, thus reducing the pollutant mass discharged to surface waters. A benefit of irrigation is a reduction in the use of potable water otherwise used for irrigation.

A mass balance on pond storage volume using rainfall data for select areas in the southeastern United States was completed to determine the percentage of stormwater runoff that can potentially be irrigated or infiltrated for each area as a function of contributing area, runoff coefficient, volume of temporary storage, and irrigation rate. Design curves were developed that relate the efficiency (E), or the percentage of runoff that is irrigated on a yearly basis, to the volume of temporary storage (V) in a reuse pond and the rate of irrigation (R). The design curves, called REV curves, permit the selection of a temporary storage volume and irrigation rate for a given efficiency, runoff coefficient, and geographic area. This paper contains example REV curves and presents simplified uses of the results.

Introduction

The pollutants associated with stormwater and the volume of stormwater discharges can result in significant impacts to the natural and manufactured environments of any watershed. As watersheds are made more impervious due to paving and other construction activities, the volume of runoff and pollutant mass discharged to surface waters increases relative to predeveloped conditions.

Potential impacts from uncontrolled runoff are loss of freshwater from an area where the rainfall occurred, additional freshwater discharges to estuaries, increased pollutant mass loadings, decreased river base flows, reduced wetland areas, and an economic loss associated with the need to replace discharged freshwater with potable or other waters.

Water policy in the state of Florida requires a performance standard for all stormwater management methods. A stormwater pollutant annual average load reduction of 80 percent for discharges to most waters and of 95 percent for those discharging into outstanding Florida waters (1) are required. Of the currently used stormwater management methods, off-line retention and chemical treatment can achieve the stated pollutant removal efficiencies. Wet detention ponds that discharge to adjacent surface waters, however, do not. If some of the detained water can be used within the watershed and not discharged to surface waters, the wet detention ponds may also meet the standards.

A Stormwater Reuse Pond

A stormwater reuse pond is proposed to retain runoff water within a watershed and to reduce the mass of pollutants in the discharges to surface water bodies. The difference between a wet detention pond and a reuse pond is the operation of the temporary storage volume. A wet detention pond is designed to discharge the runoff water and possibly some ground water to adjacent surface waters, while a reuse pond is designed to reuse a specific fraction of the runoff volume and not discharge that fraction. In this paper, mathematical relationships are developed between the reuse volume (temporary storage volume), the rate at which stormwater is reused, and the percentage of annual surface runoff that is reused.

The traditional design of pond temporary storage volume for a wet detention pond has been based on the consideration of water quality and uses a design storm. The design storm, however, usually ignores the preceding rainfall record and assumes that there is an antecedent dry period long enough to ensure that the pond is at some control elevation. The usual assumption is a zero temporary storage.

To address the sensitivity of the temporary storage volume to interevent dry periods, long-term rainfall records were used from 25 Florida and seven other southern states' rainfall stations in a model that simulates the behavior of a reuse pond over time. A spreadsheet was used to build a 15-year mass balance for a pond. After each rainfall event, surface runoff and reuse volumes were respectively added to and subtracted from the previous pond storage volume. If the temporary storage volume exceeded the available storage volume, discharge occurred. If the temporary storage volume was less than zero (the permanent pool volume was used for reuse water), supplemental water was used to replenish the pond and maintain the permanent pool. Both the rate of reuse from the pond and the reuse volume were varied. The reuse efficiency, defined as one minus the total volume of surface discharge divided by the total volume of runoff times 100, was calculated for each combination.

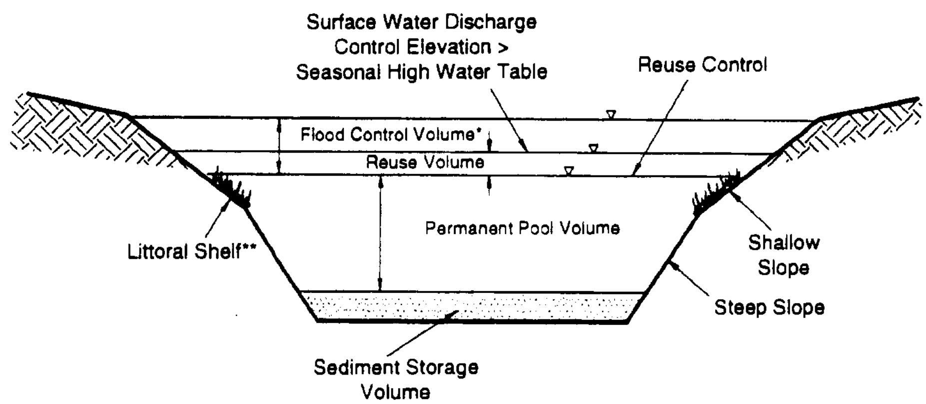
Simulation of a Reuse Pond

To establish a relationship between the efficiency, the reuse rate, and the reuse volume of a pond, a continuous time model was used to simulate the dynamics of a reuse pond. Continuous models are reported to be most representative (2). The efficiency of the pond, or the percentage of runoff that is reused, was calculated for different reuse volumes and reuse rates. Charts for different regions were produced using the local rainfall records of these regions. The term "model" is used to refer to the basic unchanged equation of the mass balance in which different rainfall records were inserted and reuse volumes and reuse rates were varied. "Simulation" is used to refer to the complete calculations of the model in which volume and rate were defined. There is only one model, while many simulations were done.

Figure 1 depicts a cross section of a typical reuse pond. The sediment storage volume lies at the bottom to receive settled matter. Above this is the permanent pool volume, which provides a minimum residence time for stormwater. The reuse volume (temporary storage volume) is the volume above the permanent pool and below the flood control structure. The flood control volume would typically be above the reuse volume.

The reuse pond differs from a typical detention pond in that instead of the temporary storage volume being depleted by a surface water discharge device (such as a bleed-down orifice in an outlet pipe), it is drawn down by a reuse system and is thus called the reuse volume. A reuse pond may deplete the pond volume below the permanent pool boundary requiring a supplemental volume to maintain this volume. A discharge structure is still necessary for flood control. Common practice should be used for the design of sediment storage, permanent pool, and flood control volumes, and their elevations and side slopes. This paper provides methodology and design criteria for the reuse volume only.

The water level of a typical reuse pond fluctuates during a year. During and following a rainfall event, there is runoff into the pond, and the water level rises to some depth above the permanent pool. If this new water level exceeds the level of the surface discharge control, discharge will occur at some rate until the water level drops back to the elevation of the control structure. The reuse pond volume is incremented daily, removing an amount of water for reuse. If the reuse volume is expended, supplemental water, such as ground water, may be used to maintain the permanent pool volume. This could occur as seepage through the sides of the pond or by mechanical pumping. This scenario was simulated by creating a mass balance for pond operation.



* Can be measured above permanent pool; however, some regulatory agencies measure above the reuse volume.
** The reader should consult local water management districts and other regulatory agencies to determine specific geometric and littoral zone design requirements.

Figure 1. Schematic of a stormwater reuse pond.

R0015992

The Model

The model is based on the continuity equation

$$\text{INPUTS} - \text{OUTPUTS} = \Delta S. \qquad \text{(Eq. 1)}$$

If all potential water movements are considered, a complete hydrologic balance may be expressed in volume units as

$$R_E + G + P \pm F - R - D - ET = \Delta S, \qquad \text{(Eq. 2)}$$

where

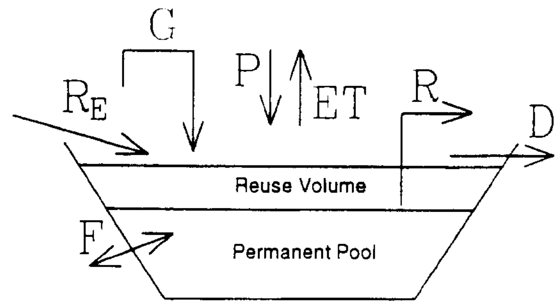
R_E = rainfall excess or runoff volume
G = supplemental water (ground water)
P = precipitation directly on the pond
F = water movement through the sides of the pond
R = reuse (infiltration)
D = discharge
ET = evapotranspiration
S = storage in pond

In Florida, the average evapotranspiration rate for a pond is generally equal to the average precipitation on the pond in a 1-year period (approximately 50 in.). Additionally, evaporation data are only available in mean monthly rates compared with the daily time step of the model, making the estimate of evaporation potentially inaccurate. These parameters were dropped from the mass balance. Also, because of its complexity, the flow of ground water through the sides of the pond was assumed to equal zero, and Equation 2 was further simplified to

$$R_E + G - R - D = \Delta S. \qquad \text{(Eq. 3)}$$

For Florida modeling purposes, there were two inputs, runoff and supplement, and two outputs, reuse and discharge (Figure 2). Runoff was established from known precipitation and watershed data. The reuse rate was a controlled variable. Both supplemental water and discharge were functions of the water level of the pond, or the storage volume. Because ground-water movement was assumed to equal zero, supplemental water is considered as that which is pumped into the pond mechanically. Supplement occurs at a rate necessary to maintain the permanent pool; the maximum required rate would equal that of reuse. Because potential storage capacity is being constantly eliminated by supplement, this may be considered as being conservative. With the previous simplifications, the actual pond may be simulated by the model.

The calculations for each simulation were done using Quattro Pro, an electronic spreadsheet. The top and bottom calculations and input data for one simulation can be seen in Figure 3. The columns of the upper portion of the simulation are the incremental registers of



$$R_E + G + \not{P} \pm \not{F} - R - D - \not{E}\not{T} = \Delta S$$

$$R_E + G - R - D = \Delta S$$

Figure 2. Summary of mass balance of reuse pond, simplified for Florida conditions.

the various parameters, which are labeled along the top. Each of these variables is defined as follows:

EVENT	A distinct rainfall occurrence; for computational purposes, each day of a multiday rainstorm is considered a separate event.
DATE	The date on which an event occurs.
DRY	The dry period separating rainfall events (days); if events occur on consecutive days there are no dry days. This value is not used in the basic model but is needed for the sensitivity analysis of the discharge potential.
RAIN	The amount of rainfall recorded during each event (inches). This information was taken directly from National Oceanic and Atmospheric Administration (NOAA) rainfall data.
RUNOFF	The amount of runoff that enters the pond during an event (inches).
REUSE	The amount of water reused during the day of an event and the dry days following the previous event (inches); the rate of reuse remains constant during a single simulation.
DISCHARGE	
Potential:	The potential amount of discharge for an event (inches); the amount that could, if necessary, physically discharge during the time since the previous event. This was established as 2 in./day over the equivalent impervious area (EIA).

R0015993

ORLANDO RAINFALL STATION (May 1974 - Dec. 1988) Volume = 3 in, Rate = 0.2 in/day

EVENT	DATE	DRY Days	RAIN In.	RUNOFF In.	REUSE In.	DISCHARGE Poten.	DISCHARGE Actual	SUPLMNT In.	NET In.
0	04-May-74								0
1	05-May-74	0	0.12	0.12	0.2	2	0	0.08	0.00
2	06-May-74	0	0.77	0.77	0.2	2	0	0.00	0.57
3	07-May-74	0	0.04	0.04	0.2	2	0	-0.00	0.41
4	08-May-74	3	0.33	0.33	0.2	2	0	0.00	0.54
5	12-May-74	1	0.15	0.15	0.8	8	0	0.11	0.00
6	14-May-74	0	0.11	0.11	0.4	4	0	0.29	0.00
7	15-May-74	0	0.46	0.46	0.2	2	0	0.00	0.26
8	16-May-74	0	0.07	0.07	0.2	2	0	0.00	0.13
9	17-May-74	5	0.23	0.23	0.2	2	0	0.00	0.16
10	23-May-74	3	0.35	0.35	1.2	12	0	0.69	0.00
11	27-May-74	4	0.06	0.06	0.8	8	0	0.74	0.00
12	01-Jun-74	0	1.19	1.19	1	10	0	0.00	0.19
13	02-Jun-74	0	0.07	0.07	0.2	2	0	0.00	0.06
14	03-Jun-74	6	0.05	0.05	0.2	2	0	0.09	0.00
15	10-Jun-74	0	2.19	2.19	1.4	14	0	0.00	0.79
16	11-Jun-74	2	0.18	0.18	0.2	2	0	0.00	0.77
17	14-Jun-74	0	0.05	0.05	0.6	6	0	-0.00	0.22
18	15-Jun-74	1	0.54	0.54	0.2	2	0	0.00	0.56
19	17-Jun-74	6	0.09	0.09	0.4	4	0	0.00	0.25
20	24-Jun-74	0	0.95	0.95	1.4	14	0	0.20	0.00
21	25-Jun-74	0	1.07	1.07	0.2	2	0	0.00	0.87
22	26-Jun-74	0	3.47	3.47	0.2	2	0	0.00	4.14
23	27-Jun-74	0	1.89	1.89	0.2	2	1.14	-0.00	4.69
24	28-Jun-74	1	3.36	3.36	0.2	2	1.69	0.00	6.16
25	30-Jun-74	0	0.17	0.17	0.4	4	3.16	0.00	2.77
26	01-Jul-74	0	0.12	0.12	0.2	2	0	-0.00	2.69
27	02-Jul-74	0	0.88	0.88	0.2	2	0	0.00	3.37
1386	23-Dec-88	4	0.04	0.04	1.4	14	0	1.36	0.00
1387	28-Dec-88		0.05	0.05	1	10	0	0.95	0.00
	Summation:		706.88	706.88	1070.40		75.72	439.24	

% Discharged = Total Discharge/Total Runoff = 10.71%
% Reused = 1 - Total Discharge/Total Runoff = 89.29%

Inputs:				
Runoff:	706.88 in.		Inputs	1146.12 in.
Supplement:	439.24 in.		- Outputs	-1146.12 in.
	1146.12 in.		Storage	0.00 in.
Outputs:				
Reuse:	1070.40 in.			
Discharge:	75.72 in.			
	1146.12 in.			

Figure 3. Example of computer model using rainfall data from Orlando, Florida.

Actual:	The amount that does discharge during an event (inches); depends on the water level of the pond but is restricted to the potential discharge.
SUPLMNT	The amount of water needed between events to maintain the permanent pool volume (inches).
NET	The amount of water above the permanent pool recorded at the end of each event (inches).

Every day in which a rainfall event takes place represents one line in the simulation. This is the fundamental time step of the model. All inputs and outputs occur during this 24-hour period. At the end of the period, the net storage value of the pond is calculated. From this value, decisions are made concerning discharge and supplement. The process then repeats itself.

The 15-year totals for rain, runoff, reuse, actual discharge, and supplement are calculated as shown in Figure 3. From these values, the efficiency, or the percentage of runoff reused, can be determined for a particular simulation. The efficiency is equal to one minus the volume of water that is discharged divided by the volume of runoff times 100. The percent discharged, the volume of water discharged divided by the volume of runoff, is also calculated. The percent reused plus the percent discharged equals 100.

At the bottom of Figure 3 is a summary of the mass balance for the entire record. Both the inputs and outputs are listed and totaled. The difference between the inputs and outputs, labeled "Storage," is compared with the final value for NET. The values should be identical. This is used primarily to check the calculations.

This single model was used to predict the behavior of a reuse pond subjected to the rainfall record of 32 different locations in the southeastern United States. Previously, one location in Florida was reported (4). To simulate a pond in a particular region, the rainfall record of that region was inserted into the DATE and RAIN columns of the model. The model was then lengthened or shortened to match the span of the rainfall record. Otherwise, no changes were made to the model. By using one model and varying only the rainfall record, the consistency of the simulations was assured.

Length of Rainfall Record

An investigative question that arises when examining the random behavior of rainfall is how large a record must be to accurately represent the meteorological characteristics of a region. In other words, how many years of rainfall data must be used to estimate the ultimate dynamics of the pond? Obviously, the greatest accuracy can be obtained by using the most data. But the incremental benefit of each additional unit of data diminishes so that there is a point beyond which using more is no longer reasonable. This is the limit for investigation.

Twenty-four individual simulations were run for the Moore Haven and Tallahassee stations using, first, 1 year of rainfall data (1988) and then incrementally adding the next previous year to the rainfall record. The yearly efficiencies for several combinations of reuse volumes and reuse rates were recorded. As expected with only a few years of data, the average yearly efficiencies fluctuated widely but then leveled out as more years of data were added. As the size of the database increased, each additional year had less impact. Beyond 15 years, there was very little change in the average annual estimate.

Volume Units

Runoff, discharge, reuse, supplement, and net storage are volumes of water that are expressed in units of inches. Volumes are commonly expressed as inches over a defined area and, likewise, the parameters of this model are based on a variable unit area that the user defines. Rates are merely volumes delivered over a period and thus can be expressed in the same manner. This unit area is the EIA of the watershed or the product of the runoff coefficient and the contributing watershed area. The volumetric unit of inches on the EIA is a way in which the results are generalized for any runoff coefficient and contributing area. Once the EIA is known, the values can be converted to more practical units using simple conversions.

Model Output

The basic function of the model is to determine a relationship between the reuse rate, the reuse volume, and the efficiency. This was done by varying the reuse rate and the reuse volume, then calculating the efficiency. Thus, a simulation was done for each combination of reuse rate and reuse volume. The reuse volumes considered varied between 0.25 and 7.0 in. on the EIA. The reuse rates varied between 0.04 and 0.30 in./day on an area equivalent to the EIA. The respective efficiencies are shown as fractions. The results are presented in chart form as shown in Figure 4. The ultimate functional product of the reuse pond model is the rate-efficiency-volume (REV) chart. Wanielista et al. (5) presents the REV charts for all of the 25 locations in Florida for which accurate and long-term rainfall data were available. Individual REV charts are specific to geographical regions with similar meteorological characteristics.

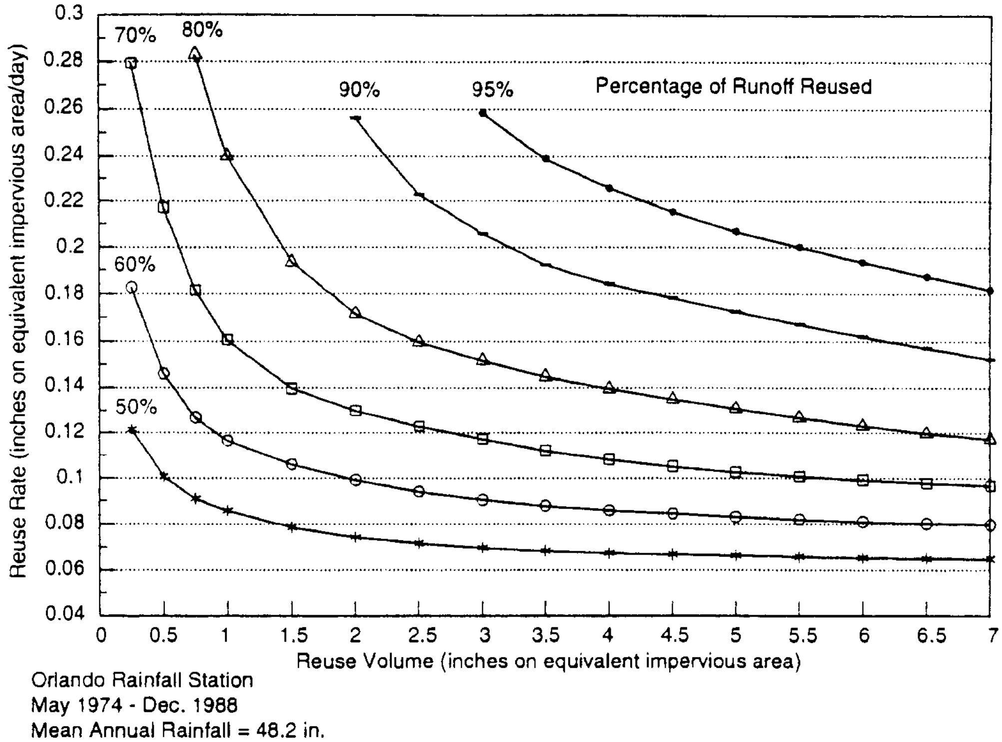


Figure 4. REV chart for Orlando, Florida.

Use of the REV Charts

REV charts relate the reuse rate, the efficiency, and the reuse volume of a pond. Recommended irrigation rates for Florida are between 0.38 in./week in the winter to 2.25 in./week in the summer (6). Information concerning any two of these three variables is necessary for the determination of the third. The use of a REV chart requires an understanding of the concept of the EIA. The units of both the reuse rate and the reuse volume are based on this area. A REV chart is specific for an area, and the accuracy of the predictions are related to the accuracy of the input data. The REV charts of this paper have been placed in a computer program that reduces the possibility of calculation errors (7).

The efficiency is defined as the average percentage of runoff that is reused over a period, specifically 15 years. A pond that discharges to surface waters 10 percent of the runoff that flows into it must reuse the remaining and so is 90 percent efficient. It may sometimes be desirable to determine the efficiency of an existing pond. More often it will be necessary to achieve a required efficiency established by local regulations, thus making the efficiency one of the known values. On every REV chart, there is a curve for each of the following efficiency levels (in percentage): 50, 60, 70, 80, 90, and 95.

Examples of Direct Use

Example 1

A watershed in Orlando must reuse 80 percent of the annual runoff from a 10-acre impervious area. The pond area is included in the impervious area. The maximum reuse storage volume available for the pond is equal to the runoff from a 3-in. rainfall event. At what rate must the runoff be reused?

Because the entire watershed is impervious, the EIA is equal to 10 acres. Because runoff equals rainfall on impervious areas, the storage volume is equal to 3 in. on the EIA. The reuse rate is a function of the efficiency and the reuse volume:

$$R = f(E,V)$$
$$= f(80\%, 3 \text{ in.})$$
$$= 0.152 \text{ in./day}$$

By referring to the Orlando REV chart (Figure 4), the necessary reuse rate is estimated at 0.152 in./day on the EIA. The rate and volume can be expressed in other units:

$$V = 3 \text{ in.} \times \text{EIA} \times \frac{10 \text{ ac}}{\text{EIA}}$$

$$= 30 \text{ ac–in.} \times \frac{43{,}560 \text{ ft}^2}{\text{ac}} \times \frac{\text{ft}}{12 \text{ in.}}$$

$$= 109{,}000 \text{ ft}^3$$

and

$$R = 0.152 \frac{\text{in.}}{\text{day}} \times \text{EIA} \times \frac{10 \text{ ac}}{\text{EIA}}$$

$$= 1.52 \frac{\text{ac–in.}}{\text{day}} \times \frac{43{,}560 \text{ ft}^2}{\text{ac}} \times \frac{\text{ft}}{12 \text{ in.}}$$

$$= 5{,}520 \frac{\text{ft}^3}{\text{day.}}$$

Example 2

An apartment complex located in Tallahassee needs to reuse 90 percent of the runoff from its parking lots. The EIA is equal to the directly connected impervious area and is 4 acres. The complex wants to use 0.26 in. of water per day over the EIA. What must the reuse volume be to maintain these conditions?

From the REV chart for Tallahassee (Figure 5), the required reuse volume is determined to be 3.5 in. on the EIA:

$$V = f\,(E,R)$$
$$= f\,(90\%,\ 0.26 \text{ in./day})$$
$$= 3.5 \text{ in.}$$

Again, the volume and rate can be expressed in other units:

$$V = 3.5 \text{ in.} \times \text{EIA} \times \frac{4 \text{ ac}}{\text{EIA}}$$

$$= 14 \text{ ac–in.} \times \frac{43{,}560 \text{ ft}^2}{\text{ac}} \times \frac{\text{ft}}{12 \text{ in.}}$$

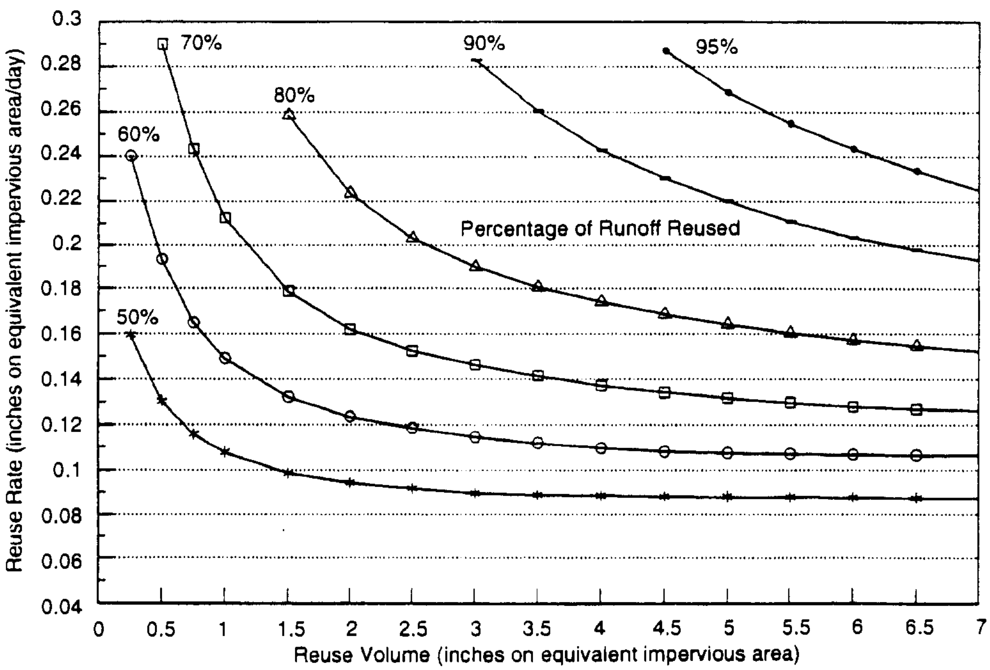
$$= 50{,}800 \text{ ft}^3$$

and

$$R = 0.260 \frac{\text{in.}}{\text{day}} \times \text{EIA} \times \frac{4 \text{ ac}}{\text{EIA}}$$

$$= 1.04 \frac{\text{ac–in.}}{\text{day}} \times \frac{43{,}560 \text{ ft}^2}{\text{ac}} \times \frac{\text{ft}}{12 \text{ in.}}$$

$$= 3{,}780 \frac{\text{ft}^3}{\text{day.}}$$



Tallahassee Rainfall Section
Jan. 1974 - Dec. 1988
Mean Annual Rainfall = 64.3 in.

Figure 5. REV chart for Tallahassee, Florida.

The previous examples illustrate the most simple application: the watershed being impervious and the volume and rate given in terms of the EIA. Much more complex design problems, however, can be solved using the same technique. The following steps can be used in any design situation:

1. Select the appropriate chart.
2. Compute the EIA of the watershed (EIA = contributing area x effective C).
3. Determine known variables in terms of the EIA.
4. Reference the chart to obtain a solution.
5. Convert the answer to desired units.

Evaporation and Rainfall on Pond

One of the initial simplifications of the pond mass balance was the assumption that the mean annual evaporation from the pond is equal to the mean annual rainfall on the pond. The evaporation totals in the Southeast may range from 30 to over 60 in./yr. Precipitation rates range from 37 in./yr in Key West to 64.5 in./yr in Tallahassee.

While evaporation and direct rainfall rates are based on the size of the pond, all other model parameters were based on the EIA. Therefore, a ratio was established between the size of the pond and the EIA. Because detention ponds usually require no more than 5 percent of the total area of the watershed, depending on the impervious area, a conservative estimate of pond area to a completely impervious area was chosen as 1:10. As an example, a 1-in. rainfall event, through direct precipitation, would add 1 in. of rainfall to the pond or 0.10 in. over the EIA.

Evaporation data were obtained from NOAA Climatological Data publications for the years 1985 through 1989. Because the locations of climatological stations match those of precipitation stations in only a few instances, evaporation data from nearby stations were used with selected model locations. Evaporation data from Lisbon and Lake Alfred were introduced into the models of Orlando and Parrish, respectively. The evaporation data were available in monthly pan evaporation totals. Fifteen years of records were used and converted to surface water evaporation rates by multiplying by a pan coefficient. The mean annual total evaporation for the two locations is 56.46 in. for Lake Alfred and 41.07 in. for Lisbon.

The evaporation function was added to the models by distributing evaporation depths in inches for each time interval. The amount of evaporation for each interval is the product of the number of days in that interval and mean daily evaporation rates for the month. To ensure the assumed distribution did not affect the total evaporation volume, the mean annual evaporation volumes for the 15-year simulations were compared with the mean volumes obtained from NOAA. The totals were almost identical.

To use the REV charts, rainfall on the pond must be included in the calculation of the EIA. When the area of the pond (approximated at 15 percent of the EIA) was added to the EIA, the pond reuse volume increased, and for a fixed reuse rate the average annual efficiency increased by at least 2.5 percent. Because rainfall on the pond reflects an impervious condition (all rainfall yields rainfall excess), it must be added to the EIA while maintaining consistent units (depth on an impervious area).

Recommendations

A mathematical mass balance model can be developed to simulate the operation of a stormwater reuse pond. This can be done for areas that have daily rainfall data available for a significant period, about 15 years.

The reuse of stormwater within a watershed from which it came should be encouraged and in some areas required. Reuse ponds can be designed to conserve water within a watershed and to reduce the mass of pollutants entering the surface waters.

The effective impervious area for a watershed should include the area of the pond when using the REV curves. The effective impervious area calculation is necessary for the use of the REV curves. More than one REV curve for a location is expressed in a figure called a REV chart.

For an average annual pollutant mass removal of 80 percent in a wet detention pond, at least 50 percent of the runoff volume should be reused when the REV charts are used for design. For a 95 percent annual pollutant mass removal, at least 90 percent of the runoff volume should be reused. The reuse percentages assume a wet detention pond will remove an average 60 percent of the incoming runoff pollution mass annually before surface discharge, which may overestimate the actual efficiency.

The reuse of stormwater is both an environmentally and economically sound management practice. The current common practice is to release stormwater to adjacent surface waters from detention ponds using weirs and orifices. Frequently, if not all the time, this detained volume of water is greater than the volume of water released from the land in its natural condition. Some fraction of this detained water can be reused within the watershed to 1) irrigate open areas, 2) recharge ground water, 3) supplement water used for certain industrial purposes, 4) enhance and create wetlands, and 5) supply water for agricultural users.

Currently, the most popular reuse method has been the irrigation of relatively open spaces, for example, golf courses, cemeteries, recreation areas, citrus groves, and common areas of apartment complexes. The primary reason for these reuse systems is economics. Many irrigation systems use treated ground water. An alternative to the use of ground water is detained stormwater. Treated ground water cost about $1.00/thousand gallons. A golf course of 100 acres using treated ground water at a cost of $1.00/thousand gallons and irrigating at 2 in./wk would pay almost $300,000/yr for the irrigation. Using detained stormwater, the irrigation system yearly cost could be less than $40,000.

In this paper, continuous modeling for reuse ponds was completed and was based on a mass balance using area-specific rainfall data to develop design criteria for stormwater reuse ponds. The design procedure relates pond temporary storage (reuse volume) to reuse rate and a percent reuse of the runoff water and is expressed as a REV curve. Also, mathematical equations for the curves have been computer coded.

The REV curves can be used for various watershed sizes or runoff coefficients. They may be used to determine the reuse rate, the reuse volume, or the efficiency of a pond. Supplemental water needs in a hydrologic balance also can be estimated. The REV charts presented in this paper could facilitate the rational planning of stormwater reuse systems.

Acknowledgments

The outcomes of this paper resulted from a research project funded by the Florida Department of Environmental Regulation in Tallahassee, Florida. The authors also appreciate the technical assistance given to them by Eric Livingston and John Cox of that department.

References

1. Cox, J. 1991. State water policy: Summary of Chapters 17-40, Florida Administrative Code. Tallahassee, FL: State Department of Environmental Regulation.
2. James, W., and M. Robinson. 1982. Continuous models essential for detention design. Proceedings of the Conference on Stormwater Detention Facilities. American Society of Civil Engineers.
3. Wanielista, M.P. 1990. Hydrology and water quantity control. New York, NY: John Wiley and Sons. pp. 4-5.
4. Wanielista, M.P., Y.A. Yousef, and G.M. Harper. 1990. Precipitation and interevent dry periods. Kyoto, Japan: International Association of Water Pollution Research.
5. Wanielista, M.P., Y.A. Yousef, G.M. Harper, and L. Dansereau. 1991. Design curves for the reuse of stormwater. Tallahassee, FL: Florida Department of Environmental Regulation.
6. Augustin, B.J. 1991. Watering your Florida lawn. Fact Sheet No. OH-9. Gainesville, FL: Institute of Food and Agricultural Sciences.
7. Wanielista, M.P., and Y.A. Yousef. 1993. Stormwater management. New York, NY: John Wiley and Sons.

Use of Sand Filters as an Urban Stormwater Management Practice

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Background

As our recognition of the need for stormwater control, from both quantity and quality perspectives, has increased, efforts to develop strategies and practices to address stormwater runoff have emerged all over the country. Many of these efforts have been developed on a state or local level depending on the specific issues that motivated program development.

The concerns over stormwater control and strategies for dealing with stormwater are now international in scope. Society as a whole needs to learn about what individuals have already accomplished to allow for evolution of control strategies and individual practices. Efforts under way at the state level (in Delaware, Florida, Maryland, South Carolina, and Washington) and at the municipal level (in Austin, Texas; Washington, DC; and Alexandria, Virginia) provide some hands-on knowledge regarding the programs and types of stormwater control practices that have been used successfully.

The intent of this paper is to discuss stormwater control practices, in particular, filtration systems. Experience with stormwater control ponds and infiltration systems has led to considerable knowledge about these methods, but interest is increasing in the use of sand filters in several locations around the country for stormwater treatment. Use of these systems will expand as national efforts addressing stormwater control are implemented.

Existing Efforts in the Use of Sand Filter Systems

The first interesting point is the way that sand filter systems have been used historically around the country. These systems are being used for onsite and regional control, as well as for water quality control only and for both water quality and water quantity control.

Austin, Texas

The city of Austin has pioneered the use of sand filters for stormwater treatment. Other areas have experimented over the years with sand filters, but Austin has made a long-term commitment to their use and evolution. The design standards for sand filters have evolved based on performance and maintenance considerations.

Sand filters are used on site and on a regional basis (usually less that 50 acres of drainage), and the filters are sized to accept and treat the first half-inch of stormwater runoff from the contributing drainage area (1). They are frequently used in conjunction with a stormwater detention basin, which provides for control of larger storms from a water quantity perspective. Good water quality data for the performance of these systems have resulted, which indicates that sand filters can be very effective at pollutant removal.

Washington, DC

Sand filter use is based on a design standard developed by the Stormwater Management Branch of the Department of Consumer and Regulatory Affairs. The sand filter system design is based on whether water quantity is a concern in addition to water quality on a specific site. Washington, DC, has a combined sewer system, and sites that discharge into a combined sewer system must design their sand filters to provide for peak control of the 15-year storm. If only water quality is an issue, a design procedure is established based on the degree of site imperviousness. For water quality control alone, storage requirements are between 0.3 and 0.5 in. of runoff per acre (2). The Stormwater Management Branch is initiating a monitoring program to determine the performance of the sand filters.

State of Delaware

Delaware has developed a sand filter design system based on the Austin design but that serves for water quality control only. It is intended for sites where stormwater runoff, only from impervious areas, may drain to the sand filter. The sand filter is designed to accept and treat the first inch of stormwater runoff and is used as either a "stand alone" practice or in conjunction with another practice, such as an infiltration practice (3). Where infiltration practices are used, the sand filter provides pretreatment of the runoff to reduce premature clogging of the infiltration practice. At this time, design performance is not being monitored, but achieving an 80-percent reduction in suspended solids is considered an acceptable practice as required under the statewide stormwater management law.

Alexandria, Virginia

The city of Alexandria has developed a design manual that supplements the northern Virginia BMP handbook (4). The Alexandria supplement details the design requirements of "no net increase" in pollutant loading for new development and a 10-percent reduction in pollutant loading at site redevelopment locations. To achieve these goals, phosphorus was accepted as a "keystone" pollutant for design purposes. The Alexandria supplement provides information on a number of different sand filter design procedures and is probably the single best compilation of information relating to design procedures developed in areas such as Austin, Delaware, and Washington.

Other Areas and Efforts

The only other procedure that is more experimental (although, in reality, they all still are) is the peat-sand filter developed by the Washington Council of Governments. This procedure is a variation of the traditional sand filter design that uses peat as a medium for enhanced nutrient reduction. The State of Washington has recently completed a stormwater design manual that presents a sand filter design based on the Austin system.

Discussion

Sand filters represent an emerging technology with significant potential for evolution in coming years. The procedure developed for the State of Delaware was intended for use on small sites where overall site imperviousness was maximized. Examples of these sites would be fast food restaurants, gas stations, or industrial sites, where space for retrofitting is not readily available. Another emphasized use for sand filters is as a pretreatment system for stormwater infiltration practices. Infiltration practices are very susceptible to clogging by particulates, and sand filters could provide an effective means to reduce particulate loading and to block oil and grease from entry into infiltration systems.

Sand filters are especially appropriate for highway systems where site conditions and right-of-ways limit the types of feasible stormwater treatment practices. Sand filter systems generally have lower maintenance needs than infiltration practices have, so their use appeals to highway officials if the costs can be made reasonable.

If the sand filter is moved to the edge of the parking lot or roadway, where structural strength is not as important, the system can be installed at significantly lower cost. The City of Alexandria has developed a variation of the Delaware approach where the sand filter is behind curb openings. In addition, increasing the head over the filter can increase the time between required maintenance of the filter, thus lowering the system's operation and maintenance costs. Consideration should be given to placing stone over the sand to prevent scour of the sand as water drops on the filter, in addition to increasing the overall depth of the sand to improve performance.

The design procedure developed for use in Delaware is meant as guidance and can be modified or enhanced as needed depending on specific site conditions. The practice as presented may be used in the middle of a parking lot, where concrete and grate strength are established, so that automobiles or trucks could travel over the system. Consultants have taken that design standard literally, which has made construction costs extremely high.

Any one of these systems could be modified or improved with proper engineering. Conversations have started with different manufacturers to see if sand filter units could be prefabricated which would reduce the overall cost of installation. The use of sand filters will dramatically increase if construction costs are reduced.

Conclusion

Sand filters have a strong potential for becoming an effective tool for stormwater treatment, but engineering expertise is necessary to improve performance and cost. With proper maintenance and in conjunction with other practices, sand filters can assist in water quality protection. They also have potential in arid regions, where more conventional practices such as wet ponds are not feasible.

We live in an era where our desires and mandates for clean water exceed our abilities to actually protect our aquatic resources when structural controls are considered as the only method of stormwater control. The term "treatment train" is certainly a concept that must be expanded if resource protection is to be realized. Sand filters are one car of the "treatment train," but the overall train must include many different considerations. Ultimately, land use must be a consideration in overall site stormwater planning, and considerations of roadway widths, curbing, and site compaction and utilization must be flexible depending on individual site needs. Why does a residential street have to be wide enough for a fire engine to turn around in? We need to question basic planning assumptions with respect to resource protection, and to evaluate whether a specific design requirement is necessary in light of that requirement's impact on our natural resources. Otherwise, we need to recognize and accept the fact that a decline in quality and productivity of our resources will occur.

References

1. City of Austin. 1988. Environmental criteria manual. Environmental and Conservation Services Department, City of Austin, TX (June).
2. Truong, H.V. 1989. The sand filter water quality structure. Stormwater Management Branch, Government of the District of Columbia, Department of Consumer and Regulatory Affairs (May).
3. Shaver, E. 1991. Sand filter design for water quality treatment. Proceedings of the Engineering Foundation Specialty Conference, Crested Butte, CO.
4. City of Alexandria. 1992. Alexandria Supplement to the Northern Virginia BMP Handbook. Department of Transportation and Environmental Services, City of Alexandria, VA (February).

Application of the Washington, DC, Sand Filter for Urban Runoff Control

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Abstract

Conventional infiltration systems are frequently used for water quality control of urban runoff. These types of urban best management practices (BMPs), however, may adversely affect ground-water quality through the migration of pollutants into ground-water aquifers. Additionally, these BMPs may not be feasible in high-density urban areas because of the large land areas required for their installation.

To address these problems, this paper presents an alternative solution: to replace conventional infiltration BMPs with the confined, underground sand filter water quality (SFWQ) control structure. Over 70 of these structures have been installed in Washington, DC, since 1988.

The Washington, DC, underground sand filter is a gravity flow system consisting of a concrete structure with three chambers. It is designed to provide quality control for the first ½ in. of runoff. The first chamber performs pretreatment of stormwater runoff by removing floating organic material such as oil, grease, and tree leaves. The second chamber is the filter chamber (process chamber) and optimally contains a 3-ft filter layer. The filter layer consists of gravel, clean sand, and geotextile filter fabric. At the bottom of the filter is a subsurface drainage system of polyvinyl chloride perforated pipes in a gravel bed. The third chamber is a discharge chamber that collects flow from the underdrain pipes.

The SFWQ structure may vary in size and shape. The depth can range from 8 to 10 ft depending on the final grading of the site.

Introduction

Urbanization resulting in surface- and ground-water contamination is a serious and constant threat to water quality. In turn, poor water quality is an undesirable economic burden on taxpayers. Because of the extremely high cost involved in restoring contaminated surface and ground water, prevention seems to be the only economical course of action to protect natural water systems.

To regulate and provide protection for surface- and ground-water systems, the federal government passed the Clean Water Act. As part of this effort, the District of Columbia enacted stormwater management regulations (DC Law 5-188, section 509-519) in January 1988. These regulations require new developments and redevelopments to control nonpoint source pollution transported from construction sites by urban runoff, using best management practices (BMPs) or best available technologies (BATs).

Infiltration devices are the most frequently used BMPs for controlling stormwater runoff in urban areas. These conventional BMPs have limitations, however, due to soil and site-specific constraints. These BMPs may also adversely affect ground water through the migration of pollutants into ground-water aquifers. Additionally, conventional infiltration systems may not be feasible in an urban environment because of the large land areas required for their installation. In an effort to mitigate these problems, an alternative design is outlined in this paper to replace the conventional infiltration BMPs, where applicable. This alternative system is called the confined sand filter water quality (SFWQ) structure and is illustrated in Figure 1. The system uses multiple filter layers combined with a moderate detention time to filter the suspended pollutant particles and hydrocarbons from urban runoff. A multiple-layer filter was chosen because it has proven to be more effective than a single-layer filter design.

Background

Infiltration practices have been widely used to improve the quality of urban stormwater runoff. Several limitations, however, are associated with the use of conventional

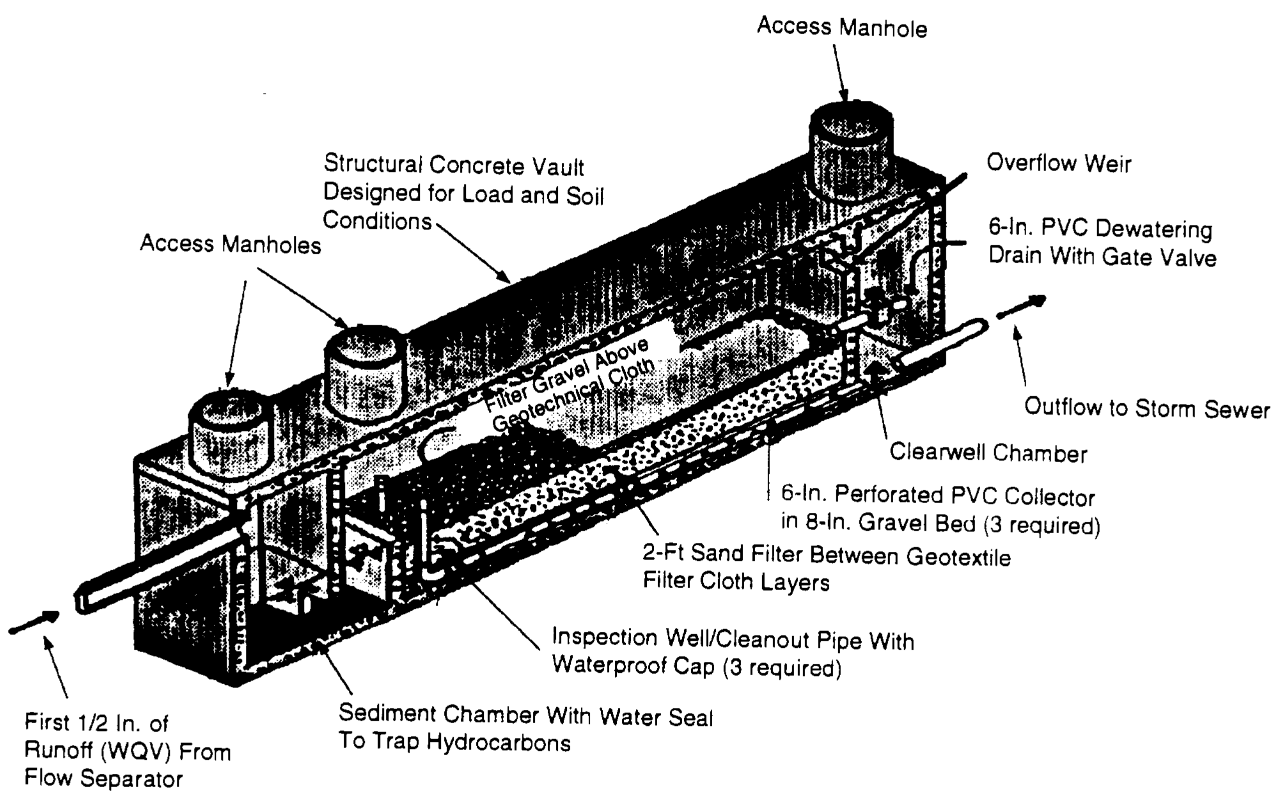

Figure 1. DC three-dimensional sandfilter centerline cutaway (source: District of Columbia).

infiltration systems. According to several studies (1-3), the practice of infiltration may have a negative impact on ground-water quality. In addition, infiltration practices are only recommended for sites with soil infiltration rates higher than 0.27 in./hr and with a clay content of less than 30 percent. Recently, a study by the Metropolitan Washington Council of Government (MWCOG) shows that over 50 percent of the infiltration trenches installed in the Metropolitan Washington region either partially or totally failed within the first 5 years of construction (4). Research has also found that clogging may occur in infiltration trenches and is also very common in other infiltration systems. In surface systems, clogging is most likely to occur near the top of the structure, between the upper layer of stone and the protective layer of filter fabric. For underground infiltration systems, clogging is likely to occur at the bottom of the structure, at the filter fabric, and at the soil interface.

Restoration of both surface and underground infiltration systems is tedious and very costly, requiring the removal of the vegetation layer, top soil, protective plastic layer, stone aggregate, and filter fabrics. If the surface layer is pavement or concrete, the rehabilitation effort becomes even more difficult and expensive. Conventional infiltration systems also require relatively large areas of land for their installation; therefore, this family of BMPs is not feasible due to the high cost of land in an urban environment.

Design Rationale

Whenever a liquid containing solids in suspension is placed in a relatively quiescent state, solids having a higher specific gravity than the liquid settle, while those having a lower specific gravity rise. The design of the SFWQ structure uses the one-dimensional "falling head test" in Darcy's Law for calculating the head loss of fluid flow through a multiple-layer filter medium to treat stormwater runoff. The design uses various media layers with different permeabilities to intercept pollutant particles as fluid flows vertically through the filter layers. This principle can be used to accelerate the removal of pollutants by increasing the residence times of stormwater runoff, and to facilitate the filtering process in the filter chamber. The SFWQ structure also utilizes Stoke's Law for terminal falling velocities of individual particles in allowing time for particles to settle out of stormwater runoff. The average detention time of this system ranges from 6 to 8 hr for an optimal design consideration.

Functional and Physical Description

The SFWQ structure is a gravity flow system consisting of three chambers. The facility may be precast or cast-in-place. The first chamber (same as water quality inlet) is a pretreatment facility removing any floating organic material such as oil, grease, and tree leaves. The chamber has a submerged weir leading to the second chamber (filter chamber) and may be designed with a flow splitter or with a bypass weir if the system is for off-line storage, as illustrated in Figure 2.

The second chamber contains 3 ft of filter material consisting of gravel, geotextile fabric, and sand, and is situated behind a 3-ft weir. At the bottom is a subsurface drainage system consisting of a parallel polyvinyl chloride (PVC) pipe system in a gravel bed. A dewatering valve is at the top of the filter layer for maintenance purposes and for safety release in case of emergency. It also has an overflow weir at the top to protect the system from backing up when the storage volume is exceeded, if the system is designed for on-line storage (Figure 3).

Water enters the first chamber of the system by gravity or by pumping. This chamber removes most of the heavy solid particles, floatable trash, leaves, and hydrocarbon material. A submerged weir (designed to minimize the energy of incoming stormwater) conveys the effluent to the second chamber. The effluent enters the filter layer by overflowing the weir typically 3 ft above the bottom of the structure. The water is filtered through various filtering layers to remove suspended pollutant particles. The filtered stormwater is then picked up by the subsurface drainage system that empties it into the third chamber. The third chamber also receives any overflow from the second chamber for an on-line system and overflow from the first chamber flow splitter for an off-line system.

Applicability

The SFWQ structure is specifically designed for highly urbanized areas where open space is not available. The

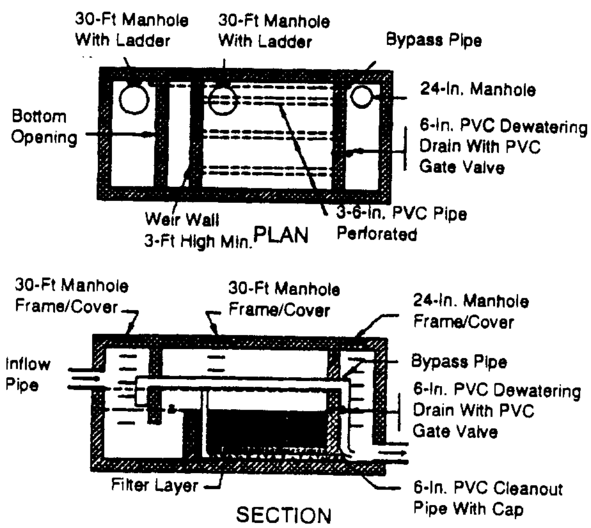

Figure 2. DC off-line underground sand filter (source: District of Columbia).

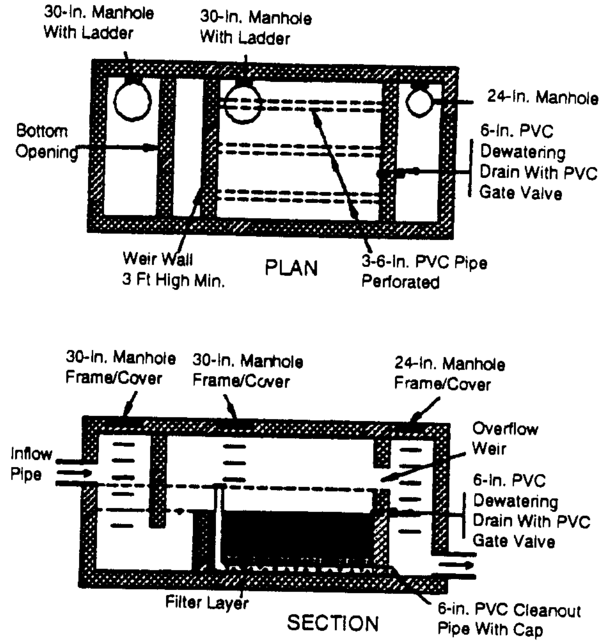

Figure 3. DC on-line underground sand filter (source: District of Columbia).

structure works best for impervious catchment areas of 1 acre or less. Multiple systems are recommended for catchment areas greater than 1 acre.

Over 70 underground and surface sand filter structures have been installed in Washington, DC, since 1988. In fact, the structure has been adopted and incorporated in the stormwater management programs of several states and neighboring jurisdictions.

The structure may also be designed to provide detention, especially for on-line application when discharge rates must be modified in accordance with local and municipal regulations. Recommended areas where this device may be used include:

- Surface parking lots.
- Underground parking lots or multilevel garages.
- Parking apron, taxiway, and runway shoulders at airports.
- Emergency stopping and parking lanes and sidewalks.
- Vehicle maintenance areas.
- On-street parking aprons in residential areas.
- Recreational vehicle camping area parking pads.
- Private roads, easement service roads, and fire lanes.
- Industrial storage yards and loading zones.
- Driveways for residential and light commercial use.
- Office complexes.

Planning Considerations

Location

The SFWQ structure must be located in areas where it is accessible for inspection and maintenance, as well as to the vacuum trucks that are usually required to provide maintenance.

Ground Water and Bedrock

The seasonally high ground-water table and bedrock should be at least 2 to 4 ft below the footing of the structure.

Size

The SFWQ structure may vary in size from a small-site single installation to large or multiple facility installations. Site topography and the presence of underground utilities, however, may limit the size and depth of the system. Use of other practices in combination with the SFWQ structure may solve this problem.

Hydraulic Head

Because the SFWQ structure is a gravity flow system, sufficient vertical clearance between the inverts of the inflow and outflow pipes must be provided. When elevation is insufficient, a well pump may be used to discharge the effluent from the third chamber into the receiving drainage system.

Water Trap

In combined sewer areas, a water trap must be provided in the third chamber to prevent the backflow of odorous gas.

Design Criteria

In designing the SFWQ structure, the nature of the area, such as imperviousness, determines the control volume of the sand filter chamber. Other recommended steps to consider when designing a SFWQ structure are the following:

- Examine the site topographical conditions and select possible outfalls from the existing drainage or sewer map.
- Review the final grading plans and determine the maximum head available between the proposed inflow and outflow pipes.
- Determine the total connected impervious area.
- Select the design (first flush) runoff based on land use characteristics. (Washington, DC, uses 0.5 in. for surface parking lots, 0.3 in. for rooftops, and 0.4 in. for other impervious surfaces.)
- Estimate the storage volume and the release rate. The storage volume and release rate depends on local stormwater management regulations.
- Select design storm(s). This should be based on the storm frequencies selected by the stormwater management authorities.
- Determine the size of the inflow, outflow, and emergency release pipes. These should be sized to pass the lowest selected storm frequency permitted by local stormwater regulations. (Washington, DC, uses 15-yr, 5-min storms for postdevelopment runoff.)
- Determine detention time. All SFWQ structures should be designed to drain the design (first flush) runoff from the filter chamber 5 to 24 hr after each rainfall event.
- Determine structural requirements. A licensed structural engineer should design the structure in accordance with local building codes.
- Provide sufficient headroom for maintenance. A minimum head space of 5 ft above the filter is recommended for maintenance of the structure. If 5 ft of headroom is not available, a removable top should be installed.

Design Procedures

Determine Design Invert Elevations

Determine the final surface elevation, invert in, invert out, and bottom invert elevation of the structure (see Figure 4):

$$D_t = (\text{Inv. in} - \text{Inv. out}) + H_w + 1, \qquad \text{(Eq. 1)}$$

where

D_t = total depth of structure (ft)
Inv. in = final invert elevation of inflow pipe (ft)
Inv. out = final invert elevation of outflow pipe (ft)
H_w = vertical height of overflow weir (ft)
1 = freeboard constant (ft)

Peak Discharge Calculation for Bypass Flow

Using the Rational Method:

$$Q_{pk} = CIA, \qquad \text{(Eq. 2)}$$

where

Q_{pk} = bypass peak flow (ft_3/sec)
C = runoff coefficiency (dimensionless)
I = rainfall intensity (in./hr)
A = drainage area (ac)

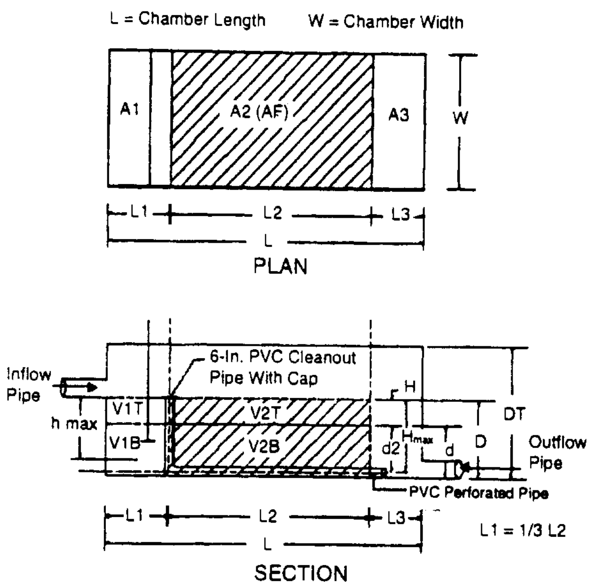

Figure 4. Design guide for DC sandfilter (source: District of Columbia).

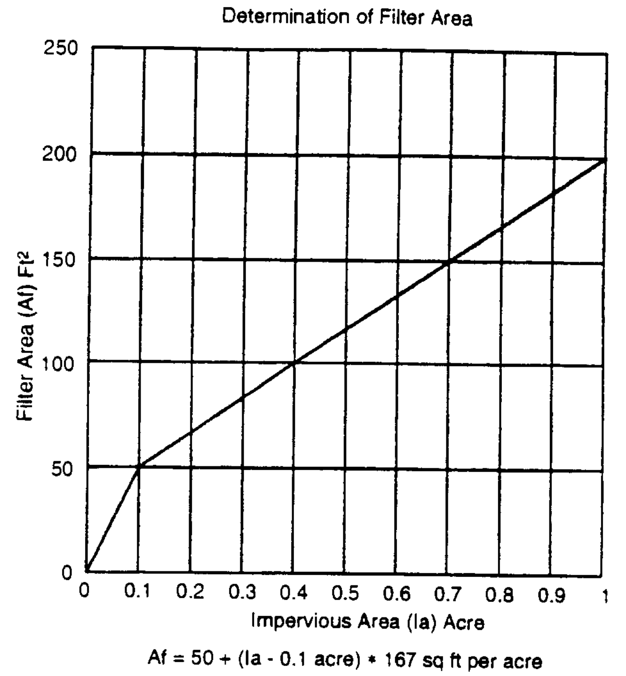

Figure 5. Filter area versus watershed imperviousness (source: District of Columbia).

Determine Area of Sand Filter

Use Figure 5 or the following equation:

$$A_f = 50 + [Ia - 0.1 \text{ acres}] \times 167 \text{ ft}^3/\text{ac}, \qquad \text{(Eq.3)}$$

where

A_f = sand filter area (ft2)
I_a = impervious area (ac)

Determine Storage Volume

Use the equation

$$V_w = (Q_i \times I_a) - (F \times T \times A_f), \qquad \text{(Eq. 4)}$$

where

V_w = volume storage needed (ft3)
Q_i = first flush runoff (in)
I_a = impervious area (ft^2)
F = final infiltration rate for filter (ft/hr)
T = filling time (1 hr, based on empirical data)
A_f = sand filter area (ft^2)

Calculate Bottom Storage Volume in Second Chamber

Use the equation

$$V_{2b} = Af \times d \times V_v, \qquad \text{(Eq. 5)}$$

where

V_{2b} = bottom volume of filter chamber (ft3)
A_f = surface area of filter layer (ft2)
d = depth of filter layer (ft)
V_v = sum of void ratio for filter media

Calculate Bottom Storage Volume in First Chamber

Use the equation

$$V_{1b} = A_1 \times d, \qquad \text{(Eq. 6)}$$

where

V_{1b} = bottom volume of first chamber (ft^3)
A_1 = surface area of first chamber (ft^2)
d = depth of filter layer (ft)

Note: $A_f/3 < A1 < A_f/2$ for optimum design condition.

Calculate Storage Volume in First and Second Chambers

Use the equation

$$(V_{1t} + V_{2t}) = V_w - (V_{2b} + V_{1b}), \qquad \text{(Eq. 7)}$$

where

$V_{1t} + V_{2t}$ = sum of top volume of first and second chambers

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V_w = volume of water from Equation 4
$V_{2b} + V_{1b}$ = sum of bottom volume of first and second chambers

Determine Maximum Storage Depth for On-Line System

Use the equation

$$D = [(V_{1t} + V_{2t})/(A_1 + A_2)] + d, \quad \text{(Eq. 8)}$$

where

D = maximum storage depth (ft)
$V_{1t} + V_{2t}$ = sum of top volume of first and second chambers
$A_1 + A_2$ = sum of surface area of first and second chambers
d = depth of filter layer (ft)

Note: D must be equal to or smaller than the difference between the invert in and invert out from Equation 1.

Determine Size of Submerged and Overflow Weirs

Submerged weir opening in first chamber:

$$A(h \times l) = Q_{pk}/C \times (2 \times g \times h_{max})^{0.5}, \quad \text{(Eq. 9)}$$

where

$A(h \times l)$ = area of weir opening (ft^2)
Q_{pk} = bypass flow from Equation 2 (ft3/sec)
C = 0.6, weir coefficient
g = 32.2 ft^2/sec
h_{max} = hydraulic head above the center line of weir (ft)
h = weir height, minimum 1 ft

Overflow weir opening in second chamber:

$$H^{1.5} = Q_{pk}/CL, \quad \text{(Eq. 9a)}$$

where

H = height of weir opening (ft)
Q_{pk} = bypass flow (ft^3/sec)
C = 3.33, weir coefficient
L = length of weir opening (ft)

Determine Flow Through Filter and Detention Time After Storage Volume Fills Up

Average flow through the filter:

$$q_f = k \times A_f \times i, \quad \text{(Eq. 10)}$$

where

q_f = flow through the filter (ft^3/hr)
k = sand permeability (ft/hr)
A_f = filter area
i = hydraulic gradient ($H_{max}/2$ x filter depth)

Estimate the detention time:

$$T_s = V_w/q, \quad \text{(Eq. 11)}$$

where

T_s = average dewatering time for SFWQ structures (hr)
V_w = volume of first flush storage from Equation 3 (ft^3)
q = average flow from Equation 10 (ft^3/hr)

Develop Inflow and Outflow Hydrographs

Figure 6 is a typical illustration of inflow/outflow hydrographs for the SFWQ structure.

For inflow hydrograph, use Modified Rational Method Hydrograph with:

$T = T_c$
$T_R = 1.67\ T_c$,

where

T = time to peak
T_c = time of concentration
T_R = recession period

For outflow hydrographs, use the following equations to determine when flow occurs:

when

$$T_c \times Q_{pk} < 2V_w, + \quad \text{(Eq. 12)}$$
$$T = [2*T_c2 - (2T_c2 - 2V_w*T_c/Q_{pk})^{0.5}].$$

when

$$T_c \times Q_{pk} = 2V_w, + \quad \text{(Eq. 13)}$$
$$T = (0.5T_c) + (V_w/Q_{pk})$$

when

$$T_c \times Q_{pk} > 2V_w, + \quad \text{(Eq. 14)}$$
$$T = [(2V_w*T_c)/Q_{pk}]^{0.5}.$$

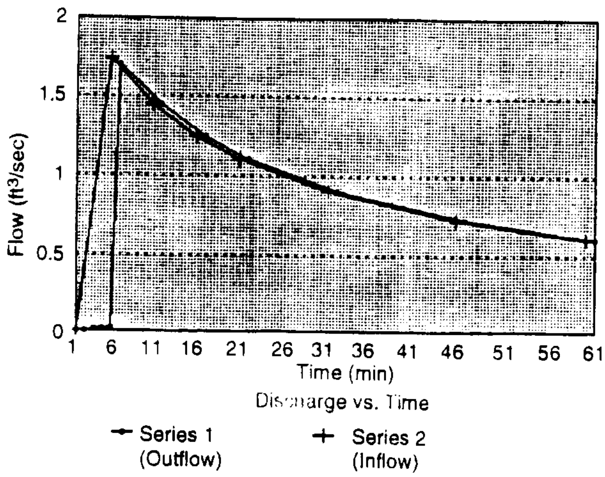

Figure 6. Typical inflow-outflow hydrograph (source: District of Columbia).

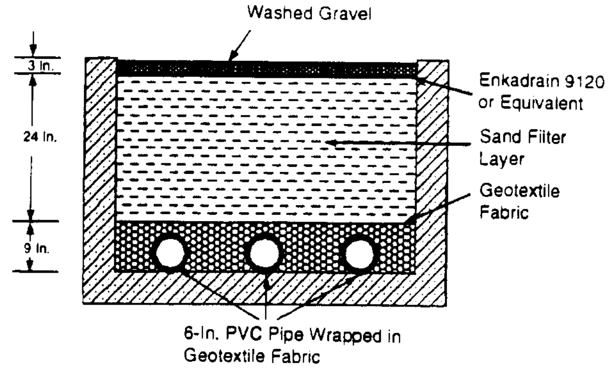

Figure 7. Cross section of filter compartment (source: District of Columbia).

Filter Layer Details

Figure 7 is a typical cross section of the filter chamber.

Upper Gravel Layer

The washed gravel or aggregate layer at the top of the filter may be 1 to 3 in. thick and meet American Society for Testing Materials (ASTM) standard specifications for 1-in. maximum diameter or DC #57 gravel.

Geotextile Fabrics

The filter fabric (geotextile fabric) beneath the top gravel layer should be Enkadrain 9120 or equivalent with the specifications shown in Table 1.

The filter cloth beneath the sand should meet the specifications shown in Table 2.

The fabric roll should be cut with sufficient dimensions to cover the entire wetted perimeter of the filter area with a 6-in. minimum overlap.Sand Filter Layer

Sand Filter Layer

The sand filter layer should be 18 to 24 in. deep. ASTM C33 Concrete Sand is recommended, but sand with similar specifications may be used.

Table 1. Geotextile Fabric Specifications

Property	Test Method	Unit	Specification
Material	Nonwoven geotextile fabric		
Unit weight	ASTM D-1777	oz/yd^2	4.3 (min)
Flow rate	"Falling head test" ASTMD-751	gpm/ft^2 lb	120 (min) 60 (min)
Puncture thickness		in.	0.8 (min)

Bottom Gravel Layer

The bottom gravel layer surrounding the collector (perforated) pipes should be 1/2- to 2-in. diameter gravel and provide at least 3 in. of cover over the tops of the drainage pipes. No gravel is required under the pipes. The gravel and the sand layer above must be separated by a layer of geotextile fabric that meets the specifications listed above.

Underdrain Piping

The underdrain piping consists of three 6-in. pipes with 3/8-in. perforations and should be reinforced to withstand the load of the overburden. All piping should be to schedule 40 polyvinyl chloride (PVC) or greater strength.

The minimum grade of piping shall be 1/8 in./ft or 1 percent slope. Access for cleaning all underdrain piping is needed. Cleanouts for each pipe should extend to the invert of overflow weir or maximum surface elevation of the storage water.

Each pipe should be carefully wrapped with geotextile fabric that meets the above specifications before placement in the filter.

Table 2. Filter Cloth Specifications

Property	Test Method	Unit	Specification
Material	Nonwoven geotextile fabric		
Unit weight		oz/yd^2	8.00 (min)
Filtration rate		in./sec	0.08 (min)
Puncture strength	ASTM D-751 (Modified)	lb	125 (min)
Mullen burst strength	ASTM D-751	psi	400 (min)
Tensile strength	ASTM D-1682	lb	300 (min)
Equivalent opening size	U.S. Standard Sieve	no.	80 (min)

Construction Specifications

The SFWQ structure may be either cast-in-place or precast. In Washington, DC, precast structures require advanced approval. The approved erosion and sediment control plans should include the specific measures to provide the protection of the filter system before the final stabilization of the site.

Excavation and Installation

Excavation for SFWQ structure and connecting pipes should include removal of all materials and objects encountered in excavation; disposal of excavated material as specified in the approved erosion and sediment control plans; maintenance and subsequent removal of any sheeting, shoring and bracing; dewatering and precautions; and work necessary to prevent damage to adjacent properties resulting from this excavation. Access manholes and steps to the filtration system should conform to local standards.

Leak Test

After completion of the SFWQ structure shell, a leak test may be performed to verify watertightness before the filter layers are installed.

Filter Materials

All filter materials in the second chamber should be placed according to construction and materials standards and specifications, as specified on an approved construction plan.

Completion and Site Stabilization

No runoff should be allowed to enter the sand filter system before completion of all construction activities, including revegetation and final site stabilization. Construction runoff should be treated in separate sedimentation basins and routed to bypass the filter system. Should construction runoff enter the filter system prior to final site stabilization, all contaminated materials must be removed and replaced with new, clean filter materials before a regulatory inspector approves its completion.

System Calibration and Verification

The water level in the filter chamber should be monitored by the design engineer after the first storm event before the project is certified as completed. If the dewatering time of the filter chamber takes longer than 24 hr, the top gravel layer and filter fabric underneath must be replaced with a more rapid draining fabric and clean gravel. The structure should then be checked again to ensure a detention time that is less than 24 hr.

Maintenance Requirements

The SFWQ structure is designed to minimize maintenance. It is subject to clogging, however, by sediment, oil, grease, grit, and other debris. Actual performance and service life of the structure is not available at this time. Nevertheless, it is still very important to provide general standard maintenance guidelines to maintain adequate structure operation. The maintenance of the system includes the following steps:

- The water level in the filter chamber should be monitored by the owner on a quarterly basis and after every large storm for the first year after completion of construction. A log of the results should be maintained, indicating the rate of dewatering after each storm and the water depth for each observation. Once the regulatory stormwater inspector indicates that satisfactory performance of the structure has been demonstrated, the monitoring schedule may be reduced to an annual basis.
- As with other pretreatment structures, the first chamber must be pumped out semiannually. If the chamber contains an oil skim, it should be removed by a firm specializing in oil recovery and recycling. The remaining material may then be removed by a vacuum pump truck and disposed of in an approved landfill. After each cleaning, refill the first chamber to a depth of 3 ft with clean water to reestablish the water seal.
- After approximately 3 to 5 yr, the upper layer of the filter can be expected to become clogged with fine silt. When the drawdown time for the filter exceeds 72 hr, the upper layer of gravel and geotextile fabric must be removed and replaced with new, clean materials conforming to the original specifications.

Conclusion and Discussion

At the present time, the environmental and economic impacts of the SFWQ structure have not been fully evaluated. A long-term monitoring program is being implemented in Washington, DC, to determine water quality benefits and address long-term maintenance concerns. The results from this monitoring effort will provide important information on the removal efficiency of common urban pollutants. In addition, the monitoring data will provide information on actual headloss in the system, which will indicate the need for filter replacement.

Based on the results of the Austin, Texas, monitoring program on its sand filter systems and on several years of success in the application of the SFWQ structure in Washington, DC, the feasibility of the SFWQ structure has been demonstrated for use in an urban environment. The authors believe that the SFWQ structure may be used as an alternative urban BMP for highly developed areas where other options are not available.

In conclusion, the design presented here is an attempt to provide an alternative solution to control nonpoint source pollution from urban stormwater runoff. The application of this system should be viewed with some caution, as the structure has not been monitored for optimal effectiveness.

When the SFWQ structure is used strictly as a gravity flow system, one of its limitations is that it requires a hydraulic head of at least 4 ft relative to the outflow pipe. To minimize this problem, further study is needed to evaluate the different thicknesses of the sand layers (with thicknesses such as 18, 12, and 6 in.) to determine the relationship between the depth of sand layer and pollutant removal efficiency.

Acknowledgments

Computer-aided design was performed by Renette Dallas, DC Environmental Regulation Administration, Washington, DC. The authors would also like to thank Renette Dallas and Collin R. Burrell, also of the DC Environmental Regulation Administration, for technical assistance.

References

1. Washington Area NURP Project. 1983. Final contract report. Manassas, VA: Occoquan Watershed Monitoring Lab.
2. U.S. EPA. 1983. Results of the nationwide urban runoff program, Vol. I. Final report. Water Planning Division.
3. Nightingale, H.T. 1987. Water quality beneath urban runoff water management basins. Water Resour. Res. 23(2):197-208.
4. Galli, J. 1992. Analysis of urban BMP performance and longevity in Prince George's County, Maryland. Washington, DC: Metropolitan Washington Council of Governments.

Additional Reading

1. Van Truong, H. 1989. The sand filter water quality structure. Washington DC: Environmental Regulation Administration.
2. Van Truong, H. 1993. The DC sand filter water quality structure, 2nd version. Draft. Washington DC: Environmental Regulation Administration.
3. Alexandria Department of Transportation and Environmental Services. 1992. Alexandria supplement to the Northern Virginia BMP handbook (adopted in February).
4. Chang, F.M., M.H. Watt, and H. Van Truong. 1986. Study of erosion and sedimentation of selected small streams in the District of Columbia. NTIS PB-86-246758. Washington, DC: WRRC.
5. Watt, H.M., J.V. O'Conor, and H. Van Truong. 1985. Ground-water problem in the mid-Atlantic fall line cities. NTIS PB-85-225985/8H. Washington, DC: WRRC.
6. Karikari, T.J., H. Van Truong, and M.K. Mitchell. 1988. DC stormwater management guidebook. Washington, DC: Environmental Control Division.
7. Truong, H.V. 1987. DC groundwater protection strategy. The District of Columbia Department of Consumer and Regulatory Affairs.
8. City of Austin. 1991. Design guidelines for water quality control basins. Austin, TX: Public Works Department.
9. Department of Public Works. 1986. DC public works water and sewer specifications and detail drawing. Washington, DC.
10. Das, B.M. 1990. Principle of geotechnical engineering, 2nd ed. Boston, MA: PWS-KENT Publishing Company.

Stormwater Measures for Bridges: Coastal Nonpoint Source Management in South Carolina

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Abstract

Although stormwater runoff from bridges has a direct pathway to estuaries, rivers, and lakes, little research has been undertaken to directly measure the concentration of pollutants flushed from the bridge surface or the impact of those pollutants on the receiving water body. A general correlation can be made, however, from the body of research available concerning runoff from roads and streets in general and from the wider body of information regarding urban runoff characteristics. The general assumption is that runoff from highways (and bridges) can negatively affect the water quality of receiving waters through the shock of acute loadings during rainfall events and through long-term exposure and/or accumulations of pollutants in sediments or marine organisms. Research does indicate a relationship between the average daily traffic volume and potential water quality impacts. Concern is heightened where the runoff has a direct, unobstructed pathway to the receiving waters and, even more so, where the receiving waters are extremely sensitive, such as shellfish habitat.

This paper provides a brief overview of potential water quality pollutants from highway and bridge runoff, then focuses on management and control measures for runoff from bridges. These include requirements of Section 6217 of the Coastal Zone Act Reauthorization Amendments and stormwater management requirements for bridges in the coastal zone of South Carolina. Included is a case study of retrofitting a major bridge already designed and under construction, which transverses significant shellfish resources in coastal South Carolina.

Introduction

South Carolina's 187-mile coastline is only the facade for some 3,000 shoreline miles of estuaries, bays, rivers, and creeks that intertwine among some 500,000 acres of coastal marshes and wetlands. This immense coastal system supports approximately 279,000 acres of estuarine shellfish-growing waters and thousands of acres of other sensitive habitats. For people to live and work in this environment, all of these coastal resources, rivers, bays, marshes, and sensitive habitats must be transversed in one form or another, most often by roadways and bridges. These roadways and bridges and their associated uses can provide a direct source of contaminants to our coastal waters and, as such, must be managed to reduce or alleviate the potential impacts.

For coastal states, addressing pollution from bridges may no longer be a choice. Section 6217 of the Coastal Zone Act Reauthorization Amendments of 1990 requires states with coastal zone programs to develop coastal nonpoint source pollution programs. Such programs must address pollution in the following areas: agriculture, silviculture, hydrologic modifications, marinas, and urban settings, the latter of which include roads and, even more specifically, bridges.

A basic assumption contained herein is that the results of studies on highways and their associated pollution potential from runoff are also applicable to highway bridges.

Contaminants

A series of studies sponsored by the U.S. Department of Transportation in the 1980s (1-3) confirms the presence and possible sources of a wide variety of contaminants that may be associated with roadways and bridges. A basic listing is presented in Table 1. These contaminants accumulate on roadway surfaces between major removal events, such as rainfalls and street sweeping (which may be rare or nonexistent in nonurban areas). The severity and order of magnitude of these contaminants are site specific and variable, and can depend on such factors as traffic characteristics, highway or bridge design, maintenance activities, accidental spills, surrounding land use, and climate.

Table 1. Common Highway Runoff Constituents and Their Primary Sources (1)

Constituent	Primary Sources
Particulates	Pavement wear, vehicles, atmosphere, highway maintenance
Nitrogen, phosphorus	Atmosphere, roadside fertilizer application
Lead	Leaded gasoline (auto exhaust), tire wear (lead oxide filler material), lubricating oil and grease, bearing wear
Zinc	Tire wear (filler material), motor oil (stabilizing additive), grease
Iron	Auto body rust, steel highway structures (guardrails, bridges, etc.), moving engine parts
Copper	Metal plating, bearing and bushing wear; moving engine parts; brake lining wear; fungicides and insecticides (roadside maintenance operations)
Cadmium	Tire wear (filler material), insecticides
Chromium	Metal plating, moving engine parts, brake lining wear
Nickel	Diesel fuel gasoline (exhaust) and lubricating oil, metal plating, bushing wear, brake lining wear, asphalt paving
Manganese	Moving engine parts
Bromide	Auto exhaust
Cyanide	Anticake compound (ferric ferrocyanide, etc.) used to keep deicing salt granular
Chloride	Deicing salts
Sulphate	Roadway beds, fuel, deicing salts
Petroleum	Spills, leaks, or blow-by of motor lubricants; antifreeze, and hydraulic fluids, asphalt surface leachate
Polychlorinated biphenyls (PCBs), synthetic pesticides	Spraying of highway right-of-ways, background atmospheric deposition, PCB catalyst in tires
Pathogenic bacteria (indicators)	Soil, litter, bird droppings, trucks hauling livestock and stockyard waste
Rubber	Tire wear
Asbestos	Clutch and brake lining wear

The studies have revealed some interesting results that may influence management decisions. To elaborate on one pollutant, tests (1) indicated that the pathogenic bacteria indicators fecal coliform and fecal *Streptococcus* were not consistently present on roadway systems at any given time or place; their presence is most often associated with nonspecific events, i.e., animal and bird droppings, soil spills, and road kills. When present, however, the bacteria can remain viable for relatively long periods in highway sweepings (up to 7 weeks) and up to 13 days in stagnant storm sewer systems. As one would expect, the tests showed that the coliform bacteria were consistently lower when runoff was conveyed through a grassy area, although none of the standard nonpoint source management measures effectively kills coliforms and their associated microbes (2).

According to the U.S. Department of Transportation (1), the major portion of priority pollution load in highway runoff was attributed to metals (e.g., lead, zinc, and copper), although a significant number of organic pollutants were present in the highway environment.

Studies (4, 5) indicate that the magnitude of pollutants associated with highway runoff is related to traffic volume. Research (2) tends to indicate that 30,000 average daily traffic (ADT) is a general threshold for the potential of impacts from highway runoff; however, several variables must be factored into this conclusion, including sensitivity of receiving waters, distance to receiving waters, type of traffic, road or bridge design, and others.

The U.S. Department of Transportation (2) has drawn the following conclusions from these studies and other literature concerning highway runoff pollution potential:

- Highway runoff does have the potential to adversely affect the water quality and aquatic biota of receiving waters.
- The significance of these adverse effects is variable by highway type and design, receiving water, and runoff event.
- Runoff from urban highways with high ADT volumes may have a relatively high potential to cause adverse effects.
- Runoff from rural highways with low ADT volumes has a relatively low potential to cause adverse effects.

Basic Management Practices and Processes

Of the variety of best management practices available for nonpoint source pollution control, four basic management measures are generally considered cost effective for treatment of highway runoff based on effectiveness for specific pollutants, relative capital costs, land requirements, and operation and maintenance costs (2):

- Vegetative controls
- Wet detention basins
- Infiltration basins
- Wetlands

Pollution measures that were not considered effective when used as a sole management tool were street cleaning, catch basins, filtration devices for sediment control, dry detention ponds, and porous pavements (2). The first three methods were not effective in capturing the fine sediments to which many pollutants attach themselves, while the dry detention pond tended to reflush the settled particles after each rainfall event. Porous pavement is limited to low-volume traffic areas, such as parking lots, because of current highway construction standards.

All of the measures have in common several physical or biochemical processes that occur to provide the necessary control of pollutants: settling, filtering, adsorption, bioassimilation, biodegradation, and volatilization or evaporation. Table 2 lists the process associated with each management measure as related to the general type of pollutant control.

Management Measures for Bridges

Although bridges can be assumed to cause the same types of water quality impacts as highways, and although the techniques to manage those impacts are fairly straightforward and generally well accepted, the unique location of bridges presents some problems. First, the runoff from the bridge must be intercepted from seeking its natural pathway and routed back to high land or another area suitable for treatment; secondly, land areas for treatment are usually limited.

Collection and transportation are most easily solved in the design of the bridge, although in coastal areas runoff may have to be transported long distances with little grade. The physical land requirements for the appropriate treatment method, however, tend to be the most limiting factors. Solutions are very site specific and must be included in the earliest planning stages of the bridge. Topography at the bridge/land junction is often the single most important factor in considering the design of an appropriate treatment method, although other factors, such as high water tables, soil types, and adjacent land use, also can be important in the design consideration process. The design of the stormwater system should not drive the design of the bridge, but neither should the design of the bridge preclude the design of an effective stormwater treatment system.

All of the traditional stormwater management methods can be considered for treatment of runoff from bridges: wet detention ponds, infiltration systems, grassed waterways, and wetlands. These can be used even in combination with less favorable methods, such as frequent sweeping or catch basins, if the lack of good alternatives so dictates. Other opportunities that may be present in the area should also be considered, such as nearby spoil disposal containment areas, preexisting treatment systems for nearby development, or discharge routing to less sensitive areas.

The U.S. Environmental Protection Agency (EPA) (6) lists several general guidelines and management practices for illustrative purposes, specifically for bridges, in the Section 6217 management measure guidance document:

Table 2. Principal Pollutant Fate Processes by Major Management Measures

	Management Measures			
Pollutant	**Vegetative Control**	**Detention Basins**	**Infiltration Systems**	**Wetlands**
Heavy metals	Filtering	Adsorption, settling	Adsorption, filtration	Adsorption, settling
Toxic organics	Adsorption	Adsorption, settling, volatilization	Adsorption, biodegradation	Adsorption, settling, biodegradation, volatilization
Nutrients	Bioassimilation	Bioassimilation	Absorption	Bioassimilation
Solids	Filtering	Settling	Adsorption, settling	Adsorption
Oil and grease	Adsorption	Adsorption, settling	Adsorption	Adsorption, settling
Biochemical oxygen demand	Biodegradation	Biodegradation	Biodegradation	Biodegradation
Pathogens	NA	Settling	Filtration	NA

NA = information not available

- Coordinate design with the Federal Highway Administration (FHWA), U.S. Coast Guard, U.S. Army Corps of Engineers, and other state and federal agencies as appropriate.
- Review National Environmental Policy Act requirements to ensure that environmental concerns are met.
- Avoid highway locations requiring numerous river crossings.
- Direct pollutant loadings away from bridge decks by diverting runoff waters to land for treatment.
- Restrict the use of scupper drains on bridges less than 400 ft in length and on bridges crossing very sensitive ecosystems.
- Site and design new bridges to avoid sensitive ecosystems.
- On bridges with scupper drains, provide equivalent urban runoff treatment in terms of pollutant load reduction elsewhere on the project to compensate for the loading discharged off the bridge.

Regardless of the "illustrative" nature of the above practices, EPA and the National Oceanic and Atmospheric Administration (NOAA) expect the states to address nonpoint pollution from bridges and to adopt enforceable policies by 1995 to manage the runoff or to document why such runoff is not a problem.

South Carolina's Approach

In 1988, the South Carolina Coastal Council was faced with the permitting of a new 2-mile bridge connecting the mainland with a major developed barrier island (see below) and crossing a major shellfish-producing area. As an outcome of the permitting of this project, the Coastal Council developed a set of guidelines to use in conjunction with the South Carolina Department of Highways and Public Transportation to allow all parties to anticipate the design of stormwater controls in new bridges. It is not unusual for bridges to be designed well in advance of the permitting process, and the inclusion of new design criteria can cause both new expenses and a politically unpleasant situation. The guidelines have been in use since 1989 and have been introduced as regulations to the 1993 South Carolina General Assembly. The regulations appear to meet the basic intent of the EPA/NOAA Section 6217 guidance, although this has yet to be determined. The basic regulations are as follows.

Stormwater Management Requirements for Bridge Runoff

The following are the criteria used to address stormwater management for bridges traversing saltwater and critical areas.

- No treatment is necessary for runoff from bridge surfaces spanning Class SA and Class SB tidal saltwaters. (SA and SB waters are suitable for primary and secondary contact recreation, crabbing, and fishing. The two classes differ in their dissolved oxygen [DO] limitations: SA waters must maintain daily averages of not less than 5.0 mg/L, and SB waters must maintain DO levels not less than 4.0 mg/L.) This runoff can be discharged through scupper drains directly into surface waters. The use of scupper drains, however, should be limited as much as possible.
- If the receiving water is classified as either outstanding resource waters (ORW) or shellfish harvesting waters (SFH), then the stormwater management requirements shall be based on projected traffic volumes and the presence of any nearby shellfish beds. Table 3 lists the necessary treatment practices over the different classes of receiving waters.
- The ADT volume is based on the design carrying capacity of the bridge.

Table 3. Requirements for Stormwater Management on Bridges in the Coastal Zone, South Carolina

	ADT Volume	
Water Quality Classification	**0-30,000**	**30,000**
ORW (within 1,000 ft of shellfish beds)	A	A
ORW (not within 1,000 ft of shellfish beds)	B	B
SFH (within 1,000 ft of shellfish beds)	B	A
SFH (not within 1,000 ft of shellfish beds)	B	B
SFH (not within 1,000 ft of shellfish beds)	B	B
SA (exceptional)	C	C
SB (high quality)	C	C

A = The first 1-in. of runoff from the bridge surface must be collected and routed to an appropriate stormwater management system or routed so that maximum overland flow occurs, encouraging exfiltration before reaching the receiving water body. Periodic vacuuming of the bridge surface should be considered.
B = A stormwater management plan must be implemented that may require the overtreatment of runoff from associated roadways to compensate for the lack of direct treatment of runoff from the bridge surface itself. Periodic vacuuming should be considered. The use of scupper drains should be limited as much as possible.

The Isle of Palms Connector: A Case Study in Retrofitting

The incorporation of a stormwater management system into a bridge design usually can be done without any great difficulty. Trying to incorporate a system into a bridge already designed and ready for permitting, however, can be much more difficult. Such was the case with the Isle of Palms Connector, an 11,500-ft, $30 million bridge that was to provide alternate access to the Isle of Palms, a barrier island town just outside of Charleston, South Carolina. The bridge route called for the crossing of some 9,000 ft of marsh, two major marsh creeks, and the Intracoastal Waterway. Location and environmental studies and basic bridge design were completed in 1979, the same year the state's coastal zone management program was authorized. Funding limitations slowed the process until 1987, when federal funds became available.

The proposed route for the Isle of Palms Connector crossed over some of the state's most productive commercial and recreational shellfish grounds. The live oyster volume in Hamlin Creek and Swinton Creek alone was surveyed by the South Carolina Wildlife and Marine Resources Department at 32,000 bushels. Annual clam production potential in the immediate area of the bridge is estimated to be between 140,000 and 250,000 clams.

The bridge was originally designed with traditional methods of handling stormwater; water was drained directly from the bridge through scuppers except at one previously identified sensitive area, where discharge was eliminated. Because there were no objections to the stormwater design in the original environmental impact assessment, approved by the FHWA in 1986, the South Carolina Department of Highways and Public Transportation was reluctant to make any changes. Relocation of the bridge was not an option, nor, as it turned out, was redesign of the bridge. The bridge was designed with approximately 9,000 ft at 0.0 percent grade, with elevated spans over the Intracoastal Waterway and one of the creeks (Figure 1). The State Highway Department estimated redesign to accommodate positive flows to both ends of the bridge at $10 million, a one-third increase in bridge cost (7).

The South Carolina Coastal Council, however, as primary permitting agency for the bridge, was sensitive to public demand that the bridge must incorporate a stormwater management system that met basic coastal stormwater guidelines (8). After several meetings, which included public input, the South Carolina Department of Highways and Transportation agreed to work with the Coastal Council in addressing stormwater within the limits of two constraints: the bridge location could not be changed, and the stormwater system must be adaptable to the existing bridge design. Once this decision was reached, both agencies began a serious and cooperative effort in resolving the problem. It was immediately apparent that the traditional methods of stormwater treatment usually employed on high land must be ruled out; other than pumping, which was explored and rejected due to cost, there was no way to get the runoff back to high ground for treatment. Therefore, the study team threw

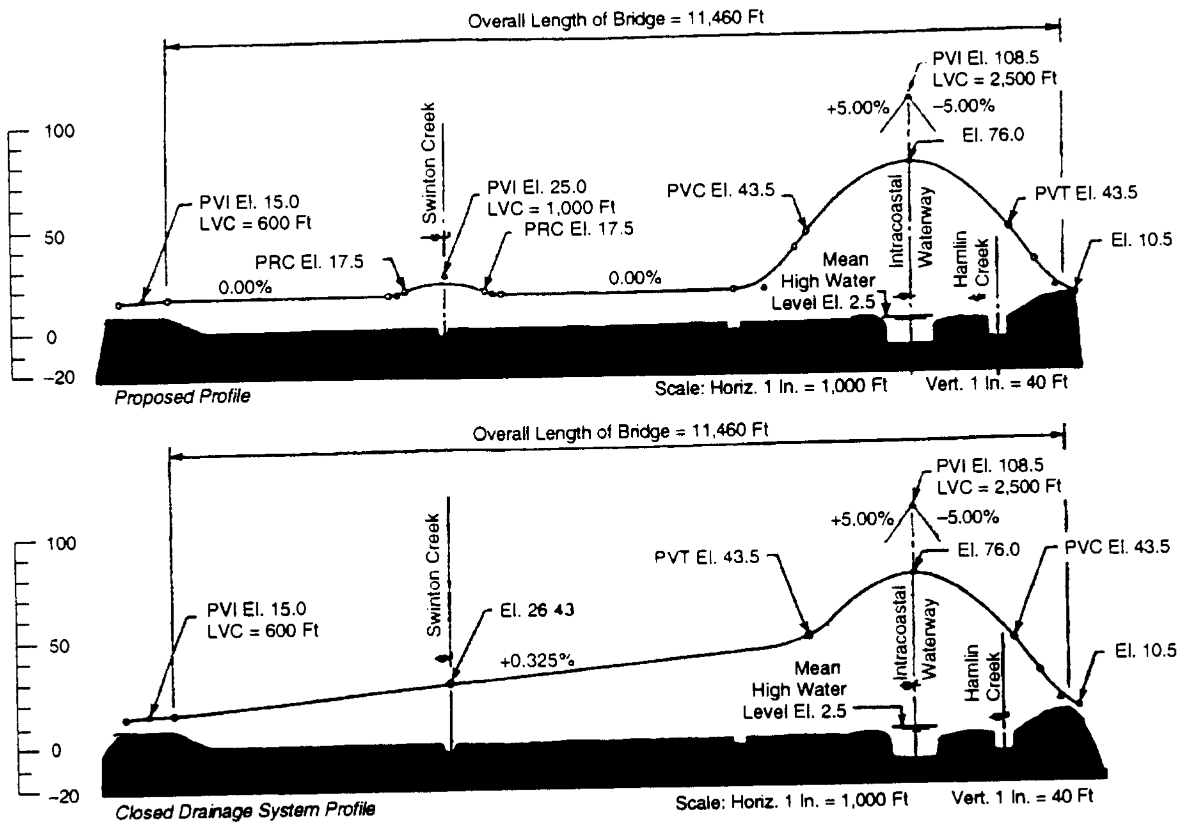

Figure 1. Proposed and closed drainage system profiles for Isle of Palms Connector.

out the preconceived traditional approaches and focused on the basic tenents of stormwater management: retention, settling, and pollutant removal. A variety of alternatives were identified, evaluated, and rejected for various reasons. Among these alternatives were storage and retention in gutters of several configurations along the shoulder of the bridge roadway and the design of an "in the marsh" sand filtering system constructed in large cylinders.

What emerged from this process was the design of an open-faced "runoff pan," 15 ft long by 32 in. wide, to be bolted in place to catch the discharge from each scupper drain (Figure 2). The pan, constructed of fiberglass, was 1 ft deep with a baffle overflow to prevent the discharge of oil and grease. In addition to containing the first 3/4 in. of runoff, the pans were to be managed with a vigorous maintenance program that would include dry/wet vacuuming on a to-be-determined basis and disposal of the residue in accordance with state hazardous waste regulations. The estimated cost for the stormwater management system, to include piping of runoff from the vertical expansions of the bridge to high ground and an adjacent spoil disposal area, was about 3.5 percent of the total bridge cost.

Accompanying this alternative was the commitment of the State Highway Department and the Coastal Council to develop a monitoring program to test the effectiveness of this technique. The monitoring program was to be implemented on completion of the bridge, estimated for the fall of 1993. Background data was collected in the summer and fall of 1993.

Both agencies, along with the concerned public, eagerly await the results of the monitoring. If successful, the runoff pan may provide one alternative for addressing stormwater management on existing bridges crossing sensitive waters.

Conclusion

Roadways and bridges are certainly not unique in their potential contribution to lessened water quality. Virtually all human activities on the land, on the water, and in the air contribute to the problem. No one solution to correct the problem exists; rather, the solution lies with the incremental "micromanagement" of each specific activity that contributes to the problem.

References

1. U.S. Department of Transportation, Federal Highway Administration. 1984. Sources and migration of highway runoff pollutants, Vol. III. Research report. Pub. No. FHWA/RD-84/059. McLean, VA.
2. U.S. Department of Transportation, Federal Highway Administration. 1988. Retention, detention, and overland flow for pollutant removal from highway stormwater runoff: Interim guidelines for management measures. Pub. No. FHWA/RD-87/056. McLean, VA.
3. U.S. Department of Transportation, Federal Highway Administration. 1988. Effects of highway runoff on receiving waters, Vol. III. Resource document for environmental assessments. Pub. No. FHWA/RD-84/064. McLean, VA.

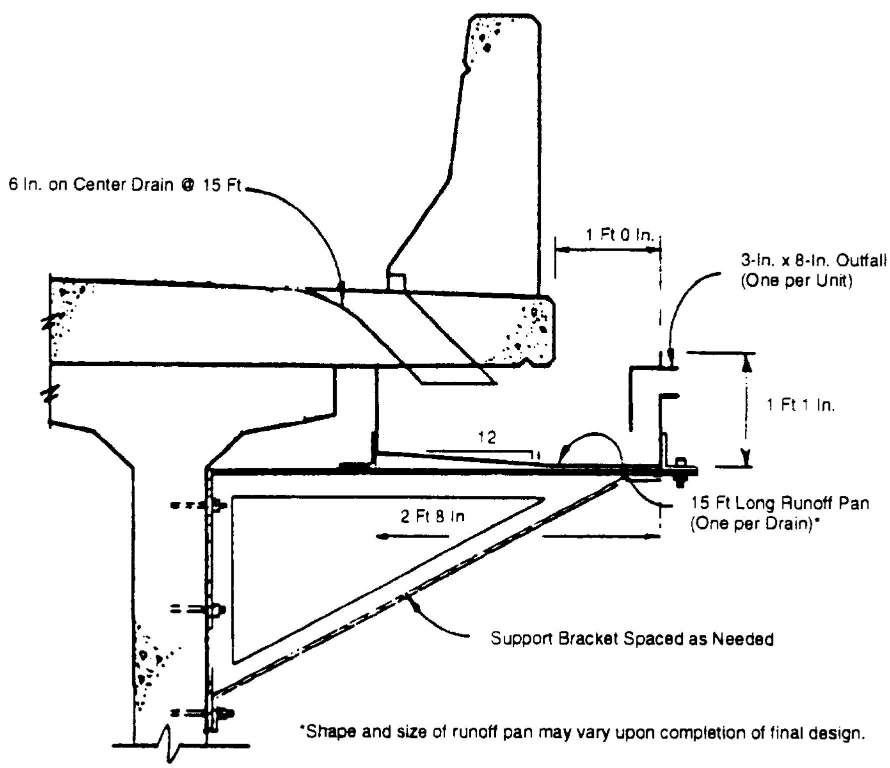

Figure 2. Schematic "runoff pan" detail: proposed Isle of Palms Connector between U.S. 17-701 and 14th Avenue, Charleston County, South Carolina.

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4. Dupuis, T.V., and N.P. Kobriger. 1985. Effects of highway runoff on receiving waters, Vol. IV. Procedural guidelines for environmental assessments. Draft Report No. FHWA/RD-84/065. Washington, DC: Federal Highway Administration.

5. Portele, G.J., B.W. Mar, R.R. Horner, and E.B. Welch. 1982. Effects of Seattle area highway stormwater runoff on aquatic biota. WA-RD-39.11. Washington State Department of Transportation.

6. U.S. EPA. 1993. Guidance specifying management measures for sources of nonpoint pollution in coastal waters. EPA/840/B-92/002. Washington, DC.

7. South Carolina Coastal Council. 1989. Coastal Council Permit CC-89-275. Charleston, SC: South Carolina Department of Highways and Public Transportation for the Isle of Palms Connector.

8. South Carolina Coastal Council. 1988. Stormwater management guidelines. Charleston, SC.

Additional Reading

1. Gupta, M.K., R.W. Agnew, D. Gruber, and W. Kreutzberger. 1981. Constituents of highway runoff, Vol. IV. Characteristics of highway runoff from operating highways. Report No. FHWA/RD-81/045. Washington, DC: Federal Highway Administration.

2. Maestri, B., F. Johnson, C.W. Burch, and B.L. Dawson. 1985. Management practices for mitigation of highway stormwater runoff pollution, Vol. IV. Executive summary. Report No. FHWA/RD-85/004. Washington, DC: Federal Highway Administration.

Controlling Pollutants in Runoff From Industrial Facilities

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Abstract

Industrial facilities can be significant contributors of pollutants to urban runoff. On November 16, 1990, the U.S. Environmental Protection Agency (EPA) published National Pollutant Discharge Elimination System (NPDES) permit application requirements for "stormwater discharges associated with industrial activities." These regulations provide a framework for reducing pollutants in runoff from the industrial facilities addressed. EPA subsequently developed a long-term strategy for issuing NPDES permits for these discharges. As the initial step in this strategy, the Agency issued general permits on September 9, 1992, and September 25, 1992, for the majority of stormwater discharges in states where EPA issues NPDES permits. This paper provides an overview of major categories of sources that contribute pollutants to runoff at industrial sites and describes pollution prevention measures in EPA's NPDES general permits.

Introduction

Pollutants in urban runoff depend in part on the nature of land use. Several studies indicate that runoff from industrial land uses is of relatively poorer water quality than runoff from other general land uses (1-5). In addition, industrial sites can be significant sources of polluted, uncontrolled nonstormwater to separate storm sewers (6, 7).

Source of Pollutants to Industrial Runoff

The volume and quality of stormwater discharges associated with industrial facilities depend on several factors, including the industrial activities occurring at the facility, the nature of precipitation, and surface imperviousness. The sources of pollutants that can affect the quality of stormwater from industrial facilities differ with the type of operations and specific facility features. For example, air emissions may be a significant source of pollutants at some facilities, material storage operations at others, and still other facilities may discharge stormwater associated with industrial activity with relatively low levels of pollutants.

Six classes of activities can be identified as major potential sources of pollutants in stormwater discharges associated with industrial activity (7-11):

- Loading or unloading of dry bulk materials or liquids.
- Outdoor storage of raw materials or products.
- Outdoor process activities.
- Dust or particulate generating processes.
- Illicit connections or inappropriate management practices.
- Waste disposal practices.

The potential for pollution from many of these activities may be influenced by the presence and use of toxic chemicals.

Loading and unloading operations typically are performed along facility access roads and railways and at loading/unloading docks and terminals. These operations include pumping of liquids or gases from trucks or rail cars to a storage facility or vice versa; pneumatic transfer of dry chemicals to or from the loading or unloading vehicle; transfer by mechanical conveyor systems; and transfer of bags, boxes, drums, or other containers from vehicles by forklift trucks or other materials handling equipment. Material spills or losses may discharge directly to the storm drainage systems or may accumulate in soils or on surfaces, to be washed away during a storm or facility washdown.

Outdoor storage includes the storage of fuels, raw materials, byproducts, deicing chemicals, intermediates, final products, and process residuals and wastes. Methods of material storage include use of storage containers (e.g., drums or tanks), platforms or pads, bins, silos, boxes, and piles. Materials, containers, and material storage areas exposed to rainfall or runoff may contribute pollutants to stormwater when solid materials wash off or materials dissolve into solution.

Other outdoor activities include certain types of manufacturing and commercial operations and land-disturbing operations. Although many manufacturing activities are performed indoors, some activities (e.g., equipment and vehicle maintenance and cleaning, timber processing, rock crushing, vehicle maintenance and cleaning, and concrete mixing) typically occur outdoors. Processing operations may result in liquid spillage and losses of material solids to the drainage system or surrounding surfaces, or creation of dusts or mists that can be deposited locally. Some outdoor industrial activities cause substantial physical disturbance of land surfaces that result in soil erosion by stormwater. For example, disturbed land occurs in construction and mining. Disturbed land may result in soil losses and other pollutant loadings associated with increased runoff rates. Facilities whose major process activities are conducted indoors may still apply chemicals such as herbicides, pesticides, and fertilizer outdoors for a variety of purposes.

Dust or particulate generating processes include industrial activities with stack emissions or process dusts that settle on plant surfaces. Localized atmospheric deposition can be a particular concern with heavy manufacturing industries. For example, monitoring of areas surrounding smelting industries has shown much higher levels of metals at sites nearest the smelter. Other industrial sites, such as mines, cement manufacturing plants, and refractories, generate significant levels of dusts.

Illicit connections or inappropriate management practices result in improper nonstormwater discharges to storm sewer systems. Pollutants from nonstormwater discharges to the storm sewer systems are caused typically by a combination of improper connections, spills, improper dumping, and improperly disposed of rinse waters, cooling waters, or other process and sanitary wastewater. Often dischargers believe that the absence of visible solids in a discharge is equivalent to the absence of pollution. Illicit connections are often associated with floor drains that are connected to separate storm sewers. Rinse waters used to clean or cool objects discharge to floor drains connected to separate storm sewers. Large amounts of rinse waters that discharge to floor drains may originate from industries using regular washdown procedures; for example, bottling plants use rinse waters for removing waste products, debris, and labels. Rinse waters can be used to cool materials by dipping, washing, or spraying objects with cool water; for example, rinse water is sometimes sprayed over the final products of a metal plating facility for cooling purposes. Condensate return lines of heat exchangers often discharge to floor drains. Heat exchangers, particularly those used under stressed conditions (e.g., exposure to corrosive fluids), such as in the metal finishing and electroplating industry, may develop pinhole leaks that result in contamination of condensate by process wastes. These and other nonstormwater discharges to storm sewers may be intentional, based on the belief that the discharge does not contain pollutants, or they may be inadvertent, if the operator is unaware that a floor drain is connected to the storm sewer.

Waste management practices include temporary storage of waste materials and operations at landfills, waste piles, and land application sites that involve land disposal. Outdoor waste treatment operations also include wastewater and solid waste treatment and disposal processes, such as waste pumping, additions of treatment chemicals, mixing, aeration, clarification, and solids dewatering.

Options for Control

Options for controlling pollutants in stormwater discharges associated with industrial activity are discussed below in terms of two major pollutant sources: 1) materials discharged to separate storm sewers via illicit connections, improper dumping, and spills; and 2) pollutants associated with runoff.

Nonstormwater Sources

As discussed above, nonstormwater discharges to separate storm sewers come from a wide variety of sources, including illicit connections, improper dumping, spills, or leakage from storage tanks and transfer areas. Measures to control spills and visible leakage can be incorporated into the best management practices discussed below.

In many cases, operators of industrial facilities may be unaware of illicit discharges or other nonvisible sources of nonstormwater to a storm sewer. In such cases, the key to controlling these discharges is to identify them. Several methods for identifying the presence of nonstormwater discharges are discussed below. (A more complete discussion of methods to identify illicit connections can be found in U.S. EPA [6, 12]). A comprehensive evaluation of the storm sewers at a facility often should incorporate several of the following methods:

- *Evaluation of drainage map and inspections:* Drainage maps should identify the key features of the drainage system (i.e., each of the inlet and discharge structures, the drainage area of each inlet structure, storage and disposal units, and materials loading areas) that may be the source of an illicit discharge or improper dumping. In addition, floor drains and other water disposal inlets thought to be connected to the sanitary sewer should be identified. A site inspection can be used to augment and verify map development. These inspections, along with the use of the drainage map, can be coordinated with other identification methods discussed below.

- *End-of-pipe screening:* Discharge points or other access points such as manhole covers can be inspected for the presence of dry weather discharges and other signs of nonstormwater discharges. Dry weather flows, material deposits, and stains are often indicators of illicit connections. Dry weather flows can be screened by a variety of methods. Inexpensive onsite tests include measuring pH; observing for oil sheens, scums, and discoloration of pipes and other structures; and colorimetric detection for chlorine, detergents, metals, and other parameters. In some cases, it may be appropriate to collect samples for more expensive analysis in a laboratory for fecal coliform, fecal *Streptococcus,* volatile organic carbon, or other appropriate parameters.

- *Manhole and internal TV inspection:* Inspection of manholes and storm sewers, either physically or by television, can be used to identify a potential entry point for illicit connections. TV inspections are relatively expensive and generally should be used only after a storm sewer has been identified as having illicit connections.

- *Dry weather testing:* Where storm sewers do not normally discharge during dry weather conditions, water can be introduced into floor drains, toilets, and other points where nonstormwater discharges are collected. Storm drain outlets are then observed for possible discharges.

- *Dye testing:* Dry weather discharges from storm sewers can occur for several legitimate reasons, including ground-water infiltration or the presence of a continuous discharge subject to a National Pollutant Discharge Elimination System (NPDES) permit. Where storm sewers do have a discharge during dry weather conditions, dye testing for illicit connections can be used. Dye testing involves introducing fluorometric or other types of dyes into floor drains, toilets, and other points where nonstormwater discharges are collected. Storm drain outlets and manholes are then observed for possible discharges. Dye testing can also be used to identify unknown submerged outfalls to nearby receiving waters.

- *Water balance:* Many sewage treatment plants require that industrial discharges measure the volume of effluent discharged to the sanitary sewer system. Similarly, the volume of water supplied to a facility is generally measured. A significantly higher volume of water supplied to the facility relative to that discharged to the sanitary sewer and other consumptive uses may be an indication of illicit connections. This method is limited by the accuracy of the flow meters used.

- *Schematics:* Where they exist, accurate piping schematics can be inspected as a first step in evaluating the integrity of the separate storm sewer system. The use of schematics is limited because schematics usually reflect the design of the piping system and may not reflect the actual configuration constructed. Schematics should be updated or corrected based on additional information found during inspections.

Smoke tests are sometimes listed in the literature as a method for detecting illicit connections to separate storm sewers. While smoke tests can be used to identify inflow of stormwater to sanitary sewers, they can be much less effective for identifying discharges of nonstormwater to storm drains. This is because many nonstormwater drainage locations have a sewer gas trap that blocks smoke used in a test. Smoke tests can identify nonstormwater discharges to storm drains if the piping for the nonstormwater discharge has a vent or does not have a sewer gas trap.

Options for Preventing Pollutants in Stormwater

The following five categories describe options for reducing pollutants in stormwater discharges from industrial plants:

- Providing end-of-pipe treatment.
- Implementing best management practices (BMPs) to prevent pollution.
- Diverting stormwater discharge to treatment plants.
- Using traditional stormwater management practices.
- Eliminating pollution sources/water reuse.

A comprehensive stormwater management program for a given plant often includes controls from each of these categories. Development of comprehensive control strategies should be based on a consideration of plant characteristics.

End-of-Pipe Treatment

At many types of industrial facilities, it may be appropriate to collect and treat the runoff from targeted areas of the facility. This approach was taken with the 10 industrial categories with national effluent guideline limitations for stormwater discharges: cement manufacturing (40 CFR 411), feedlots (40 CFR 412), fertilizer manufacturing (40 CFR 418), petroleum refining (40 CFR 419), phosphate manufacturing (40 CFR 422), steam electric (40 CFR 423), coal mining (40 CFR 434), mineral mining and processing (40 CFR 436), ore mining and dressing (40 CFR 440), and asphalt emulsion (40 CFR 443).

Best Management Practices

BMPs encompass a wide range of management procedures, schedules of activities, prohibitions on practices, and other management practices to prevent or reduce the pollution of waters of the United States. BMPs also include operating procedures, treatment requirements and practices to control plant site runoff, and drainage from raw materials storage, spills, or leaks. Requirements for BMP-based pollution prevention plans generally applicable to all industries are discussed in more detail in the paper in the context of the U.S. Environmental Protection Agency's (EPA's) general permits for stormwater discharges associated with industrial activity.

In addition to generic BMPs or pollution prevention plans, industry- or activity-specific BMPs can be used. Table 1 provides a listing of industry-specific BMPs that the Washington State Department of Ecology has developed.[1]

Diversion of Discharge to Treatment Plant

Where stormwater discharges contain significant amounts of pollutants that can be removed by a wastewater or sewage treatment plant, the stormwater discharge can be diverted to a wastewater treatment plant or sanitary sewage system. Such diversions must be coordinated with the operators of the sewage treatment plant and the collection system to avoid problems with either combined sewer overflows (CSOs), basement flooding, or wet weather operation of the treatment plant. Where CSO discharges, flooding or plant operation problems can result, and onsite storage followed by a controlled release during dry weather conditions may be considered.

Traditional Stormwater Management Practices

In some situations, traditional stormwater management practices such as grass swales, catch basin design and maintenance, infiltration devices, unlined onsite retention and detention basins, regional controls (offsite retention or detention basins), and oil and grit separators can be applied to an industrial setting. Care must be taken, however, to evaluate the potential of many of these traditional devices for ground-water contamination. Other types of controls, such as secondary containment systems, can be used to prevent catastrophic events that can lead to surface or ground-water contamination via traditional stormwater measures. In some cases, it is appropriate to limit traditional stormwater management practices to those areas of the drainage system that generate stormwater with relatively low levels of pollutants (e.g., many rooftops, parking lots, etc.). At facilities located in northern areas of the country, snow removal activities may play an important role in a stormwater management program.

Elimination of Pollution Sources/Water Reuse

In some cases, the elimination of a pollution source or water reuse may be the most cost-effective way to control pollutants in stormwater discharges associated with industrial activity. Options for eliminating pollution sources include reducing onsite air emissions affecting runoff quality, changing chemicals used at the facility, and modifying materials management practices such as moving storage areas into buildings. Water reuse involves collecting runoff and using it in a process or in some manner that does not release the pollutants in the stormwater to the environment. For example, many inorganic wood preserving facilities use drip pad runoff to dilute wood preserving fluids used in their processes. In some cases, it may be less expensive to store and treat stormwater for subpotable, industrial water supply purposes than purchasing municipal potable water.

Clean Water Act Requirements

In 1972, the Clean Water Act (CWA) was amended to provide that the discharge of any pollutants to waters of the United States from a point source is unlawful, except where the discharge is authorized by an NPDES permit. The term "point source" is broadly defined to include "any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, [or] channel, . . . from which pollutants are or may be discharged." Congress has specifically exempted agricultural stormwater discharges and return flows from irrigated agriculture from the definition of point source.

Most court cases have supported a broad interpretation of the term "point source" under the CWA. For example, the holding in *Sierra Club v. Abston Construction Co., Inc.*, 620 F 2d. 41 (5th Cir., 1980) indicates that changing the surface of land or establishing grading patterns on land where the runoff from the site ultimately is discharged to waters of the United States will result in a point source:

> A point source of pollution may be present where [dischargers] design spoil piles from discarded overburden such that, during periods of precipitation, erosion of spoil pile walls results in discharges into a navigable body of water by means of ditches, gullies and similar conveyances, even if the [dischargers] have done nothing beyond the mere collection of rock and other materials. . . . Nothing in the Act relieves [dischargers] from liability simply because the operators did not actually construct

[1] The document *Best Management Practices for the Use and Storage of Hazardous Materials* (14) also provides examples of industry-specific BMPs. The guidance addresses small mechanical repair facilities, large mechanical repair facilities, dry cleaning facilities, junkyards, photo processing facilities, print shops and silk screen shops, machine shops and airport maintenance facilities, boat manufacturing and repair facilities, concrete plants and mining facilities, agricultural facilities, paint manufacturers and distributors, and plastics manufacturers.

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Table 1. **Categories of Targeted Stormwater Controls Addressed in Puget Sound Guidance (13)**

Category	Targeted Stormwater Controls
Manufacturing facilities	Cement Chemical Concrete products Electrical products Food products Glass products Industrial machinery and equipment, trucks and trailers, aircraft, parts and aerospace, railroad equipment Log storage and sorting yards, debarking Metal products Petroleum products Printing and publishing Rubber and plastic products Ship and boat building and repair yards Wood products Wood treatment Other manufacturing businesses
Transportation and communication	Airfields and aircraft maintenance Fleet vehicle yards Railroads Private utility corridors Warehouses and miniwarehouses Other transportation and communication businesses
Wholesale and retail businesses	Gas stations Recyclers and scrap yards Restaurants/fast food Retail general merchandise Retail/Wholesale vehicle and equipment dealers Retail/Wholesale nurseries and building materials Retail/Wholesale chemicals and petroleum Retail/Wholesale foods and beverages Other retail/wholesale businesses
Service businesses	Animal care services Commercial car and truck washes Equipment repair Laundries and other cleaning Marinas and boat clubs Golf and country clubs, golf courses, and parks Miscellaneous services Professional services Vehicle maintenance and repair Multifamily residences Construction businesses
Pubic agencies	Public buildings and streets Vehicle and equipment maintenance shops Maintenance of open space areas Maintenance of public stormwater facilities Maintenance of roadside vegetation and ditches Maintenance of public utility corridors Water and sewer districts and departments Port districts
Source controls	Fueling stations Vehicle/Equipment washing and steam cleaning Loading and unloading liquid materials Liquid storage in aboveground tanks Container storage of liquids, food wastes, and dangerous wastes Outside storage of raw materials, byproducts, and finished products Outside manufacturing activities Emergency spill cleanup plans Vegetation management/integrated pest management Maintenance of storm drainage facilities Locating illicit connections to storm drains

those conveyances. . . . Conveyances of pollution formed either as a result of natural erosion or by material means, and which constitute a component of a drainage system may fit the statutory definition and thereby subject the operators to liability under the Act.

Although the definition of point source is very broad, before 1987 efforts under the NPDES program to control water pollution focused on controlling pollutants in discharges from publicly owned treatment works (POTWs) and industrial process wastewaters. The major exceptions to this are the 10 effluent limitation guidelines that EPA has issued for stormwater discharges: cement manufacturing (40 CFR 411), feedlots (40 CFR 412), fertilizer manufacturing (40 CFR 418), petroleum refining (40 CFR 419), phosphate manufacturing (40 CFR 422), steam electric (40 CFR 423), coal mining (40 CFR 434), mineral mining and processing (40 CFR 436), ore mining and dressing (40 CFR 440), and asphalt emulsion (40 CFR 443).

As part of the Water Quality Act of 1987, Congress added Section 402(p) to the CWA to require EPA to develop a comprehensive, phased program for regulated stormwater discharges under the NPDES program. One of the first priorities under the stormwater program was to develop NPDES requirements for stormwater discharges associated with industrial activity.

On November 16, 1990, EPA published the initial NPDES regulations under Section 402(p) of the CWA (see 55 FR 47990). The November 16, 1990, regulations:

- Defined the initial scope of the program by defining the terms "stormwater discharge associated with industrial activity" and large and medium "municipal separate storm sewer systems."
- Established permit application requirements.

The regulatory definition of the term "stormwater discharge associated with industrial activity" is provided at 40 CFR 122.26(b)(14) and addresses point source discharges of stormwater from eleven major categories of facilities. Table 2 summarizes these 11 major categories.

The NPDES regulations provided three options for submitting permit applications for stormwater discharges associated with industrial activity: 1) individual applications, 2) group applications for groups of similar industrial discharges, and 3) where an appropriate general permit has been issued, submittal of a notice of intent (NOI) to be covered by a general permit. The group application option is no longer available; EPA received over 1,100 group applications covering over 45,000 facilities. The Agency has organized these applications into the 32 industrial sectors shown in Table 3 and intends to develop guidance on issuing permits for the 32 industrial sectors.

Table 2. Summary of Classes of Industrial Facilities Addressed by Regulatory Definition of "Stormwater Discharge Associated With Industrial Activity"

Class	Description
(i)	Facilities subject to stormwater effluent limitations guideline, new source performance standards, or toxic pollutant effluent standards (see 40 CFR Subpart N)
(ii)	Manufacturing facilities classified as Standard Industrial Classification (SIC) 24 (except 2434), 26 (except 265 and 267), 28 (except 283), 29, 311, 32 (except 323), 33, 3441, and 373
(iii)	Active and inactive mining operations classified as SIC 10-14
(iv)	Hazardous waste treatment, storage, or disposal facilities that are operating under interim status or a permit under Subtitle C of RCRA
(v)	Landfills, land application sites, and open dumps that receive industrial wastes
(vi)	Recycling facilities, including metal scrapyards, battery reclaimers, salvage yards, and automobile junkyards
(vii)	Steam electric power generating facilities
(viii)	Transportation facilities classified as SIC 40, 41, 42 (except 4221-25), 43, 44, 45, and 5171, which have vehicle maintenance shops, equipment cleaning operations, or airport deicing operations
(ix)	Sewage treatment plants with a design flow of 1.0 million gal/day or more or required to have an approved pretreatment program
(x)	Construction activities except operations that result in the disturbance of less than 5 acres of total land area and that are not part of a larger common plan of development or sale
(xi)	Facilities under SIC 20, 21, 22, 23, 2434, 25, 265, 267, 27, 283, 285, 30, 31 (except 311), 323, 34 (except 3441), 35, 36, 37 (except 373), 38, 39, and 4221-25 (and which are not otherwise included within categories (i)-(x))

Table 3. Industrial Sectors Identified in NPDES Group Application Process

Sector	SIC Codes/Activities Represented	Number of Facilities
1	SIC 24—Lumber and Wood Products	2,640
2	SIC 26—Paper and Allied Products	1,023
3	SIC 28—Chemicals and Allied Products	1,498
4	SIC 29—Petroleum Refining and Related Industries	2,245
5	SIC 32—Stone, Clay, Glass, and Concrete Products	4,786
6	SIC 33—Primary Metal Industries	730
7	SIC 10—Metal Mining	188
8	SIC 12—Coal Mining	495
9	SIC 13—Oil and Gas Extraction	457
10	SIC 14—Mining and Quarrying of Nonmetallic Minerals	2,437
11	Hazardous Waste Treatment Storage or Disposal Facilities	77

Table 3. **Industrial Sectors Identified in NPDES Group Application Process (continued)**

Sector	SIC Codes/Activities Represented	Number of Facilities
12	Industrial Landfills, Land Application Sites, and Open Dumps	1,430
13	SIC 5015—Used Motor Vehicle Parts	2,009
14	SIC 5093—Scrap and Waste Materials	1,688
15	Steam Electric Power Generating Facilities	162
16	SIC 40—Railroad Transportation	1,024
17	SIC 41—Local and Suburban Transit and Interurban Highway Passenger Transportation SIC 42—Motor Freight Transportation SIC 43—United States Postal Service	13,089
18	SIC 44—Water Transportation	368
19	SIC 3731—Ship Building and Repairing SIC 3732—Boat Building and Repairing	498
20	SIC 45—Air Transportation	1,581
21	SIC 5171—Petroleum Bulk Stations and Terminals	131
22	Domestic Wastewater Treatment Plants	1,249
23	SIC 20—Food and Kindred Products SIC 21—Tobacco Products	2,608
24	SIC 22—Textile Mill Products SIC 23—Apparel and Other Finished Products Made From Fabrics and Similar Materials	872
25	SIC 25—Furniture and Fixtures	339
26	SIC 27—Printing, Publishing, and Allied Industries	65
27	SIC 30—Rubber and Miscellaneous Plastic Products	190
28	SIC 31—Leather and Leather Products	61
29	SIC 34—Fabricated Metal Products SIC 391—Jewelry, Silverware, and Plated Ware	965
30	SIC 35—Industrial and Commercial Machinery SIC 37—Transportation Equipment	935
31	SIC 36—Electronic Components SIC 357—Computer and Office Equipment SIC 38—Measuring, Analyzing, and Control Instruments; Photographic and Optical Goods, Watches, and Clocks	14
32	SIC—Miscellaneous Manufacturing Industries	769

Long-Term Strategy

Many of the initial concerns regarding the NPDES stormwater program focused on adapting the NPDES permit program to effectively address the large number of stormwater discharges associated with industrial activity. In response to these concerns, EPA developed a strategy for permitting stormwater discharges associated with industrial activity that will serve as a foundation for future program development and technology transfer. The strategy consists of two major components: a tiered framework for developing permitting priorities and a framework for the development of state stormwater management plans.

Permitting Priorities

Under the strategy, most stormwater permitting activities are described in terms of the following four classes of activities:

- *Tier I—Baseline permitting:* One or more general permits will be developed initially to cover the majority of stormwater discharges associated with industrial activity.
- *Tier II—Watershed permitting:* Facilities within watersheds shown to be adversely affected by stormwater discharges associated with industrial activity will be targeted for individual or watershed-specific general permits.
- *Tier III—Industry-specific permitting:* Specific industry categories will be targeted for individual or industry-specific general permits.
- *Tier IV—Facility-specific permitting:* A variety of factors will be used to target specific facilities for individual permits.

These four classes of activities will be implemented over time and will reflect priorities within given states. In most states, Tier I activities will be the starting point. Initially, the coverage of the baseline permits will be broad. As priorities and risks within the state are evaluated, however, classes of stormwater discharges or individual stormwater discharges will be identified for Tier II, III, or IV permitting activities.

State Stormwater Management Programs

State stormwater management programs are to provide, among other things, a description of NPDES permit issuing activities for stormwater discharges associated with industrial activity, including categories of industrial activity that are being considered for industry-specific general permits. These plans will assist EPA in developing technology transfer activities with other states, evaluating states' progress in implementing stormwater permitting activities, and identifying both successes and difficulties with ongoing program implementation.

EPA's Baseline General Permits

Consistent with the long-term permit issuance strategy, EPA published Tier I general permits, which potentially could apply to the majority of stormwater discharges associated with industrial activity located in 12 states on

September 9, 1992, and September 25, 1992 (see 57 FR 41236 and 57 FR 44438). The 12 states where the EPA general permits apply are Alaska, Arizona, Florida, Idaho, Louisiana, Maine, Massachusetts, New Hampshire, New Mexico, Oklahoma, South Dakota, and Texas. Other states have authorized NPDES state programs, and the state issues NPDES permits instead of EPA.

Consolidating many sources under a general permit greatly reduces the administrative burden of issuing permits for stormwater discharges associated with industrial activity. Several advantages to this approach are:

- Pollution prevention measures and/or BMPs are established for discharges covered by the permit.
- Facilities whose discharges are covered by the permit are certain of their legal responsibilities and have an opportunity to comply with the CWA.
- EPA and authorized NPDES states will begin to collect and review data on stormwater discharges from priority industries, thereby supporting subsequent permitting activities.
- The public, including municipal operators of municipal separate storm sewers, will have the opportunity to review data and reports developed by industrial permittees pursuant to NPDES requirements.
- The baseline permits will provide a basis for coordinating 1) requirements for stormwater discharges associated with industrial activity with 2) requirements of municipal stormwater management programs in permits for discharges from municipal separate storm sewer systems.
- The baseline permits will provide a basis for bringing selected enforcement actions.
- The baseline permit, along with state stormwater permitting plans, will provide a focus for public comment on draft permits and subsequent phases of the permitting strategy for stormwater discharges.

The Agency believes that Tier I permits can establish the appropriate balance between monitoring requirements and implementable controls that will initiate facility-specific controls and provide sufficient data for compliance monitoring and future program development.

Permit Requirements

The major requirements of EPA's Tier I stormwater general permits are notification requirements, requirements for stormwater pollution prevention plans, and special requirements for selected facilities.

Notification Requirements

The general permits require the submittal of an NOI by the discharger before the authorization of discharges. In addition, operators of stormwater discharges that discharge through a large or medium municipal separate storm sewer system must, in addition to submitting an NOI to the Director, submit a copy of the NOI to the municipal operator of the system receiving the discharge.

Tailored Pollution Prevention Plan Requirements

All facilities covered by EPA's general permits must prepare and implement a stormwater pollution prevention plan. These tailored requirements allow the implementation of site-specific measures that address features, activities, or priorities for control associated with the identified stormwater discharges. The approach taken allows the flexibility to establish controls that can appropriately address different sources of pollutants at different facilities.

The pollution prevention approach adopted in the general permits focuses on two major objectives: 1) to identify sources of pollution potentially affecting the quality of stormwater discharges from the facility, and 2) to describe and ensure implementation of practices to minimize and control pollutants in stormwater discharges.

The stormwater pollution prevention plan requirements in the general permits are intended to facilitate a process whereby the operator of the industrial facility thoroughly evaluates potential pollution sources at the site and selects and implements appropriate measures to prevent or control the discharge of pollutants in stormwater runoff. The process involves the following four steps:

- Formation of a team of qualified plant personnel responsible for preparing the plan and assisting the plant manager in its implementation.
- Assessment of potential stormwater pollution sources.
- Selection and implementation of appropriate management practices and controls.
- Periodic evaluation of the ability of the plan to prevent stormwater pollution and comply with the terms and conditions of this permit.

This process is shown in Figure 1. A complete description of this process can be found in U.S. EPA (15).

Pollution Prevention Team

As a first step in the process of developing and implementing a stormwater pollution prevention plan, permittees must identify a qualified individual or team of individuals to be responsible for developing the plan and assisting the facility or plant manager in its implementation. When

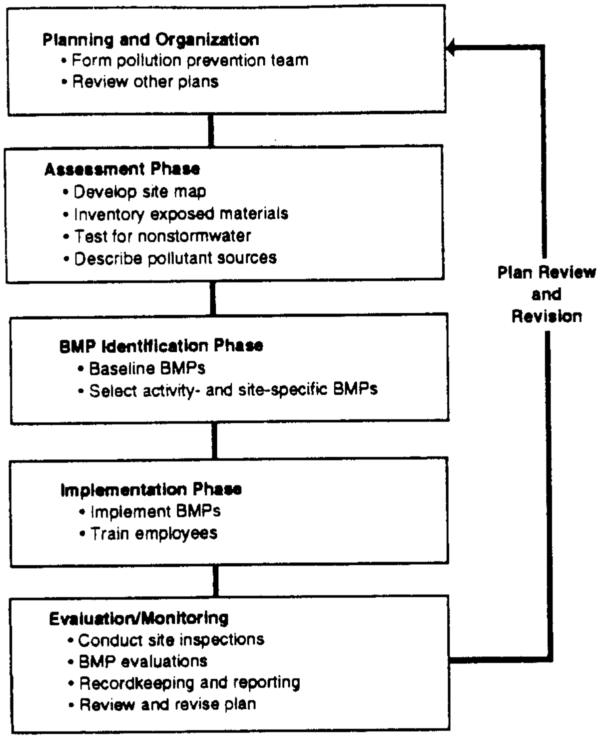

Figure 1. Pollution prevention plan process.

selecting members of the team, the plant manager should draw on the expertise of all relevant departments within the plant to ensure that all aspects of plant operation are considered. The plan must clearly describe the responsibilities of each team member as they relate to specific components of the plan. In addition to enhancing the quality of communication between team members and other personnel, clear delineation of responsibilities will ensure that a specified individual or group of individuals addresses every aspect of the plan.

Description of Potential Pollution Sources

Each stormwater pollution prevention plan must describe activities, materials, and physical features of the facility that may contribute significant amounts of pollutants to stormwater runoff or, during periods of dry weather, result in pollutant discharges through the separate storm sewers or stormwater drainage systems. This assessment of stormwater pollution risk will support subsequent efforts to identify and set priorities for necessary changes in materials, materials management practices, or site features, as well as aid in the selection of appropriate structural and nonstructural control techniques. Plans must describe the site drainage, provide an inventory of exposed materials, describe significant spills and leaks that have occurred at the facility, and include existing sampling data.

Each pollution prevention plan must include a certification that discharges from the site have been tested or evaluated for the presence of nonstormwater discharges. The certification must describe possible significant sources of nonstormwater, the results of any test and/or evaluation conducted to detect such discharges, the test method or evaluation criteria used, the dates on which tests or evaluations were performed, and the onsite drainage points directly observed during the test or evaluation. Acceptable test or evaluation techniques are discussed earlier in this paper.

The description of potential pollution sources culminates in a narrative assessment of the risk potential that sources of pollution pose to stormwater quality. This assessment should clearly point to activities, materials, and physical features of the facility that have a reasonable potential to contribute significant amounts of pollutants to stormwater. Any such activities, materials, or features must be addressed by the measures and controls subsequently described in the plan. In conducting the assessment, the facility operator must consider loading and unloading operations, outdoor storage activities, outdoor manufacturing or processing activities, significant dust or particulate generating processes, and onsite waste disposal practices. The assessment must list any significant pollution sources at the site and identify the pollutant parameter or parameters (i.e., biochemical oxygen demand, suspended solids, etc.) associated with each source.

Measures and Controls

Following completion of the source identification and assessment phase, the permittee must evaluate, select, and describe the pollution prevention measures, BMPs, and other controls that the facility will implement. BMPs include processes, procedures, schedules of activities, prohibitions on practices, and other management practices that prevent or reduce the discharge of pollutants in stormwater runoff.

The plan requirements emphasize the implementation of pollution prevention measures that reduce possible pollutant discharges at the source. Source reduction measures include, among others, preventive maintenance, chemical substitution, spill prevention, good housekeeping, training, proper materials management, material segregation or covering, water diversion, and dust control. The remaining classes of BMPs, which involve recycling or treatment of stormwater, allow the reuse of stormwater or attempt to lower pollutant concentrations before discharge.

The pollution prevention plan must include a schedule specifying the time or times during which each control or practice will be implemented. In addition, the plan should discuss ways in which the controls and practices relate to one another and, when taken as a whole, produce an integrated and consistent approach for preventing or controlling potential stormwater contamination problems. The portion of the plan that describes the measures and controls must address the following minimum components:

- *Good housekeeping:* Good housekeeping involves using common sense to identify ways to maintain a clean and orderly facility and keep contaminants out of separate storm sewers. It includes establishing protocols to reduce the possibility of mishandling chemicals or equipment, and training employees in good housekeeping techniques.
- *Preventive maintenance:* Permittees must develop a preventive maintenance program that involves regular inspection and maintenance of stormwater management devices and other equipment and systems. The program description should identify the devices, equipment, and systems that will be inspected; provide a schedule for inspections and tests; and address appropriate adjustment, cleaning, repair, or replacement of devices, equipment, and systems. For stormwater management devices such as catch basins and oil/water separators, the preventive maintenance program should provide for periodic removal of debris to ensure that the devices are operating efficiently.
- *Spill prevention and response procedures:* Based on an assessment of possible spill scenarios, permittees must specify appropriate material handling procedures, storage requirements, containment or diversion equipment, and spill cleanup procedures that will minimize the potential for spills and in the event of a spill enable proper and timely response. Areas and activities that typically pose a high risk for spills include loading and unloading areas, storage areas, process activities, and waste disposal activities. These activities and areas, and their accompanying drainage points, must be described in the plan. For a spill prevention and response program to be effective, employees should clearly understand the proper procedures and requirements and have the equipment necessary to respond to spills.
- *Inspections:* Qualified facility personnel must be identified to inspect designated equipment and areas of the facility at appropriate intervals specified in the plan. A set of tracking or followup procedures must be used to ensure that appropriate actions are taken in response to the inspections.
- *Employee training:* The pollution prevention plan must describe a program for informing personnel at all levels of responsibility of the components and goals of the stormwater pollution prevention plan. Where appropriate, contractor personnel also must be trained in relevant aspects of stormwater pollution prevention.
- *Recordkeeping and internal reporting procedures:* The pollution prevention plan must describe procedures for developing and retaining records on the status and effectiveness of plan implementation. At a minimum, records must address spills, monitoring, and inspection and maintenance activities. The plan also must describe a system that enables timely reporting of stormwater management-related information to appropriate plant personnel.
- *Sediment and erosion control:* The pollution prevention plan must identify areas that, due to topography, activities, soils, cover materials, or other factors, have a high potential for significant soil erosion. The plan must identify measures that will be implemented to limit erosion in these areas.
- *Management of runoff:* The plan must contain a narrative evaluation of the appropriateness of traditional stormwater management practices (i.e., practices other than those that control pollutant sources) that divert, infiltrate, reuse, or otherwise manage stormwater runoff to reduce the discharge of pollutants. Appropriate measures may include, among others, vegetative swales, collection and reuse of stormwater, inlet controls, snow management, infiltration devices, and wet detention/retention basins.

Based on the results of the evaluation, the plan must identify practices that the permittee determines to be reasonable and appropriate for the facility. The plan also should describe the particular pollutant source area or activity to be controlled by each stormwater management practice. Reasonable and appropriate practices must be implemented and maintained according to the provisions prescribed in the plan.

In selecting stormwater management measures, it is important to consider the potential effects of each method on other water resources, such as ground water. Although stormwater pollution prevention plans primarily focus on stormwater management, facilities must also consider potential ground-water pollution problems and take appropriate steps to avoid adversely affecting ground-water quality. For example, if the water table is unusually high in an area, an infiltration pond may contaminate a ground-water source unless special preventive measures are taken. Under EPA's July 1991 Ground Water Protection Strategy, states are encouraged to develop comprehensive state ground-water protection programs (CSGWPP). Efforts to control stormwater should be compatible with state ground-water objectives as reflected in CSGWPPs.

Comprehensive Site Compliance Evaluation

The stormwater pollution prevention plan must describe the scope and content of comprehensive site inspections that qualified personnel will conduct to 1) confirm the accuracy of the description of potential pollution sources contained in the plan, 2) determine the effectiveness of the plan, and 3) assess compliance with the terms and conditions of the permit. The plan must indicate the frequency of such evaluations, which in certain cases must be at least once a year.

Material handling and storage areas and other potential sources of pollution must be visually inspected for evidence of actual or potential pollutant discharges to the drainage system. Inspectors also must observe erosion controls and structural stormwater management devices to ensure that each is operating correctly. Equipment needed to implement the pollution prevention plan, such as that used during spill response activities, must be inspected to confirm that it is in proper working order. The results of each site inspection must be documented in a report signed by an authorized company official.

Based on the results of each inspection, the description of potential pollution sources and the measures and controls in the plan must be revised as appropriate within 2 weeks after each inspection.

Special Requirements for Selected Facilities

EPA's general permits also establish special requirements for selected classes of facilities. These include:

- *Sampling requirements:* Targeted classes of facilities are required to monitor their stormwater discharges for specified parameters. Facilities that are a member of a targeted class but that can certify that they do not have materials or equipment exposed to precipitation are not required to monitor. This is intended to provide facilities with an incentive to eliminate exposure to precipitation.
- *EPCRA facilities:* Certain facilities that are subject to reporting requirements under Section 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA) because they manufacture or use large amounts of toxic chemicals are subject to special requirements under the NPDES general permits. These special requirements include provisions that are similar to spill prevention, countermeasure, and control (SPCC) plan requirements, and include provisions for secondary containment or equivalent controls for liquid storage areas. In addition, a professional engineer (PE) must inspect the site, review the plan, and certify that the stormwater pollution prevention plan has been prepared in accordance with good engineering practices.
- *Salt piles:* Salt piles must be enclosed or covered to prevent exposure to precipitation.
- *Coal pile runoff:* The permit establishes numeric effluent limitations for coal pile runoff.

Municipal Role in Implementation

The NPDES stormwater program establishes a permit approach that envisions complementary, cooperative efforts by the permit-issuing agency and municipal operators of large and medium municipal separate storm sewer systems to develop programs that result in controls on pollutants in stormwater discharges associated with industrial activity that discharge through municipal systems.

Under the complementary permit approach, stormwater discharges associated with industrial activity that discharge through large and medium municipal separate storm sewer systems are required to obtain permit coverage. Permits for these discharges will establish requirements (such as pollution prevention requirements or monitoring) for industrial operators. Any records, reports, or information obtained by the NPDES permit-issuing authority as part of the permit implementation process, including site-specific stormwater pollution prevention programs that are developed pursuant to the draft general permit, are available to municipalities. This will assist municipalities in reviewing the adequacy of such requirements and developing priorities among industrial stormwater sources. In addition, these permits provide a basis for enforcement actions directly against the owner or operator of stormwater discharges associated with industrial activity.

A second permit, issued to the operator of the large or medium municipal separate storm sewer, establishes the responsibilities of the municipal operators in controlling pollutants from stormwater associated with industrial activity that discharges through their systems. Municipal programs to reduce pollutants in industrial site runoff specifically will address municipal responsibilities in controlling pollutants from industrial facilities. In addition, programs to identify and control nonstormwater discharges to municipal separate storm sewer systems will in many cases focus on industrial areas because these areas often have a significant potential for illicit connections, spills, and improper dumping.

Municipal operators of these systems can assist NPDES permit issuing authorities:

- By identifying priority stormwater discharges associated with industrial activity to their systems.
- In inspecting facilities and reviewing and evaluating stormwater pollution prevention plans that industrial facilities are required to develop under the draft general permit.
- In compliance efforts regarding stormwater discharges associated with industrial activity to their municipal systems.

A pilot program conducted by municipalities in the Santa Clara Valley illustrates how a municipality can work with an NPDES authority to control pollutants in stormwater discharges associated with industrial activities. (A more complete description of the pilot program and its findings is provided in the Santa Clara Valley Nonpoint Source Pollution Control Program [3]). One of the major goals of the program was to reduce discharges to storm drains of dry- and wet-weather heavy metals that result from activities such as processing, storage, and maintenance activities conducted at industrial sites. Components of the program included the following:

- Municipalities developed industrial inspection and illegal dumping/illicit connection programs to ensure that activities focus on priority industries.
- Monitoring requirements were established in the California NPDES general permit for industries. Municipalities evaluated monitoring data collected by priority industries.
- The California NPDES general permit allowed for exemption for industries from monitoring where the municipality provides certification that the industry pollution prevention plan is adequate.
- Municipalities developed industry specific guidance.[2]
- Municipalities implemented a "Clean Bay Business" award program.
- Market-based incentives were considered, such as trading reductions from car pooling and telecommunication programs for pretreatment requirements.

Key findings of the pilot programs identified the following components needed for a successful program:

- Hands-on field training conducted by an experienced industrial inspector.
- Classroom training on industrial stormwater requirements and on methods of communicating with facility managers.
- Classroom training on other related industrial regulatory programs (e.g., HAZMAT, pretreatment).
- A reference manual on the regulations and local legal authority.
- Adequate legal authority to allow site access and take progressive enforcement actions.

[2]See *California Storm Water Best Management Practice Handbook: Industrial/Commercial* (16), which addresses how to prepare a stormwater pollution prevention plan and how to select BMPs. The guidance also addresses source controls for nonstormwater discharges; vehicle and equipment fueling; vehicle and equipment washing and steam cleaning; vehicle and equipment maintenance and repair; outdoor loading/unloading of materials; outdoor container storage of liquids; outdoor process equipment operations and maintenance; outdoor storage of raw materials, products, and byproducts; waste handling and disposal; contaminated or erodible surface areas; building and grounds maintenance; building repair; remodeling and construction; and overwater activities. In addition, the guidance covers treatment control BMPs and measuring BMP performance.

- Prioritizing facilities based on existing information before conducting inspections.
- Advance communications, in the form of a letter, to industries before conducting the inspections.
- A plan for followup actions, including enforcement, where necessary.

References

1. Pitt, R. 1992. Stormwater, baseflow, and snowmelt pollutant contributions from an industrial area. Presented at the 65th Annual Conference, Water Environment Federation, New Orleans, LA (September).
2. U.S. EPA. 1983. Results from the Nationwide Urban Runoff Program, Vol. 1. Final report. NTIS PB84185552.
3. Santa Clara Valley Nonpoint Source Pollution Control Program. 1992. Source identification and control report. December 1.
4. Ontario Ministry of the Environment. 1986. Toronto area watershed management strategy study: Humber River pilot watershed project. June.
5. U.S. EPA, Region 5. 1990. Urban targeting and BMP selection: An information and guidance manual for state nonpoint source program staff engineers and managers. Region 5, Water Division, Chicago, IL 60604 (November).
6. U.S. EPA. 1993. Investigation of inappropriate pollutant entries into storm drainage systems: A user's guide. EPA/600/R-92/238 (January).
7. U.S. EPA. 1991. Federal Register 56:40948. August 16.
8. American Society of Civil Engineers. 1988. Design of urban runoff quality controls. New York, NY: American Society of Civil Engineers.
9. Tomo/American Society of Civil Engineers. 1989. Urban stormwater quality enhancement: Source control, retrofitting, and combined sewer technology.
10. U.S. EPA. 1979. NPDES best management practices guidance document.
11. U.S. EPA. 1991. Analysis of implementing permitting activities for stormwater discharges associated with industrial activity.
12. U.S. EPA. 1990. Manual of practice: Identification of illicit connections. September.
13. Washington State Department of Ecology. 1992. Stormwater management manual for the Puget Sound Basin, Vol. I. Minimum technical requirements. February.
14. Alachua County Office of Environmental Protection. Best management practices for the use and storage of hazardous materials. Gainesville, FL.
15. U.S. EPA. 1992. Stormwater management for industrial activities: Developing pollution prevention plans and best management practices.
16. California State Stormwater Task Force. 1992. California stormwater best management practice handbook: Industrial/Commercial. March.

The Role of Education and Training in the Development of the Delaware Sediment and Stormwater Management Program

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On May 31, 1990, the General Assembly of the State of Delaware enacted new legislation on stormwater management and placed it within the revised framework of the state's sediment control law to emphasize the integral relationship between the two programs. Governor Castle signed the legislation into law at a public ceremony on June 15, 1990. The effective date of the regulations was January 23, 1991. Program implementation was initiated on July 1, 1991.

The role of education and training in the development and implementation of Delaware's sediment and stormwater program was recognized at the legislative onset. The educational effort continued through the evolution, development, and promulgation of the regulations and remains an essential component of program strategy. The sediment and stormwater regulations are specific as to the training requirements and opportunities for education that are to be provided for contractors, construction review/inspection personnel, and plan design professionals.

This paper discusses the education and training accomplishments to date, their value to successful program inauguration, and specific training objectives being developed to meet the requirements of the new law and regulations in Delaware.

Background

The State of Delaware has had an erosion and sediment control program since 1978. That program was only marginally successful due to budget and personnel limitations. Environmentally oriented initiatives in other states and within the federal government have since provided an impetus for the Department of Natural Resources and Environmental Control (DNREC) to attempt program improvements with respect to sediment control and stormwater management.

In 1989, DNREC representatives conducted onsite reviews of the existing sediment control program to document program effectiveness. It was readily apparent that too few resources were devoted to a program that lacked legislative and regulatory authority. The site problems were recorded through slide documentation so that a public education program could be developed that clearly showed the need for program improvements.

At the same time, DNREC, in association with local conservation districts, was considering the need for a statewide stormwater management program that considered water quantity and water quality requirements. Fortunately (or unfortunately, depending on the perspective), during the summer of 1989, Delaware had several severe flooding events that reinforced the concept that the state needed a stormwater management program that would prevent existing problems from getting worse.

Delaware does not have a strong environmental lobby group to advocate the passage of new environmental programs, so DNREC has developed a consensus-style approach to get legislation and subsequent regulations accepted by the legislative bodies and the regulated community.

Legislative Process

As the legislation was developed, DNREC sponsored two workshops at which the concept behind the proposed legislation was discussed in a public forum accompanied by slide presentations. The slide presentation focused on problem identification, the proposed state program to address the problems, and the degree to which, in the opinion of DNREC, the sediment and stormwater program was going to evolve. Individual meetings were held with contractors' associations, engineering consultants, land developers, and the general public.

In addition to those workshops and meetings, presentations were made to legislative committees in an informal setting so that individual committee members would have a basic understanding of the need for legislation.

The proposed legislation passed through a state senate committee and the full senate in only 2 days, with not one negative vote. The passage of the legislation through two committees in the state house of representatives and the full house took approximately 1½ months and again received no negative votes. The educational process prior to submission of the legislation and during the legislative process was so successful that not one affected group submitted comments that were in opposition to the legislation. The legislation passed through three committees and two houses unanimously. The legislation was signed into law by Governor Castle in a public ceremony on June 15, 1990.

Regulatory Process

The legislation has several components that specifically address education and training, but one component critical to the process of regulation adoption was the requirement in the law that the regulations were to be developed with the assistance of a regulatory advisory committee. Recognizing the need for program consensus, DNREC placed the regulatory advisory committee requirement within the legislation so that the affected entities would participate in the regulatory process.

The regulatory advisory committee was composed of representatives of 20 organizations representing such groups as contractors, developers, consulting engineers, utility companies, local governments, and conservation districts. DNREC prepared drafts of the regulations prior to meetings. Each section, subsection, paragraph, sentence, and word that was proposed for the regulations was subject to the scrutiny of the regulatory review committee. Each member of the committee did not have to approve all aspects of the regulations, but rather the committee needed to substantially concur. Eight full committee meetings were held, and through the meeting process committee members could understand the rationale behind the various regulatory requirements. As a result, the committee members substantially concurred on all aspects of the regulations. In fact, committee members tended to become advocates of the regulations when they were published for public input.

In addition to the regulatory review committee process, meetings were also held with any interested individual or entity. Once the regulations were in a rough state of completion, three public workshops were held around the state to solicit input from a broader range of interests than just those represented by the regulatory review committee. The input received during this public review process was limited, but the informal public process prepared people for what was intended in the regulations so that any significant opposition to any of the requirements could be addressed before the formal regulation adoption process.

On the basis of the input received from the workshops, DNREC initiated formal regulation adoption procedures with no major changes to the body of the regulations. Announcements were placed in newspapers regarding DNREC's intentions, and a formal public hearing was held on January 16, 1991. Due to the consensus-building process, in which the regulated community participated in developing the regulations, not one adverse comment was received during the public hearing process. The entire public hearing took less than 15 minutes, as there were no questions or comments due to public awareness of the regulations' contents.

The entire process of legislative and regulatory development and approval clearly demonstrates that a consensus-building approach to environmental requirements may be an effective means of obtaining the programmatic infrastructure needed to implement an effective program. In large part due to the strong involvement of the regulated community, there is a significant effort in the law and regulations regarding education and training of contractors, inspectors, consultants, and the general public. It is the position of the authors that environmental programs can only be effective if the regulated community is involved in program development and evolution, recognizes the program need, and understands and accepts their obligations under the regulatory requirements. The individual educational and training obligations under the law and regulations are discussed as they affect the overall sediment and stormwater program.

Delaware Sediment and Stormwater Contractor Certification Program

During the development of the Delaware Sediment and Stormwater Regulations, a provision was made to provide for mandatory training and certification of individuals performing sediment and stormwater related construction. Section 13 of the regulations states that "After July 1, 1991, any applicant seeking sediment and stormwater plan approval shall certify to the appropriate plan approval agency that all responsible personnel involved in the construction project will have a certificate of attendance at a Departmental sponsored or approved training course for the control of sediment and stormwater, before initiation of land-disturbing activity."

"Responsible personnel" means any foreman or superintendent who is in charge of onsite clearing and land-disturbing activities for sediment and stormwater control associated with a construction project.

"Land-disturbing activity" means a land change or construction activity for residential, commercial, silvicultural, industrial, and institutional land uses that may result in soil erosion from water or wind or movement of sediments or pollutants into state waters or onto lands in the state,

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or which may result in accelerated stormwater runoff including, but not limited to, clearing, grading, excavating, transporting, and filling of land.

Contractor Certification Program Development

The development of the Contractor Certification Program was part of a general sediment and stormwater educational package funded by a Section 205 (G) grant under the Clean Water Act from the U.S. Environmental Protection Agency. Other tasks included a review of similar programs throughout the mid-Atlantic region, contracting for aerial photography of sites under construction, preparation of a portable soils exhibit, and identifying future training and educational needs. The grant tasks were carried out jointly through a memorandum of understanding between DNREC's Division of Water Resources and the New Castle Conservation District. A steering committee was formed in April 1990 and met seven times over the course of the following 9 months. The purpose of the committee was to provide input for the development and implementation of the grant tasks.

It was determined that the certification program was to use a slide presentation format since excellent documentation was already available and additional field slides were easily obtained. In addition to the field slides of sediment and stormwater construction practices, text and technical slides needed preparation. A local company was contracted to produce this material.

The certification program was developed with a 3½- to 4-hour time frame in mind. This would allow for morning or afternoon sessions, even occasional evenings, as necessary. Maryland has enjoyed success for many years in their sediment control training program using a similar format and time frame.

A 55-page narrative describing the slide presentation was developed and made available to the audience upon request. This was done to encourage attention to the slide presentation rather than preoccupation with taking notes. Finally, it was decided that participants should receive a durable plastic laminate card with the state logo and the individual's name and certification number imprinted on it. This would give the participants a tangible item to associate with the completion of the program.

Contractor Certification Program Implementation

By the end of January 1991, the program was ready to be presented. Certain restrictions were placed upon class size in order to communicate most effectively. Optimal class size was 30 to 40 members. Limiting the class size meant that the program would have to be presented many times; therefore, by July 1, 1991, not all of the contractors needing to complete the certification program would have the opportunity to do so. The Sediment and Stormwater Regulations provide for interim certification if individuals notify DNREC of their intent to register for the next available course.

The certification program was designed for presentation in two ways. First, the conservation districts, counties, and other agencies given the responsibility of certain program elements would set up the programs in their own jurisdictions, giving them a chance to meet with the regulated community and explain local program requirements. Second, DNREC would present the program to any regulated company, business or organization if they could provide a suitable location and a minimum of 15 individuals to be trained. DNREC also provided training for DNREC staff and several hundred Delaware Department of Transportation inspectors, technical staff, and engineers.

Throughout the first 6 months of presentations, we were surprised and pleased not only with the response from the contractors but also from the engineers, consultants, and developers who wanted to attend the certification program. All told, from February 1991 until July 1991, DNREC presented the program on 37 occasions, certifying over 1,100 individuals from 300 companies and organizations.

As stated earlier, this was possible only with the assistance from the three state conservation districts, county governments, the Department of Transportation, and organizations such as the Associated Builders and Contractors and the Delaware Contractors Association. As of January 1, 1993, almost 2,000 individuals have completed this training.

Initially, a program quiz was developed not so much to grade the participants but to obtain feedback on the retention of the material being provided. A program evaluation was later substituted for the quiz so that we could determine if any changes or improvements should be made to the training program. A representative sample of 100 evaluations was compiled, the results of which appear in Figure 1. Most notable is that 96 percent of respondents would recommend this training (Question 7), and 86 percent wished to continue in this training (Question 8).

By continuing the Contractor Certification Program, not only are the requirements of the Delaware Sediment and Stormwater Regulations being met, but the knowledge gained by the participants in this program is being transferred to the field through proper construction practices.

Delaware Certified Construction Reviewer Course

The Delaware Sediment and Stormwater Regulations also provide for special site inspection or review requirements under certain site conditions. Section 12 of the

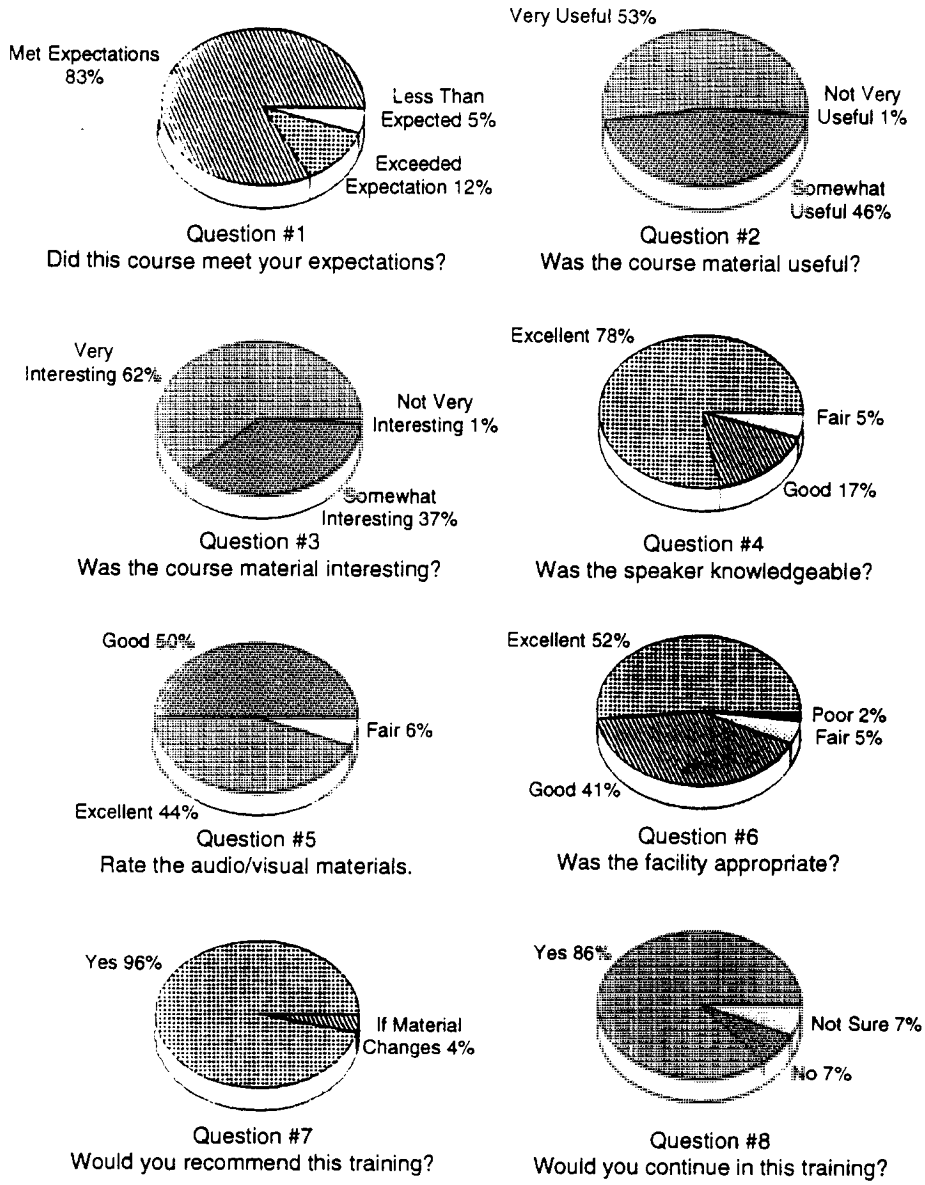

Figure 1. Sediment and stormwater contractor certification program course evaluation.

regulations identifies these site conditions that allow DNREC or the appropriate plan approval agency to require that a certified construction reviewer be present on site. Examples of site conditions that would warrant this requirement would be a site in excess of 50 acres of disturbed area or any site experiencing significant sediment and stormwater problems. The owner or developer of the site in these cases would be responsible for providing a certified construction reviewer for any or all parts of the construction phase as deemed necessary by the plan approval agency. The main responsibility of these individuals is to ensure the adequacy of construction pursuant to the approved sediment and stormwater management plan.

As with the Contractor Certification Program, DNREC has the responsibility to provide training to certify these construction reviewers. A formal Sediment and Stormwater Management Certified Construction Reviewer Course was developed in cooperation with Delaware Technical and Community College. Course material was developed to instruct participants in basic hydrology and hydraulics, soils, vegetative establishment, construction practices, plan preparation and implementation, inspection, enforcement, and maintenance. To instruct this course, over 20 professionals in the area of sediment and stormwater management were recruited, representing government agencies, private industry, and the consulting and engineering community.

The course format was developed to be presented in eight $3\frac{1}{2}$-hour weekly sessions. An examination was developed and arrangements made with Delaware Technical and Community College for Continuing Education Credits to be issued.

We anticipated a lot of interest in this course offering, so registration was limited to one individual per company or organization. In addition to the private community, an attempt was made to include at least one individual that works for each agency responsible for delegation of sediment and stormwater program elements. In all, 85 seats were quickly filled for this course. The second time this course was offered, the class sessions were reduced to four all-day sessions. This seemed to suit the class participants' schedule better.

One important measure of success is the evaluation question that asked class participants to indicate whether the course did not meet, met, or exceeded expectations. The breakdown is as follows:

- 41 responses, or 74 percent of the class, stated that the course met their expectations.
- 12 responses, or 22 percent of the class, stated that the course exceeded their expectations.
- 2 responses, or 3.5 percent of the class, stated that the course did not meet their expectations.

The success of this program is directly attributable to the preparation of the speakers, the attentiveness of the class, and the hard work of the Delaware Sediment and Stormwater Program staff.

Stormwater Management Technical Sessions

The engineering and design community in Delaware has also indicated the need for DNREC to present more design-oriented training in sediment and stormwater management. To date, there have been several workshops in U.S. Department of Agriculture Soil Conservation Service TR-55 and TR-20 hydrologic analyses sponsored by local conservation districts and enlisting the assistance of the Soil Conservation Service. DNREC recognizes the need to expand this basic training and make available more design-oriented training for the consultant community.

Coinciding with the development and release of the *Delaware Stormwater Management Design Manual* in the summer of 1993, training classes were scheduled to present this material in modules, as the manual was developed. This training will help ensure that stormwater management practices are designed to meet established minimum criteria.

Summary

The education and training component of the Delaware Sediment and Stormwater Management Program is one of several areas of program development that will continue to respond to the needs of the regulated community. One obvious benefit in a small state like Delaware is that the efforts of a regulatory agency in providing education and training to the regulated community are recognized and appreciated. As previously discussed, the Sediment and Stormwater Management Program depends highly on interagency cooperation and communication with the businesses and industry involved. By maintaining education and training objectives as a high priority, DNREC will increase chances for program success.

Development and Implementation of an Urban Nonpoint Pollution Educational and Informational Program

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Abstract

Sampling, Abatement, Follow-up, Education, and Response (SAFER) was formed by the Washtenaw County's Environmental Interest Group on January 1, 1992. SAFER includes the county departments of Environmental Coordination, Environmental Services, Drain Commissioner, Planning, and Cooperative Extension, as well as the Soil Conservation District, Huron River Watershed Council, Ecology Center of Ann Arbor, and the Southeast Regional Groundwater Education Center. The purpose of SAFER is to "provide for coordination of water protection programs through inter- and intracounty agencies and group cooperation."

Education is a key element of SAFER. Four groups are targeted for education by SAFER: government, business and industry, community groups, and schools. SAFER members develop their own specific educational programs and materials. Through SAFER, these are coordinated to provide uniform and accurate information to targeted segments of the community. This avoids costly duplication of services.

To effectively deliver an educational program, the target audience must first be determined, then an analysis of existing educational programs must be made to build on past successes. Through this process, an approach is determined that is most likely to be successful. Prior to beginning the educational program, the establishment of an evaluation process is critical.

Overview of Washtenaw County's SAFER Group

Sampling, Abatement, Follow-up, Education, and Response (SAFER) was formed by Washtenaw County's Environmental Issues Group on January 1, 1992. The Environmental Issues Group consists of departments within Washtenaw County government that indirectly or directly manage the environment of Washtenaw County. This provides the county with a coordinated approach to addressing environmental issues. The Environmental Issues Group is chaired by the Environmental Coordination Office. Other member groups within the Environmental Interest Group are the Sheriff's Department, Environmental Services, Emergency Management, Planning, Public Works, Drain Commissioner, and Cooperative Extension, as well as the county's Health Officer. This group meets monthly to discuss the status of county programming, pending state and federal legislation, "hot" environmental topics or issues, and strategic planning.

SAFER was formed as a work group of the Environmental Issues Group "to provide for coordinative water protection programs through inter- and intracounty agencies and group cooperation." SAFER consists of groups internal and external to Washtenaw County government that are involved in dealing with the county's ground and surface water. SAFER includes the county departments of Environmental Coordination, Environmental Services, Drain Commissioner, Planning, Cooperative Extension, Soil Conservation District, Huron River Watershed Council, and Ecology Center of Ann Arbor, as well as the Southeast Regional Groundwater Education Center (SER-GEM). During its first year of operation in 1992, the group focused on categorizing and compiling all current water quality programs and their products. The 1992 SAFER Directory compiled over 100 products addressing water quality issues within the county.

Education is a key element of SAFER. Four target groups for educational programs in SAFER are government, business and industry, community groups, and schools. The SAFER Educational Subcommittee in 1993 is compiling all educational programs and materials on water quality related issues, similar to the 1992 SAFER Directory. Through SAFER, educational materials are coordinated to provide current and accurate information to the community while avoiding costly duplication of services.

Urban Nonpoint Pollution Education

The development and implementation of a nonpoint pollution educational and informational program is critical to a successful urban project. Public awareness of urban nonpoint pollution is relatively low, and the media tends to focus on health or environmental risks that are easy to define, such as AIDS or hazardous waste issues. Due to its nature, nonpoint pollution is harder to pinpoint. Urban nonpoint pollution prevention requires a long-term commitment to changing attitudes.

Urban nonpoint pollution can be directly attributed to people. We all contribute to it. People are accustomed to focusing on easier issues, where the blame can be attributed to activities outside their control. An example is auto safety. People are very concerned about vehicle safety when a manufacturing error is the cause, such as exploding gas tanks. These same people, however, are not as focused on actions that they control, such as wearing seat belts.

An environmental example is oil spills. A study by the Michigan Department of Natural Resources (MDNR) in 1989 found that more oil is illegally released into the environment in Michigan annually than was released in the Valdez tanker incident. Getting people to buy into the idea that they are a major part of the problem is a critical step in gathering their support and cooperation.

Target Audience

Before an education information program can be developed, the target audience must be identified. A general educational approach will not change the habits of a wide range of target groups. Each targeted group must be analyzed independently to understand its particular needs and to develop specific actions it can take. Next, the various media options must be explored.

A multimedia approach enhances the opportunities of reaching larger segments within the target audience. For example, handing out flyers at a garden show will not reach several socioeconomic classes; a spot on a local radio station may be more appropriate. Some common public outreach materials are fact sheets, pamphlets, radio, television, newspapers, magazines, displays, models, posters, group presentations, and one-on-one or community events.

Using existing resources in your educational program is important. An educational program workshop for composting in the community could also be a forum for supplying information to the public on preventing urban nonpoint pollution through the proper application of fertilizers and use of environmentally friendly alternatives to pesticides. By networking with existing programs in the community, nonprofit programs will not compete for and confuse the audience.

Educational Gaps

After analyzing current educational resources within the community, identify audiences and approaches not currently used. All targeted groups need to receive your message. Target groups in the community must "buy into" their contribution to nonpoint pollution and their ability to prevent or minimize it. Urban educational programs must be innovative, well conceived, multimedia, and coordinated with other educational programs in the community.

A large number of ongoing urban nonpoint education programs exist in communities throughout the country. These programs have been developed for various types of audiences. Prior to implementing a program "from scratch," review all ongoing programs. These can be found in EPA "News Notes," as well as through professional groups, conferences, and environmental publications. Regional EPA offices are also a valuable resource for finding suitable ongoing programs. Using existing programs saves time and money.

Program Evaluation

An integral part of all educational programs is evaluation. Valuable time and resources can be wasted if information supplied to an audience is not effective. When developing the evaluation mechanism for the educational process, make sure the educational program focus enhances the overall water quality objectives. One way to evaluate the educational process is to apply Bennett's Hierarchy of Evidence for Program Evaluation. Bennett uses seven steps of evaluation. In an inverted scale, these steps are:

1. Inputs of program resources that are used to make the program work.
2. Activities which can include internal events, such as planning, or external events involving an audience.
3. Involvement of the target audience in activities, focusing on hands-on type activities.
4. The target audience's view of the program.
5. KASA change, or the change in knowledge, attitudes, skills, or aspirations of the audience.
6. Changes in behavior that result from the educational program.
7. End results that reflect the program's goals and objectives.

Many techniques can be used to measure the seven Bennett attributes. The basic who, what, where, and when questions are useful when establishing the specific evaluation technique.

Many books and guides can help in developing program evaluation. Studying these before finalizing an evaluation process is highly recommended. If there are time constraints or expertise is not available for evaluation, this component can be done by an outside party. The key is to establish the evaluation mechanism before implementing the educational program.

Huron River Pollution Abatement Program

Overview

The Huron River Pollution Abatement Project (HRPAP), which encompassed the urbanized area of Washtenaw County, was formed and implemented in 1986 by the county's Drain Commissioner's Office in conjunction with the Environmental Services Department. Public education was a major objective of the project. The educational program used by the HRPAP was designed after reviewing earlier area pilot water quality programs and their targeted community groups. The HRPAP focused on business, industry, community, and school groups.

Business/Industry

The HRPAP conducted surveys and dye tests of facilities located in the urbanized areas of Washtenaw County. Staff interviewed facility owners and managers on their particular businesses and gained critical information about their operations. When a common need was found—for example, an owner unable to dispose of a certain type of waste—the project staff worked with the owner to resolve the problem. For example, many facility operators with oil separators were not familiar with separators and were unable to find a licensed waste hauler to service them. The HRPAP developed a maintenance guideline for the operators, contacted all local waste haulers, and developed a list of haulers that would service oil separators. This information was then distributed to all facilities with oil separators.

Community and Civic Group Education

Over 200 educational presentations were made to the community during the HRPAP's 6 years. The HRPAP used various media to educate the community. One of the most effective was the local press. Articles concerning the HRPAP were published on an ongoing basis. Press releases noted significant events and common problems found within the community.

A second approach to outreach was through community events. Examples are the Ann Arbor City Art Fair and the Ypsilanti City Heritage Festival. These events attract hundreds of thousands of people. Display booths and pamphlets were developed for participating in these events. This became a forum for discussing water quality related issues one-on-one with the public.

School Education

The HRPAP made its first school educational presentation to a third-grade class in 1988. Word of mouth led to over 25 presentations per year in six local school districts. HRPAP student interns with an educational background formulated lesson plans for different grade levels on nonpoint pollution and related topics, such as the water cycle and household hazardous waste.

In classrooms, educational programs concentrated on hands-on activities. Two water quality models were built. One electronic model, entitled "Pathways to Pollution," lights up various pollution pathways when the appropriate button is pushed. A second model is a transparent representation of a town showing the sanitary and storm sewer systems. The students place a dye into catch basins, floor drains, and toilets to observe the route the water takes directly to the stream or the wastewater treatment plant. This model has examples of both proper and improper connections.

Conclusions

The majority of urban nonpoint pollution can be directly attributed to the activities of people. Most people are not aware of the impacts their routine activities at home and at work have on water quality. Education is a key component to improving urban water quality problems. Key target audiences in the community need to be identified, existing educational resources studied, educational program gaps identified, and an evaluation process included to measure a program's effectiveness.

The key to an educational program is to focus on practical activities that the target group can do to eliminate water pollution. A long-term, sustained educational effort leads to an increased awareness and respect for the interdependence of all elements in the ecosystem and for how individual activities affect them. This ultimately leads to a sense of mutual responsibility and a long-term commitment to continued environmentally sound actions.

Acknowledgments

The author would like to acknowledge the support and help of Dr. Rebecca Head, Group Director, Environment and Infrastructure; Janis Bobrin, Drain Commissioner; Robert Blake, Director, Environmental Services; David Dean; H. Leon Moore; Jeffry Krcmarik; and David Wilson, as well as other members of SAFER.

Training for Use of New York's Guidelines for Urban Erosion and Sediment Control

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Introduction

New York State still does not have a statewide erosion and sediment control law. Unlike many of its neighboring states, New York continues to leave the initiation of such control to local units of government. Historically, counties, towns, and villages have enacted ordinances once a significant environmental accident has occurred. Jurisdiction occurs at the local level, with planning boards having approval authority to issue permits to develop. Because each board is dealing with its local area, the regulations and processes for gaining approval vary from locale to locale.

Technical standards for controlling erosion and sediment were developed by the Soil Conservation Service in March 1988 and issued as *New York Guidelines for Urban Erosion and Sediment Control.* This document provides design details and specifications for both temporary and permanent management practices, as well as resource-planning concepts. Known as the "Blue Book," the document provides consistency in the technical approach to erosion and sediment control plans for construction sites. It has been adopted by the New York State Department of Environmental Conservation and the U.S. Army Corps of Engineers, Buffalo District, as criteria for erosion and sediment control plans. The New York State Department of Transportation has incorporated many of its details into its highway design manual.

In April 1992, the New York State Department of Environmental Conservation (NYS-DEC), Division of Water, published *Reducing the Impacts of Stormwater Runoff From New Development.* This document establishes performance standards for stormwater management control in New York for projects requiring NYS-DEC review. Standards were set for both water quantity and water quality. Water quantity is addressed by requiring no greater discharges from the site after development than present before development for the 2-, 10-, and 100-year frequency storm events. Water quality is addressed by retaining the "first flush," which is defined as the greater of one-half inch of runoff or runoff resulting from a 1-year, 24-hour storm, from the land area for which the infiltration rate has been changed.

These two documents finally provide guidance for erosion and sediment control and stormwater management for local units of governments as well as regulatory agency staffs. Their use and application depends on what the site's size and resource constraints are and whether a local ordinance is in place. The local approval process, in communities with such a regulation, generally requires a formal review of the plan with its erosion and sediment control and stormwater management component by either the town or village engineer and a local soil and water conservation district staff person or health department official. Unfortunately, many of these individuals are unable to identify problems or lack the knowledge of design details to control sediment from the site.

Once a developer begins operations in the field, the building inspector, code enforcement officer, or health department official is responsible for inspecting the site for compliance to the approved plan as well as to ensure that the contractor maintains the installed practices. These field inspectors require training in the concepts of erosion and sediment control installation and maintenance.

Clean Water Act Mandates

On October 1, 1992, stormwater regulations went into effect under the Clean Water Act that require individuals, agencies, and municipalities to apply for a National Pollutant Discharge Elimination System (NPDES) permit for stormwater discharges from a variety of activities. New York State is a NPDES-delegated state, and the

Department of Environmental Conservation is administering this program through their State Pollutant Discharge Elimination System (SPDES) permit. One of the 11 categories covered in the regulations is construction activity. Under this activity, any site where 5 or more acres are disturbed must have an erosion and sediment control plan and a stormwater management plan. The 5-acre size limit has been challenged as arbitrary, and the size limit could be changed to 1 acre of disturbed area. A developer needs to file a Notice of Intent at least 48 hours before beginning operations to have "coverage." This notice is filed with the U.S. Environmental Protection Agency in Newington, Virginia. Under the regulations, copies of the erosion and sediment control plan and stormwater management plan are to be kept on site. Copies of each are also sent to the municipality that has jurisdiction. NYS-DEC does not want the notices or plans sent to its offices; they will not be reviewing or approving these plans. Who will? What will be the local impacts?

As a result of this mandate, many New York counties, towns, and villages will be receiving many erosion and sediment control and stormwater management plans. The majority of these units of government are still unaware of the requirements of the national program and of what their role is or should be. There is a great need for administrators, planners, and legislators to become aware of the program and the process. Technical staff need to learn the principles of planning, design, construction, and inspection for erosion and sediment control and stormwater management systems.

Positive aspects of the NYS-DEC approach to the program include the opportunity for local policy development, provisions for local ordinances, and the formation of interagency partnerships. Because NYS-DEC recognizes that authority should rest at the local level, communities have control over the quality of the natural resources in their backyards. Of course this may require additional staff or cooperation with other agencies to assist with implementation.

Training Programs

Early efforts in erosion and sediment control began with awareness seminars at the local level. The seminars usually lasted 2 hours an evening for local officials involved in the site review and approval process. Recognizing problems, learning the planning steps, and becoming familiar with practices and guidelines were the limit of these seminars.

The complexity of requirements and the technical needs have increased dramatically due to recent mandates. The Soil Conservation Service, in cooperation with NYS-DEC and Syracuse University, has developed a tiered educational program in erosion and sediment control and stormwater management.

A 1-day seminar has been developed for planning board members, environmental management council members, legislators, and town boards, and has included legal advisors, consulting engineers, and other agency personnel responsible for environmental analysis. This agenda is included as Figure 1. This seminar stresses site planning through a slide presentation that demonstrates problems without control and shows practices necessary to maintain resources on the site. Stormwater management performance standards are reviewed in accordance with NYS-DEC criteria. This seminar is reinforced with two specific site examples. Attendees are asked to work in small design teams to design an erosion and sediment control plan for the first site. These same design teams are asked to critique the second site, which already has an erosion and sediment control plan. Thus, attendees go from designers to reviewers in applying their knowledge of these principles.

A 2-day workshop has been developed for the technical staffs of resource agencies, consulting engineers, local governments, and others with technical review or design responsibility (see Figure 2). This session begins with a quick overview of the principles of erosion and sediment control, then continues with a class exercise to design an erosion and sediment control plan for a development site while working in design teams of approximately four individuals. The afternoon of the first day is spent at a field site gathering specific resource information and data to design a detailed erosion and sediment control plan for the site. The design teams also compute and compare peak discharges for the site for predevelopment and postdevelopment conditions using Soil Conservation Service Technical Release 55, Urban Hydrology for Small Watersheds (TR-55). The session concludes with group presentations.

A 3-day short course with Syracuse University has been developed to address the specific technical needs of consulting engineers working with stormwater and erosion control systems. This tuition-based course provides for more indepth design of erosion and sediment control practices using a field site. Sizing stormwater detention basins is also required. In addition to the increased technical emphasis, additional speakers from state and local agencies provide a component on rules and regulations. Syracuse University awards two continuing education units for this course, which 57 people have completed to date. The agenda is included as Figure 3.

Urban Erosion Control and Stormwater Design (CIE 600) stands as a fully accredited 3-hour graduate level course in the Civil and Environmental Engineering Department at Syracuse University. It was taught for the first time in the 1992 fall semester and will be taught again this September. It was developed as a hands-on course that requires detailed designs for two projects, using field trips and six additional site review projects.

EROSION AND SEDIMENT CONTROL SEMINAR
AGENDA

8:30 AM	Registration
9:00 AM	Introduction and Course Overview
9:15 AM	Developing an Erosion and Sediment Control Plan — Planning Considerations — Factors That Influence Erosion — Elements for a Sound Plan — Vegetative and Structural Components — Standards and Specifications
11:00 AM	Site Example — Develop Conceptual Erosion and Sediment Control Plans
12:00 PM	**LUNCH (ON YOUR OWN)**
1:00 PM	Site Review — Critique an Erosion and Sediment Plan for a Specific Site
3:30 PM	Wrap Up/Summary
4:30 PM	Adjournment

Figure 1. Erosion and Sediment Control Seminar agenda.

EROSION AND SEDIMENT CONTROL WORKSHOP

AGENDA

First Day

8:30 AM	Registration
9:00 AM	Introduction and Course Overview
9:15 AM	Developing an Erosion and Sediment Control Plan —Planning Considerations —Factors That Influence Erosion —Elements for a Sound Plan —Vegetative and Structural Components —Standards and Specifications
11:00 AM	Site Example —Develop Conceptual Erosion and Sediment Control Plans
12:00 PM	**LUNCH (ON YOUR OWN)**
1:00 PM	Design Session—Site-Specific Practices —Temporary Swale —Sediment Trap —Urban Runoff
2:30 PM	Field Problem—Design Teams —Gather Data —Develop Concepts in Field
4:30 PM	Adjournment

Second Day

8:30 AM	Complete Group Designs
10:00 AM	Design Critiques
12:00 PM	**LUNCH (ON YOUR OWN)**
1:00 PM	Design Session —TR-55 Analysis for Structures —Rock Outlet Protection —Class Discussion
3:00 PM	Wrap Up and Summary
3:45 PM	Adjournment

Figure 2. Erosion and Sediment Control Workshop agenda.

SYRACUSE UNIVERSITY
UNIVERSITY COLLEGE
EROSION AND SEDIMENT CONTROL

SHORT COURSE AGENDA
April 28-30, 1992

First Day

9:00 AM	Registration and Coffee	Dr. Stephan Nix
	Introduction and Course Overview	
10:00 AM	Legislation, Ordinances, and Regulatory Review Process	Mr. Robin Warrender Mr. William Morton Mr. Russell Nemecek
11:00 AM	Developing Your Stormwater Management Plan and Practices	Mr. William Morton
12:00 PM	Lunch	
1:00 PM	Urban Hydrology and Flow Routing	Mr. Donald W. Lake, Jr.
2:15 PM	Break	
2:30 PM	Urban Hydrology and Flow Routing (continued)	
4:30 PM	Adjourn	

Second Day

8:00 AM	Developing Your Erosion Control Plan	Mr. Donald W. Lake, Jr.
9:30 AM	Break	
9:45 AM	Erosion and Sediment Control Practice Standards	Mr. Donald W. Lake, Jr.
11:30 AM	Lunch (En Route to Field Site)	
12:00 PM	Field Tour/Site Problems	Mr. Donald W. Lake, Jr.
3:00 PM	Group Design Session	
5:00 PM	Adjourn	

Third Day

8:00 AM	Group Presentations and Critiques	
10:00 AM	Break	
10:15 AM	Group Presentations (continued)	
11:45 AM	Wrap Up—Adjourn Short Course	Dr. Stephan Nix
1:00 PM	Certified Professional Erosion Specialist Exam Part II (Optional)	Mr. Donald W. Lake, Jr.

Figure 3. Erosion and Sediment Control short course agenda.

In addition, the class participates in a town planning board meeting. Syllabus topics (see Figure 4) include manual and computer analyses of stormwater discharges and lectures by a plant materials specialist, a code enforcement officer, and governmental representatives dealing with rules and regulations. Twelve students enrolled in the first class, which was extremely well received by both students and the people who provided the example sites.

Summary

Over 2,600 people have received training through 76 different seminars, workshops, short courses, and the graduate course since the training effort began in the fall of 1988. These tiered training sessions have evolved one after another based on needs at the local level. Leaders in the NYS-DEC recognized that benefits are local so training efforts should be local. This has led to interagency cooperative agreements between the U.S. Department of Agriculture, Soil Conservation Service, and NYS-DEC to bring training directly to the communities.

There is no sign of these training requests letting up. An average of 10 requests for the seminar sessions are made at the local level during the year. In addition, the proposed cooperative agreement for Fiscal Year 1994 between the Soil Conservation Service and NYS-DEC calls for five 1-day seminars, four 2-day workshops, four 2-day TR-55 hydrology workshops, and two short courses. The Syracuse University graduate course will be taught again this fall. Future projects also include workshops for New York State code enforcement officers, development of a field notebook for job superintendents, and field application courses for equipment operators. After all, equipment operators have the last word in installation.

We have come a long way, but we can see that challenges are still ahead of us to educate public planners, legislators, consultants, technical staff, and contractors in the use of sound erosion and sediment control and stormwater management practices to protect and enhance water quality and the environment.

DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING
SYRACUSE UNIVERSITY

CIE 600

URBAN STORMWATER AND EROSION CONTROL DESIGN
FALL 1992

SCHEDULE:	Monday/Wednesday 6:15-7:45 PM Peck Hall, University College
INSTRUCTOR:	Donald W. Lake, Jr., PE State Conservation Engineer, USDA-SCS
TEXT:	SWCS, Empire Chapter, **New York Guidelines for Urban Erosion and Sediment Control**, October 1991; Soil Conservation Service, Technical Release 55, **Urban Hydrology for Small Watersheds**, June 1986; New York State Department of Environmental Conservation, **Reducing the Impacts of Stormwater Runoff From New Development**, April 1992.
GRADING:	Assignments: 40% Mid-Term Exam: 30% Final Exam: 30%

Course Content:

Week:	**Topics:**	**Reading**	**Instructor**
8/31	Introduction to Urban Stormwater and Erosion Control Design (1)*		Lake
9/7	Resource Planning and Stormwater Impacts (2)	Ch. 1, NY Guide and DEC Manual	Lake
9/14	Computing and Controlling Sediment and Runoff (2)	Ch. 8, Appendix B, NY Guide	Lake
9/21	Stabilizing Soil, Vegetative and Biotech (2)	Chs. 4 and 5, NY Guide	Dickerson Lake
9/28	No lecture—E&S Field Exercise (10/3, 8:30-11:30 AM) (turn in 10/7)	NY Guide	Lake
10/5	Urban Hydrology (2)	SCS-TR-55	Lake
10/12	Urban Hydrology (1) and Site Exercise Critique (1)		Lake
10/19	NO CLASS—HYDROLOGY PROJECT		Lake
10/26	Urban Hydrology Computer Program (1) and MIDTERM	Tr-55	Chapman Lake

Figure 4. Urban Stormwater and Erosion Control Design course agenda.

Week:	Topics:	Reading	Instructor
*Number of lectures that week			
11/2	Construction/Maintenance/Code Enforcement	NY Guide	Proietta
11/9	Town Planning Board Assignment and Stormwater Field Exercise (11/14—9:00 AM)		Lake
11/16	Performance Standards for Stormwater Management	Chs. 5 and 6, DEC Manual	Warrender Morton
11/23	Flow Routing (1)		Nix
11/30	Flow Routing (2)		Nix
12/7	Stormwater Basin Design (2)	DEC Manual	Lake
12/14	Course Review		Nix
12/21	FINAL EXAM		Lake

Instructors

Donald W. Lake, Jr., PE, State Conservation Engineer, USDA-SCS
John Dickerson, Northeast Plant Materials Specialist, USDA-SCS
Dana Chapman, Asst. State Conservation Engineer, USDA-SCS
Robin Warrender, Chief, Nonpoint Source, Division of Water, NYS-DEC
William Morton, Resource Specialist, NYS Department of Environmental Conservation
Dr. Stephan Nix, Professor, Syracuse University, Civil and Environmental Departments

Figure 4. Urban Stormwater and Erosion Control Design course agenda (continued).

Field Office Technical Guide:
Urban Standards and Specifications

Gary N. Parker
U.S. Department of Agriculture, Soil Conservation Service
Champaign, Illinois

Abstract

The *Field Office Technical Guide* is the primary technical reference for the Soil Conservation Service (SCS). It presently contains general resource references and soil and site information, and describes conservation management systems, practice standards and specifications, and conservation effects. Although SCS maintains offices and provides assistance in all Illinois counties, the technical guide does not contain any information specific to natural resource use and management in urban areas. Therefore, in June 1992 the SCS in Illinois entered into an agreement with the Illinois Environmental Protection Agency to develop technical information describing best management practices (BMPs) for controlling urban nonpoint source water pollution.

Currently in development, this information will include 40 BMP standards and accompanying construction specifications, material specifications, and standard drawings. It will also include estimates of pollutant removal effectiveness and stormwater pollutant export, as well as planning and design criteria. When complete, this material will become part of the *Field Office Technical Guide.* The Illinois Environmental Protection Agency will also use the information in a separate, stand-alone technical manual. This material will be useful to planners, engineers, architects, and construction contractors, as well as to local government staff.

Background

The Soil Conservation Service (SCS), an agency of the U.S. Department of Agriculture, is the major federal agency providing natural resource management assistance on nonfederal land. Its primary responsibility is to provide leadership and expertise in managing natural resources in nonurban areas. Currently, SCS maintains a network of field offices in nearly every county in the country, providing local citizens with direct access to a wide range of technical specialists. These specialists include engineers, soil scientists, biologists, agronomists, and natural resource planners.

The technical material and expertise that has been developed to support SCS activities largely pertains to agricultural or rural settings. For example, the seed mixtures that most SCS specifications call for are those appropriate for agricultural areas and not necessarily for parks, recreation sites, or lawns. In addition, design criteria for waterways and diversions assume an agricultural land use context.

Despite this rural, nonurban emphasis within the agency, SCS maintains a field staff in urban and urbanizing areas. In Illinois, this urban staff serves over one-half the state's population. This urban presence has enabled SCS to develop some urban expertise. For instance, SCS TR-55 hydrology modeling techniques are widely used to estimate runoff from urban areas. Moreover, the PL-566 watershed projects constructed in the Chicago suburbs have given the agency some expertise in urban construction site issues. The SCS, however, has not provided any systematic technical support to its field staff on natural resource management issues in an urban setting. It has instead relied on the ability of its staff to adapt the provided information from a rural to an urban environment.

To become more effective in addressing key natural resource issues in urbanizing areas, the SCS in Illinois has initiated several activities:

- It is actively participating in a coalition of state and federal agencies to prepare a strategy for coordinating agency activities in northeastern Illinois.
- It is reviewing and clarifying its policy relative to providing assistance in nonagricultural areas.

- It is expanding the technical information its staff uses when providing assistance to decision-makers in urban areas.

The third initiative listed is the subject of this paper. In June 1992, SCS entered into an agreement with the Illinois Environmental Protection Agency to prepare a set of standards and specifications describing BMPs for controlling urban nonpoint source water pollution. In addition, the SCS will provide estimates on the range of pollutant removal effectiveness and criteria for planning runoff management. The agency will incorporate all this material into its *Field Office Technical Guide.*

Field Office Technical Guide

The *Field Office Technical Guide* is the primary technical reference for the SCS. It contains technical information about conservation of soil, water, air, plant, and animal resources. The guide is designed for use by technically trained people who are assisting landowners and users, land managers, government officials, and other decision-makers to plan, apply, and maintain appropriate conservation practices. The technical guide also is a major reference for those addressing top-priority resource goals identified by the National Program for Soil and Water Conservation. These goals are to reduce the damage caused by excessive erosion and to protect water from nonpoint source pollutants. The technical guide identifies sediment, nutrients, animal waste, pesticides, and salinity as nonpoint source pollutants.

The *Field Office Technical Guide* contains five sections:

- The "General Resource References" section lists references, cost data, maps, climate data, cultural resources information, threatened and endangered species, and pertinent state/local laws, ordinances, and regulations.
- The "Soil and Site Information" section describes the soil survey of the local area. It contains soil descriptions and interpretations that can be used to make decisions about land use and management. This section identifies soil characteristics that limit or affect land use and management, and rates soils according to limitations, capability, or potential.
- The section on "Conservation Management Systems" provides information for developing resource management systems to prevent or treat problems associated with soil, water, air, and related plant and animal resources. This section includes quality criteria that describe the level of resource protection that decision-makers should try to achieve to meet resource quality goals.
- The "Practice Standards and Specifications" section alphabetically lists conservation practices used by the field office, followed by practice standards and specifications. It may also include references and documentation requirements for the individual practices. Practice standards establish the minimum level of acceptable quality for planning, designing, installing, operating, and maintaining conservation practices. Practice specifications describe the technical details and workmanship required to install the practice, as well as the quality and extent of materials used in the practice.
- The last section, "Conservation Effects," contains information describing the economic and environmental effects of implementing particular practices and systems. The purpose of this section is to provide decision-makers with a way to evaluate the extent to which various alternatives can meet their goals.

As stated previously, this guide is the primary technical reference for SCS staff, particularly those at the field level. The guide is also useful to Soil and Water Conservation District staff, and to consultants and staff of state, county, and municipal governments. To expand its usefulness, however, the SCS urban field staff in Illinois have recommended that the guide include information that is directly relevant to natural resource management in an urban environment and is user friendly to urban clients. The material now being developed will attempt to meet that need.

New Material for the *Field Office Technical Guide*

The new material will supplement and expand the existing material in the guide's fourth section, *Practice Standards and Specifications.* The SCS will modify or develop 40 BMPs that deal specifically with urban natural resource management.

Each BMP standard will follow a uniform format:

- "Definition": describes what the practice is.
- "Purpose": explains what the intended effect of the practice is, that is, why this practice is used.
- "Conditions Where the Practice Applies": describes the types of sites where the practice would be appropriate; this section also describes limiting factors such as slope percent, maximum drainage areas, and maximum flow velocities.
- "Criteria": describes, in general terms, material and construction requirements and usually provides references to specific material and/or construction specifications.
- "Considerations": offers general information regarding factors to consider when deciding on the appropriateness of a particular practice; in some cases, this section is a brief, narrative, nontechnical summary of the "Conditions" section.

- "Plan and Specification Requirements": describes the nature and extent of the information the contractor needs to build the practice; it lists the requirements of the plans and specifications needed to install a practice.
- "Operation and Maintenance Requirements": describes the needed operation and maintenance actions and suggests the frequency with which they should be performed.

The revised fourth section of the technical guide will also include all the material specifications and constructions referenced in the practice standards, as well as a series of standard drawings for the practices. The standards and specifications will be available on computer disk. The standard drawings, which will be developed using a CAD system, also will be available on disk. This will allow engineers and consultants to access the material in preparing construction plans and specifications.

In addition to the SCS incorporating the new material into the Illinois *Field Office Technical Guide*, the Illinois Environmental Protection Agency plans to issue a stand-alone technical manual of those standards for use by consultants, state agencies, and local governments. The project is scheduled for completion in December 1994.

Stormwater Outreach at the Federal Level: Challenges and Successes

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Background

Stormwater regulations brought a distinctly different community into the realm of U.S. Environmental Protection Agency (EPA) regulation. Many members of this community have never before been regulated by an environmental program. The regulated community now includes all major cities and unincorporated areas with populations of 100,000 or more, as well as a very large, diverse group of industries. The most important factor influencing success with the stormwater regulations is education. By educating all parties concerned with the program, the community can begin to practice all that EPA is learning about how to provide a cleaner, safer environment.

The principal elements of an outreach program are communication and education, with a focus on influencing how people and organizations act. Given this, the National Pollutant Discharge Elimination System (NPDES) stormwater outreach program at the national level should, among other things:

- Disseminate information and educate people about the effects of receiving water pollution from diffuse sources, such as the loss of recreational activities.
- Promote positive environmental results, including the reduction of pollutant loadings into receiving waters.

Theoretically, accomplishing these goals should elicit a successful outreach program at any level. In fact, success is much more elusive. Of course, many outreach programs implement this theory very effectively. At the federal level, however, EPA has 16 different customers reflecting 10 EPA regions, 50 states, thousands of municipalities, and hundreds of thousands of facilities, trade associations, and professional groups. Moreover, when factoring in to this multitude Congress, EPA's own management, and scarce resources, a successful outreach program becomes a tremendously complex and costly endeavor.

At the federal level, it is crucial to provide as much information as possible to as many people as possible. Therein lies the biggest challenge in outreach at the federal level. This paper presents some of the challenges in developing an outreach strategy for the stormwater program at the federal level. It also describes some of the projects EPA's Office of Water has under way, some of which have worked very well and some of which have not. In addition, the paper discusses what the future holds for the stormwater outreach program.

Challenges of Developing a Stormwater Outreach Strategy

For its first year or so, the strategy of the stormwater outreach program consisted of a hotline, which addressed most needs, and speaking engagements, which filled in the gaps.

Almost immediately after the NPDES stormwater program was born, several years ago, the stormwater hotline was established. Since its inception, the hotline has received over 90,000 calls. The hotline staff answers questions, distributes documents, and handles registration for EPA workshops and seminars.

The other important element of the early stages of the stormwater program was speaking engagements and workshops. These continue to be one of the best ways to get "the word out" correctly. Regulated communities need to know exactly how the stormwater program affects them. For example, the program held 12 workshops between 1990 and 1991 to explain the November 10, 1990, regulations.

As the stormwater program matured, it became apparent that the community needed a more substantial outreach strategy. The hotline staff quickly found it difficult to refer all policy interpretation calls to EPA stormwater staff. At that time, the staff at Headquarters was very small and the regions were overburdened.

Consequently, the Headquarters stormwater staff expanded, and one of its first tasks was to develop an outreach plan. The first step was to identify the plan's customers, which turned out to be just about everyone. Primary customers are the regions and states. Of course, there are 11 categories of regulated industries and over 200 municipalities in Phase I alone. The list of customers continues to grow when the general public, elected officials, professional associations, trade groups, and consultants all are factored in. These groups require a different level of understanding of stormwater regulations. This presented a major challenge because the staff needed to examine each document and ensure that it satisfied the needs of more than one group of customers.

This early outreach strategy assumed knowledge of what the customers wanted. The assumption, however, was wrong. There was one crucial step in strategy development that the stormwater staff neglected to complete: ask the customers. Because of their enormous number, however, asking them all was impossible. Some customers, of course, in addition to the regulated community, are the states and regions, who are trying desperately to run their own stormwater programs. These customers were finally asked about the outreach plan at the 1992 Stormwater Coordinator's Conference in Atlanta, Georgia. The stormwater staff reviewed what they had been doing to date, and customers offered helpful suggestions on what to do next. Customers also participated in a session specifically targeted at designing the stormwater workshops held in April 1993 in Annapolis, Maryland, so as to ensure customer input.

During this meeting, it became apparent that many states and regions were duplicating work unnecessarily, that is, developing something that another state had already developed. This was very frustrating for all those involved. Some kind of clearinghouse or electronic communications system was desperately needed. Research, however, had already shown that it could cost from $750,000 to $1 million to set up such a system. This cost prevented Headquarters from accomplishing this effort on its own. Therefore, it asked the states to help by directing their 104(b)(3) grant funds to this effort. This seemed the only way to accomplish the goal quickly and effectively. Although this sounded like it would work, it has not. There is quite a bit of reluctance to use that money for this task. Therefore, stormwater personnel have begun to look for other avenues.

The challenges multiply when budget constraints are considered. One of the biggest problems involves printing a developed document. The printing budget at Headquarters has taken some very serious cuts. Despite attempts to solve this problem, difficulties continue. For instance, Headquarters has tried to distribute items electronically, but this can cause more problems than it solves. Budget cutbacks have seriously hampered plans to develop more public education materials than are currently available.

Of course, nearly everyone has been hit very hard by budget problems. Some states and counties have offered very creative ideas about getting the "most bang for your buck!" This issue has shed new light on the problem of getting out as much information as possible.

These are just some of the challenges stormwater staff have faced in putting together an outreach strategy. The next section describes some current outreach projects.

Current and Developing Outreach Activities

Research

A primary task has been to research existing outreach activities. Much information on these activities exists, and both researchers and audiences find this an ongoing educational process. Research efforts include:

- Research on outreach activities
  Audience: Headquarters management, regions
- Research on videos
  Audience: Headquarters management
- Research on clearinghouses
  Audience: Headquarters management, regions

Current research on existing outreach activities examines their successes and failures. Hopefully, this effort will help target materials and practices that can be expanded to a national level. While outreach videos have had difficulty with funding, the staff is researching what is out there, again, in case it finds something that works well and can be expanded to a national level. Finally, research on clearinghouses began before stormwater staff heard from the regions and states. The staff tried to learn of available clearinghouses to examine the possibility of their use or adaptation.

Outreach Strategy

The strategy is expected to be presented in a dynamic document. Its audience is Headquarters management and the regions. Hopefully, the document will provide an adaptable framework for designing and completing outreach projects within an assigned time frame.

Fact Sheet Development

Because the stormwater program involves so many issues and firestorms, staff often produce fact sheets to clear up confusion. Past fact sheets have focused on:

R0016051

- The Transportation Act's effect on the stormwater program.
- The Ninth Circuit Court decision that affected municipalities.
- The Municipal Part II guidance document.
- Phase II progress and results of public meetings.

Question and Answer Document

The audience for this document is the regions and industries via trade associations. The first volume was developed based on questions from the hotline. The staff compiled over 50 commonly asked questions and answers into one document, which has been distributed through the hotline.

The second volume covers more complex interpretations of the regulations, including questions on sampling, group applications, and the Ninth Circuit Court decisions. Again, distribution will probably proceed through the hotline.

Stormwater Workshops

In fiscal year (FY) 1991, the stormwater staff at Headquarters conducted 12 workshops on the basics of the stormwater program. The workshop audience consisted of regions, states, and the regulated community. The objective was to inform as many people as possible about the requirements of the November 16, 1990, rule. Attendance was in the thousands. The effort was successful.

In FY 1992, the stormwater staff presented workshops and spoke to over 4,000 people. These workshops focused on the requirements of the general permit and the development of pollution prevention plans. In addition, workshops for municipalities covered the requirements of the Part 2 municipal application. All these workshops were well received and also considered successful.

The FY 1993 workshops presented by Headquarters focused on developing pollution prevention plans. The staff developed a workshop series with the first day targeted to reach state and EPA regional representatives. This day is a train-the-trainer session to teach the audience how to lead a workshop on pollution prevention for industry. The second day is designed for the industrial regulated community and focuses on industrial and construction pollution prevention plan development. This day should include case studies and interactive exercises.

These workshops mark the first effort by the stormwater program to conduct workshops of this kind. The hope was to meet the objectives identified by the regions and states at the 1992 Stormwater Coordinator's Conference in Atlanta. Due to budget problems, Headquarters was limited to the number of workshops it could conduct in each region. The goal was, however, for state and regional staff to be able to present the workshops on their own. Each state was to receive a set of slides and speaking materials for its own use.

Municipal Support Division/Permits Division Pamphlet on Stormwater

The audience for this publication is Headquarters, the regions, and the general public. This project has experienced difficulties getting started due to contractual problems. It is, however, now moving ahead toward completion. The pamphlet is predominantly aimed at members of the general public who have little or no knowledge of the stormwater program.

Updated Stormwater Overview

This document addresses general information needs. Its audience consists of Headquarters, the regions, and the general public. The Overview reviews who the stormwater program covers, what their application options are, and what the deadlines are associated with those applications. As the program grows and changes, the Overview is updated. Distribution is currently through the stormwater hotline.

Raindrop Report (Status of the Stormwater Program)

This document is targeted to Headquarters, the regions, and the general public. It supplies a brief update on current activities in the stormwater program and features relevant information from recent *Federal Registers.* In addition, it describes outreach activities and provides specifics on applications submitted and general permits.

Articles for Newsletters

Stormwater staff are developing articles by request for publication in various journals and newsletters. They are trying to establish a regular submittal effort to some publications, such as the *Nonpoint Source News Notes*, which is published by the Headquarters nonpoint source program to supplement the bulletin board.

General Permit Effectiveness Study

The purpose of this effort is to determine the effectiveness of the general permit approach in implementing Phase I. The evaluation assesses, among other things, the rate of compliance, the level of awareness, and the quality of pollution prevention plans being developed. This effort also is identifying obstacles that prohibit the general permit from being as effective as possible.

Monthly Conference Calls

As of March 1993, Headquarters had completed 15 regularly scheduled conference calls with stormwater regional coordinators. These meetings have proven very successful, and they should continue.

Stormwater Awards

These awards recognize municipalities and industries that demonstrate a commitment to protecting and improving the quality of the nation's waters through outstanding implementation of innovative and cost-effective stormwater control programs and projects. In 1991, the winner for a stormwater control program or project by a municipality was Murray City, Utah. In 1992, the city of Orlando, Florida, won, and Prince George's County, Maryland, took second place. Nominations are sought from the 10 EPA regions.

National Stormwater Coordinator's Conference

This annual event is indispensable for planning and feedback from the states and regions. The meeting is designed for regional and state stormwater coordinators, as well as for Headquarters staff.

Continuous Speaking Engagements

Stormwater staff receive requests to speak to groups twice a week on average. While they are not always able to fill some requests because of a limited travel budget, the staff respond to as many as possible. In FY 1992, staff participated in about two dozen talks or seminars, not including the workshops.

Phase II Outreach Meetings

The Phase II Outreach Meetings are a series of meetings designed to include individuals that may be affected by the Phase II regulations in the development of those regulations. As of this writing, four meetings have been held (two in Washington, one in Dallas, and one in Chicago) to involve as many people as possible.

Information and Education Catalog

Another important project is the management and periodic update of the Information and Education Catalog, which was distributed at the National Urban Runoff Management Conference. The author and Tom Davenport manage this project. Everyone concerned should have a copy of this excellent document. Management plans to expand the manual to include stormwater information. In addition to putting out several calls for information, the conference registration packet included a form to fill out if individuals wanted this catalog to include a particular document. Management believes this document will help in the tremendous demand for technology transfer in the stormwater and nonpoint source programs. This, of course, is a top priority that customers have requested.

Electronic Sources

Linking to other clearinghouses and bulletin boards should improve communications. The nonpoint source program at Headquarters has been extremely helpful by placing information and announcements on its electronic bulletin board and in the *Nonpoint Source News Notes* publication. This has proven to be a good way to meet customer needs.

Further Considerations

Education is becoming one of the most important aspects of the stormwater program as people learn about the regulation and how it affects their day-to-day lives. Industries as part of their pollution prevention plans are developing training and education programs for their own employees. Cities are training their employees in sampling techniques and safety procedures as well as developing excellent public education programs. Tremendous efforts involving stormwater education are being undertaken. Stormwater Headquarters needs to know about the successful programs to help the lesser programs learn.

As this program moves forward, each success in educating those affected by the stormwater program, including the general public, leads to greater accomplishments. As these successes continue to build, more people will understand the intent and effects of protecting and cleaning up the waters of our nation. It is a cycle in which we all play a major role.

Training for Construction Site Erosion Control and Stormwater Facility Inspection

Richard Horner
University of Washington, Seattle, Washington

Abstract

Probably the leading reason that stormwater management programs fail in effectively protecting water resources is the lack of followup to ensure that permit conditions are met, approved designs are properly installed, and temporary and permanent management practices and facilities are maintained. Avoiding this downfall requires obtaining the legal authority for and then instituting a coordinated program extending from the first submission of permit applications through construction and all phases of site operation. This program should have components covering the construction phase as well as permanent practices and facilities. While somewhat different elements are appropriate for the two components, they share the common precepts of sound underlying planning; competent plan review; and effective inspection, maintenance, and enforcement. The University of Washington's Center for Urban Water Resources Management and Office of Engineering Continuing Education have developed and are offering courses to train personnel responsible for various aspects of the suggested program. This paper emphasizes the training for site inspectors. For construction-site inspectors, it covers the role of the erosion and sediment control (ESC) plan, the applicability of many ESC practices, key points to check when inspecting them, and how to deal with various circumstances that can arise during inspections. For permanent drainage system inspectors, the paper covers both the initial construction and continuing operation of facilities and offers guidance on key inspection points and such issues as safety, tracking maintenance, and waste handling.

Introduction

Effective stormwater management requires successful execution of steps at all phases of a project. These phases and the accompanying management steps include analysis of potential problems in the planning stage, quality design of programs and practices to protect aquatic resources as the project takes shape, competent review of plans at the permit application point, proper implementation of approved plans during construction, and correct operation and practices at facilities after their installation. All phases of the process need improvement through a better basis in knowledge and greater skills in application. Probably the weakest areas and the leading causes of program failures and environmental damage are implementation during construction and long-term operations.

Redressing this weakness will require widespread development of comprehensive and aggressive programs of inspection during the construction of developments and their stormwater management systems, followed by ongoing inspection of operating systems to ensure sufficient maintenance for continuing adequate performance. The diffusion of development and tradition of local land-use control prevalent in most of the United States will necessitate local acquisition of the legal authority, where it does not now exist, to institute these programs. As is already occurring in some places, it is likely that larger units of government will become involved in setting standards for these programs. The U.S. Environmental Protection Agency's National Pollutant Discharge Elimination System (NPDES) program is presently extending authority over programs in the largest cities and counties and at sites of construction larger than 5 acres and involving industrial activity. Still, the details and the responsibility for conducting the programs will very likely rest with local governments.

The concern of this discussion is the development and execution of local programs to upgrade significantly the quality of followup to increase the probability that approved stormwater management plans are effective. The scope of the programs envisioned would extend from the point of permit issuance through construction and all the years of site operation to follow project completion. The programs might be considered to have distinct components, covering, for example, erosion and sediment control (ESC) inspection at construction sites, inspection of the construction of storm runoff quantity and quality control facilities, and the periodic inspection and maintenance of operating facilities. However they are structured, these programs should embrace some common principles. They should be the logical extension of and ultimate implementation vehicle for the foregoing phases of planning, design, and plan review. Further, they should be conceived and conducted as essential elements of a successful program, deserving of the needed funding, staffing, support by administrators and public officials, training of personnel, and enforcement authority.

This discussion covers aspects of program development and especially emphasizes training for site inspectors. For these purposes it divides the overall program into two components. One covers construction site ESC programs. The second covers permanent drainage practices and facilities, both their inspection at construction and followup inspection and maintenance. In both cases, the paper recommends program structures and discusses some key program elements. It then offers specific examples of inspection checks to perform in the field. The goal of the paper is to give the reader a basis for beginning program design and undertaking the key element of training the staff who will be charged with its performance.

The discussion was derived from two courses developed and offered by the University of Washington's Center for Urban Water Resources Management and Office of Engineering Continuing Education. The course coverage is organized in the same manner as this presentation, and course manuals are available for ESC inspector training (1) and permanent drainage system inspector training (2). Important contributions to the material presented in these courses and in this discussion have been made by local governments and state agencies in the Puget Sound area of Washington state that have been working actively to improve stormwater management through good followup.

Construction Site ESC Inspection Programs

Program Development

Program Elements

The following elements are recommended for a comprehensive construction site ESC program:

- ESC planning
- A plan review process
- Contractor education
- An inspection and enforcement process

The subsections to follow cover two of these program elements in detail, ESC planning and inspection and enforcement. The latter discussion is then extended in the following section to examples of inspection guidelines for common practices.

ESC Planning

ESC planning is an absolute prerequisite for an effective program. A careful site analysis should produce a standalone plan (i.e., a plan devoted exclusively to this aspect of the project) developed with the same thoroughness and care as any other plan in the overall construction set. It is intended for use by the plan reviewer, the construction superintendent and other contractor personnel, and the construction site inspector. This subsection outlines the ESC planning process from beginning to end and concludes with an example of a complete plan.

In approaching an ESC plan, the planner must:

- Understand the erosion process, so that it can be controlled.
- Know the site and the construction plan, so that both potential problems and solutions will be apparent.
- Understand the various ways that erosion can be prevented or that eroded sediments can be caught.

The erosion process is first reviewed for the lessons it can offer ESC planning. Erosion has been understood for thousands of years, as is attested by the extensive evidence of terraced farming—some continuing today—in steep terrain in ancient cultures. Figure 1 illustrates the types of erosion and its nature. Soils can be loosened and set in motion initially by the impact of falling raindrops. Erosion progresses, although gradually, as runoff flows in a sheet over a bare surface and exerts shear stress, which is a function of velocity, on soil particles. The rate of erosion increases when flow concentrates and increases in velocity. Channels formed by these flows are known as rills. When rills join and form highly concentrated, rapidly flowing channels, the rate increases still further, a stage termed gully erosion. Erosion can progress still further to mass wasting when a whole area loses stability.

Several factors involving site soils, vegetation, and topography influence the erosion process. Soil erodability is greater in the case of silts and fine sands than clays or soils with a substantial gravel content. Relatively high organic content also offers cohesiveness that resists erosion. Clays tend to produce a larger volume of runoff, however, because of their relatively poor permeability, which exerts more erosive stress on soil. Vegetative cover offers a number of important advantages, including reducing raindrop impact, slowing runoff velocity, helping to absorb water, and holding soil in place. In regard to topography, both slope gradient and length tend to increase velocity and the resulting frictional

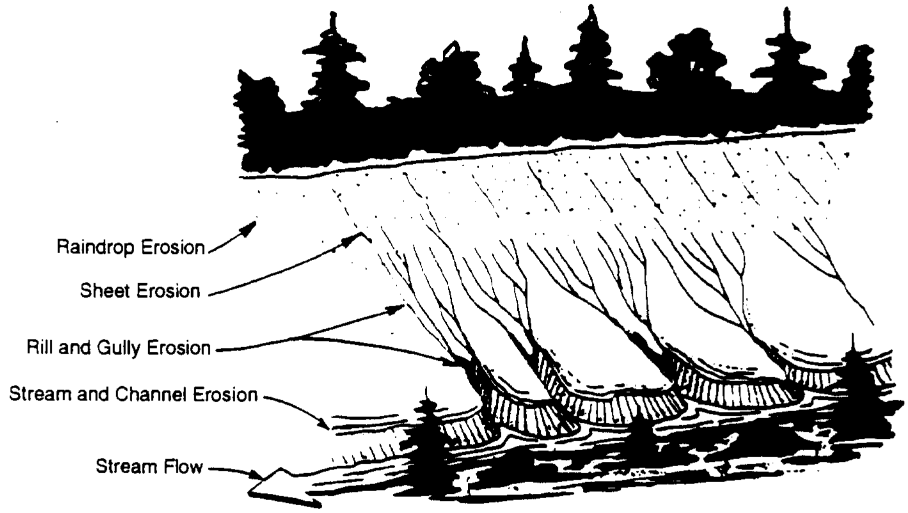


Figure 1. Soil erosion processes (3).

shear stress. Erosion hazards relative to slope gradient and length are listed in Table 1.

Acquiring the familiarity with the site and proposed construction necessary to proceed with the ESC plan involves data collection and analysis. Site data should be collected in regard to:

- Soils
- Vegetation
- Topography
- Ground-water table
- Neighboring water bodies
- Adjacent properties
- Drainage routes and patterns (define subbasins)
- Potential areas of serious erosion problems
- Existing development, utilities, and dump sites

The following construction plan information should be cataloged at the outset of planning:

- Grading (location, amount)
- Topographic changes
- Clearing and grading limits
- Drainage changes

Table 1. Soil Erodability Relative to Slope Gradient and Length

Erosion Hazard	Slope Gradient	Maximum Length
Low	0-7%	300 ft
Moderate	7-15%	150 ft
High	>15%	75 ft

- Materials to be used and locations of use and storage
- Access points

ESC planning should proceed with reference to certain basic principles, as follows:

- First consider all means of preventing erosion; only consider trapping sediments from unavoidable erosion. Prevention has the potential to be more effective in resource protection than later treatment and less costly.
- Phase construction and post clearing limits to maintain as much natural vegetation as possible and for as long as possible.
- Plan construction to fit the site; use terrain advantageously and avoid critical areas.
- Cluster buildings and other developed features, and minimize their impact on impervious area.
- Plan for control of erosion subbasin by subbasin.
- Minimize extent and duration of vegetation removal (especially during wet season) and soil disturbance.
- Stabilize and protect disturbed areas as soon as possible.
- Use natural drainage features, existing vegetation, and materials found on the site.
- Minimize slope length and gradient to control runoff velocities.
- Divert offsite runoff away from disturbed areas.
- Retain any released sediment within the construction area and reduce tracking off site.
- Have a thorough maintenance and followup program.
- Take measures to control potential pollution from construction materials (e.g., paving materials, petroleum

products, other vehicle fluids, fertilizers, pesticides, grinding and sanding debris, wastes).

An ESC plan consists of a narrative and site plans. Points that should be covered by the narrative include 1) a project description, 2) a description of existing and modified site conditions, 3) descriptions of ESC best management practices (BMPs), 4) descriptions of BMPs for pollutants other than sediments, 5) plans for permanent stabilization, 6) calculations, and 7) provisions for inspection and maintenance. Site plans are maps and engineering plans illustrating and specifying the project's location, existing and modified site conditions, and BMPs. The set of site plans should include 1) a data collection worksheet (principally showing topography, soils, and vegetation), 2) a data analysis worksheet (mainly indicating drainage subbasins and primary drainage courses), 3) a site plan development worksheet (showing existing and finished contours, roadways, and permanent stormwater facilities), 4) the ESC plan (showing BMP locations), and 5) diagrams of representative BMPs, as appropriate. The ESC plan (item 4 in the set) is the key element for implementing the plan. BMPs are usually specified on this plan using a system of symbols, which are defined in a legend.

Inspection and Enforcement

The most important general needs of an inspection and enforcement program are a staff dedicated to the function, specific staff training, and administrative support. These needs are best provided for by a dedicated revenue source, such as a stormwater utility assessment. The staff should not have unrelated and distracting duties such as inspection of other facets of construction. Initial training should offer needed background in, for instance, legal and regulatory requirements, water quality, hydrology, soils, and vegetation. Subsequent training should provide detailed coverage of BMP requirements, such as discussed in the following section. Strong support from administrators is essential for a staff undertaking a relatively new function that might be unpopular in terms of economic interests.

Beyond these basic needs are some specific issues to clarify during program development for incorporation as formal program elements. Recommendations on the issues presented in this paper are drawn from experience in the Puget Sound region, especially in King County and the cities of Bellevue and Redmond. One of these issues is the response to a situation in which measures in an approved ESC plan proved inadequate. Strong permit review should normally limit these instances, but unforeseen circumstances can still arise. Inflexible adherence to an ESC plan can be self-defeating when measures prove to be inadequate for whatever reason; thus, the jurisdiction should retain the authority to require additional measures if needed. This option should be noted in a statement on each ESC plan.

A second issue is how field change orders will be handled. The policy should call for careful but expeditious consideration of requests for plan changes, generally after consultation with plan review personnel. Finally at issue is the granting of variances from code requirements. Conditions on granting variances should be strict and specific, such as:

- The expected result should be at least comparable to the outcome expected to be achieved with the approved method.
- Sufficient background information and justification should be presented for adequate assessment of the alternative.
- The ability should be retained with the variance to meet objectives of safety, function, appearance, environmental protection, and maintainability based on sound engineering judgment.
- The variance should be in the public interest.

Enforcement authority must be obtained and the system of enforcement defined and made clear to the regulated parties. A system successfully used by the city of Bellevue has a sequence of three steps, as follows:

- A verbal warning, with a deadline for correction.
- A correction notice (with specifications of corrections), a deadline, and a warning about the consequences of noncompliance.
- A stop-work order, with a warning about the consequences of noncompliance.

ESC Practices and Their Inspection

Categories of Practices

The numerous ESC practices in use can be categorized in various ways. The most basic division is between erosion control practices, which prevent or minimize erosion, and sediment control practices, which attempt to capture soil released through erosion. Within each of these broad groupings are several categories that represent general strategies for achieving either erosion control or sediment control. In addition to sediments, construction sites can generate many other pollutants, such as petroleum products, solvents, paints, sanding dusts, pesticides, and fertilizers. It is most efficient to manage those materials along with sediments and to inspect the management practices for them simultaneously with ESC inspection. Therefore, these practices represent another basic division.

Following is the breakdown of ESC practices used by Reinelt (1), with the number of individual practices in each category. The 29 practices represented are by no means the only ones, but they are the most widely recognized and used. Twenty-two of the 29 (all but the sediment trapping techniques) are preventive and are thus generally the most cost-effective options; however, the straw bale and filter fabric fences and sedimentation ponds among the trapping techniques are most commonly used practices.

1. Erosion control
   - 1.1. Natural vegetative cover—two practices
   - 1.2. Temporary cover—three practices
   - 1.3. Permanent vegetation establishment—two practices
   - 1.4. Stabilized construction entrance and roads—three practices
   - 1.5. Runoff control—eight practices
2. Sediment trapping techniques—seven practices
3. Management of other construction site pollutants—four practices

The following passages provide inspection checklists for example practices, generally the most common, in each category and subcategory. The checklists are divided into checks to be made when the practice is implemented and checks to be made on each followup visit to determine the need for maintenance or replacement of the ESC materials. Many of the points are illustrated in diagrams that accompany the checklists.

While much of an inspector's work is performed in the field, it is often advisable or even absolutely necessary to do some background work in the office before going out to inspect an installation. This work mainly consists of consulting the ESC plan to determine the specifications. The plan should be retained on the construction site should the inspector or construction personnel need to refer to it.

1. Erosion control

1.1. Natural vegetative cover

1.1.1. Phasing construction

Phasing construction is a practice in which clearing operations are performed in stages to take advantage of cover that exists on site before construction.

Installation checks:

1. Are areas that will not be cleared set off with plainly visible clearing-limit fencing?
2. Is plainly visible flagging placed at the drip line of trees to be protected (see Figure 2)?
3. Are fills and cuts near protected trees treated as shown in Figure 2?
4. Is final vegetation established as soon as portions of the site can be made ready?

Maintenance checks:

1. Do fencing and flagging need repair or replacement for personnel to see it clearly?
2. Do exposed or injured roots of protected trees need covering or dressing?

1.2. Temporary cover

Temporary cover practices recognize that portions of most construction sites remain unworked for months, during which time very large amounts of erosion can occur unless these areas are stabilized. Stabilization can be achieved with temporary seeding or various kinds of slope coverings, or both. Slope coverings include both mulches and commercial mats and blankets. It is often necessary to apply temporary cover to different areas several times during construction.

Mulches, mats, and blankets can serve several purposes in erosion control: covering the slope temporarily to prevent erosion by raindrop impact and the friction of runoff, holding water to encourage grass growth, protecting grass seedlings from heat, and enriching the soil. Straw, hay, wood fiber, wood chips, and other natural organic materials can serve as mulches. Inspection guidelines for straw and wood fiber are given below as examples. Mats and blankets are manufactured from both natural and synthetic materials. Guidelines are given for several varieties.

1.2.1. Temporary seeding

Installation checks:

1. Is the soil stabilized within the period specified by regulation? (This period varies from place to place, depending on climate patterns. In the Puget Sound area of Washington, which receives most of its rainfall in the winter, the specified periods are within 2

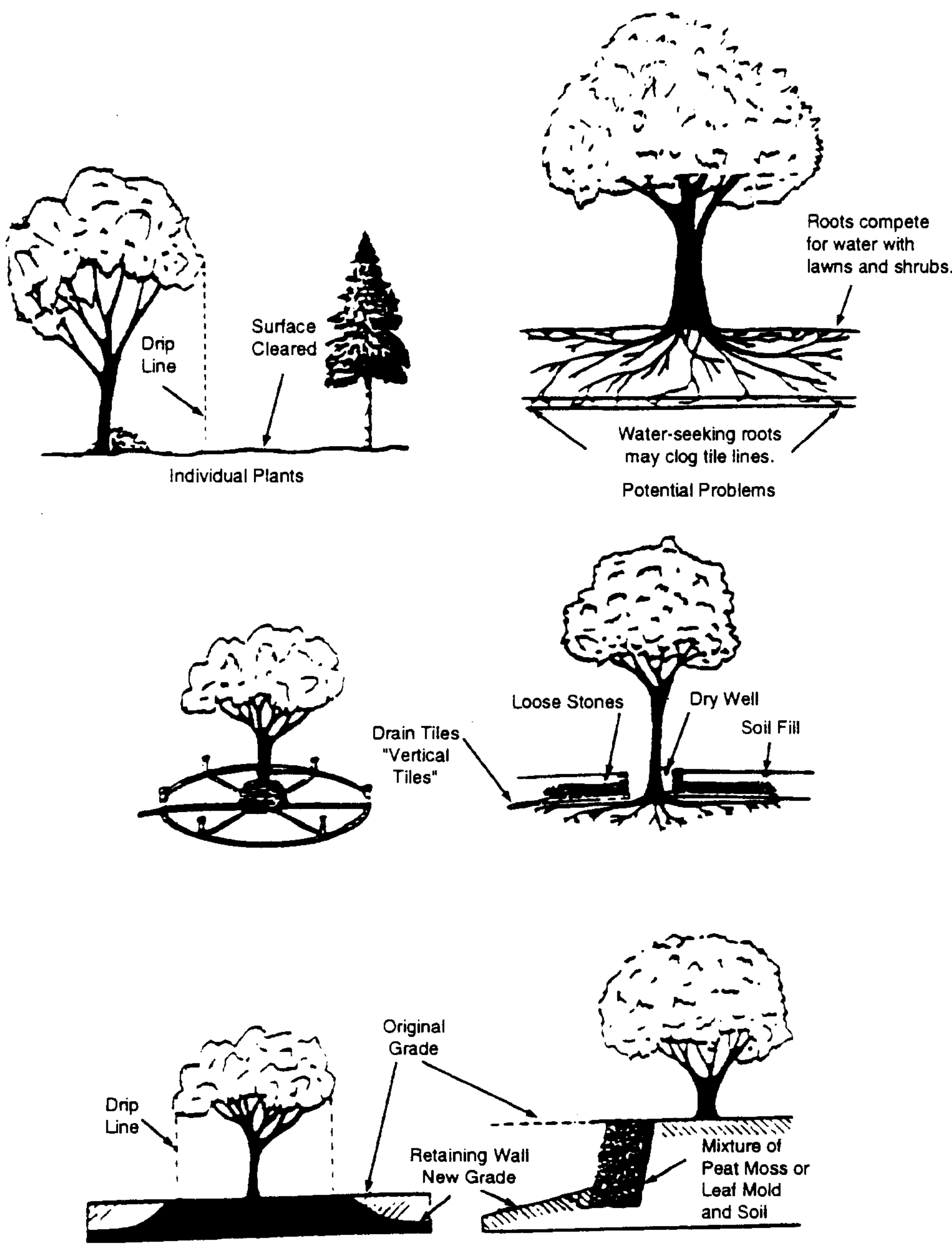


Figure 2. Guidelines for preserving natural vegetation (3).

days during the months October to April and within 7 days during the months May to September.)

2. If used without slope covering practices, is temporary seeding limited to slopes of less than 10 percent and 100 ft in length? If the slope exceeds either limit, is a mulch or mat slope covering used?

3. Has the seedbed been prepared with at least 2 to 4 in. of tilled topsoil?

4. Is fertilizer use limited as much as possible; if used, is it applied in amounts no greater than the needs of the grass for the prevailing soil conditions?

5. Is mulch applied for protection if seeding occurs when temperatures can be high or runoff is likely to occur before the grass is well established?

6. Is irrigation provided if planted when rainfall might be insufficient for good establishment?

Maintenance checks:

1. Is it necessary to irrigate and/or reseed?

2. Is maintenance fertilizer needed?

1.2.2. Straw mulch

Straw mulch can be used without seeding or, for better erosion control, with seeding.

Installation checks:

1. Is the straw spread generally a minimum of 2 in. deep (corresponds to 2 to 3 tons per acre) and greater on very steep slopes, adjacent to sensitive areas, and where concentrated flow passes over the slope?

2. Is the mulch anchored as needed by crimping, disking, rolling, or punching into soil or by moistening, tackifying, or netting?

Maintenance checks:

1. Is replacement needed as a result of blowing away or decomposition over time?

2. Is there any fire hazard requiring moistening?

1.2.3. Wood fiber mulch

Wood fiber mulch should only be used with seeding and generally should be used with a soil bonding agent.

Installation checks:

1. Is the mulch used with seeding and a soil bonding agent? Were the bonding agent distributor's application guidelines followed?

2. Has the wood fiber been applied to cover the soil completely, allowing no bare soil to show through (corresponds to about 1 ton per acre and is adequate for most circumstances)? Are there any special circumstances, such as seeding during hot weather, when the amount should be increased by about 50 percent?

Maintenance checks:

1. Is replacement needed as a result of loss over time?

1.2.4. Excelsior

Excelsior is a product made of fine wood shavings that assume a more-or-less helical form. As a consequence of this form, excelsior does not lie in close contact with the soil and allows runoff to drain beneath it and cause erosion. Therefore, it should be used only with seeding, where it is very useful in holding moisture and providing protection from direct sun in hot periods. Suppliers generally market several grades for sheet and channelized flow and different velocities.

Installation checks:

1. Is the excelsior used only with seeding?

2. Was an appropriate material selected according to manufacturer's recommendations and then placed and stapled as recommended by the manufacturer?

3. On slopes, was it placed 3 ft over the crest or in an anchor ditch?

4. In ditches, was it placed in the direction of water flow with any seams offset 6 in. from the ditch centerline?

Maintenance checks:

1. Is replacement needed as a result of damage or loss over time?

1.2.5. Mats and blankets

Examples of materials produced in a mat or blanket form for erosion control are jute, woven straw, and synthetics. Mats can be used without seeding, or with seeding for better erosion control. As with excelsior, suppliers generally market several grades for sheet and channelized flow and different velocities.

Installation checks:

1. Was an appropriate material selected according to manufacturer's recommendations and then placed and stapled as recommended by the manufacturer?
2. Was it placed in the direction of water flow, in full contact with the soil but not tightly stretched?

Maintenance checks:

1. Is replacement needed as a result of damage or loss over time?

1.3. Permanent vegetation establishment

Permanent vegetation should be established as soon as possible after all construction is completed in each segment of the site. Grass can be established by seeding or sodding. Seeding is generally preferred because of the lower cost and greater flexibility in selecting grass species. Sod is often available only in limited varieties, which may not be the most suitable for erosion control and other purposes unless grown to order. In some cases, overseeding with preferred species is recommended in the spring, when grass must be established with sod in the winter. Species should be selected based on local climatological and soil conditions, with reference to regional guidance documents, and, when necessary, in consultation with regional experts.

1.3.1. Permanent seeding

Installation checks:

1. Has the seedbed been prepared by loosening with a plow if subsoils are highly compacted. spreading 2 to 6 in. of topsoil, and lightly rolling?
2. Is fertilizer use limited as much as possible; if used, is it applied in amounts no greater than the needs of the grass for the prevailing soil conditions?
3. Is mulch applied for protection if seeding occurs when temperatures can be high or runoff is likely to occur before the grass is well established?
4. Is irrigation provided if planted when rainfall might be insufficient for good establishment?

Maintenance checks:

1. Is it nencessary to water, reseed, or add fertilizer?

1.3.2. Sodding

Installation checks:

1. Is the sod placed from the lowest area and perpendicular to water flow?
2. Are sod strips wedged tightly together and joints staggered at least 12 in.?
3. Is the sod stapled if on a steep slope?

Maintenance checks:

1. Is overseeding needed, either to repair damage or to install a preferred grass species?

1.4. Stabilized construction entrance and roads

The entrance is the most important access route to stabilize, since it is the last point at which tracking sediment off site can be stopped. If equipment travels extensively on unstabilized roads on the site, a tire and vehicle undercarriage wash near the entrance will be needed. Perform washing on crushed rock. Wash water will require treatment in a sediment pond or trap.

1.4.1. Stabilized construction entrance (see Figure 3)

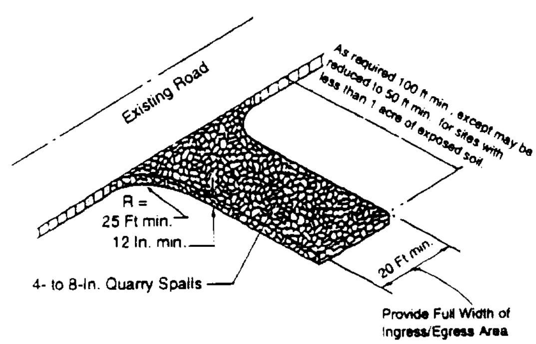


Figure 3. Stabilized construction entrance (from Washington Department of Ecology, 1992).

Installation checks:

1. Is the entrance constructed with quarry spalls 4 to 8 in. in size and at least 12 in. thick?
2. Is the stabilized entrance sized correctly for the site?
3. If the entrance sits on a slope, is a filter fabric fence in place downgradient?

Maintenance checks:

1. Is the entrance clogged with sediments, requiring top dressing the pad with clean 2-in. rock?
2. Is it necessary to clean up any sediments carried from the site onto the street?

1.5. Runoff control

Runoff control represents various practices designed to keep water from coming in contact with bare soil or controlling its velocity if it does. Included are drains for surface and subsurface water, dikes and swales placed across slopes to interrupt runoff, and roughness created on the surface to reduce velocity. Example guidelines presented below are for a pipe slope drain and surface roughening.

1.5.1. Pipe slope drain (see Figure 4)

A temporary pipe slope drain is an effective technique for preventing erosion on a slope caused by runoff from a higher elevation. Upslope runoff needs to be collected and directed into the drain effectively and then discharged in a controlled way to prevent erosion at the bottom of the slope.

Installation checks:

1. Are no more than 10 acres drained into a single pipe slope drain?
2. Was a minimum 6-in. metal toe plate placed at the entrance to prevent undercutting?
3. Is runoff directed into the pipe with interceptor dikes at least 1 ft higher at all points than the top of the pipe?
4. Is there a slope toward the pipe on a grade of at least 3 percent at the inlet?
5. If the pipe is 12 in. in diameter or larger, was a flared entrance section installed and connected securely to the drain with water-tight connecting bands?

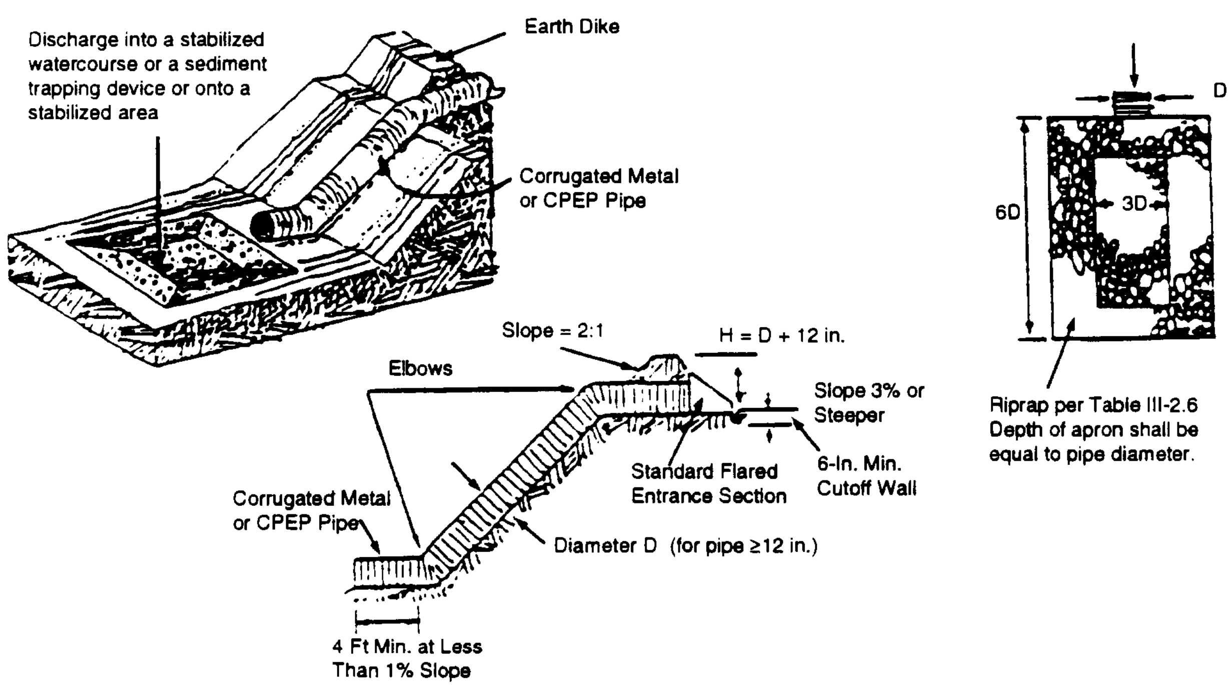


Figure 4. Pipe slope drain details (3).

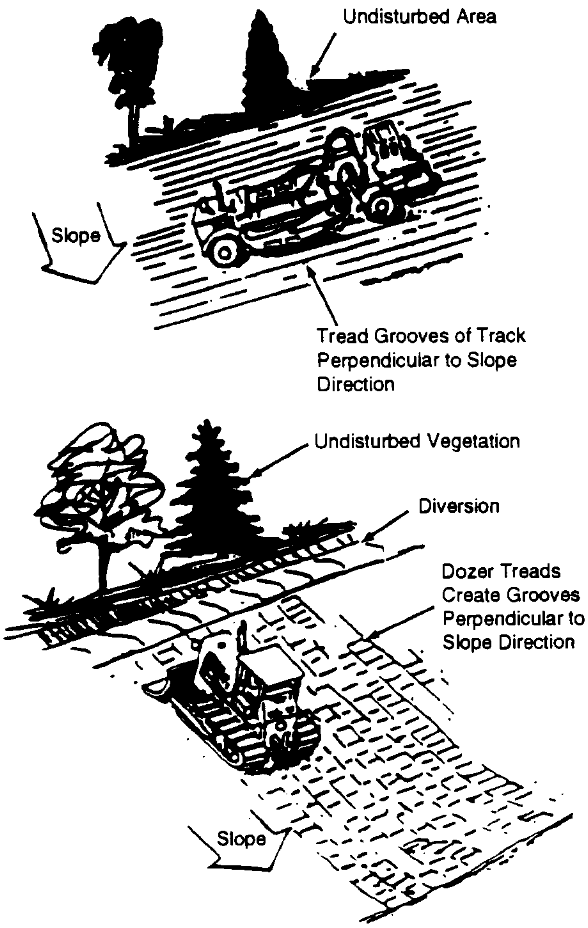


Figure 5. Examples of surface roughening using heavy equipment (3).

6. Was the soil thoroughly compacted at the entrance and underneath the pipe?

7. Were gasketed, water-tight fittings placed between pipe sections, were the sections securely fastened, and was the drain anchored to the soil?

8. Was the area below the outlet stabilized with a riprap apron?

9. If the drainage can carry sediment, is it treated in a sediment pond or trap?

Maintenance checks:

1. Is undercutting or bypassing occurring at the inlet, requiring reinforcing of the headwall with compacted earth or sandbags?

2. Is erosion occurring at the outlet, necessitating rebuilding the apron?

1.5.2. Surface roughening (see Figure 5)

A roughened surface is an easy and inexpensive way to reduce runoff velocity, encourage the growth of vegetation, increase runoff infiltration, and trap some sediment. It is not effective enough to use alone but can reduce the load on sediment trapping installations downstream. Roughening is best used on slopes steeper than 3 horizontal to 1 vertical that do not require mowing. There are several methods of roughening a surface, all of which involve forming horizontal depressions with equipment. Methods include tracking perpendicular to the slope direction, driving treaded equipment along the slope direction to get grooves perpendicular to the slope, or tilling (preferred because it avoids compaction). On steeper slopes (steeper than 2 horizontal to 1 vertical) a stair-step pattern should be formed.

Installation checks:

1. Have all exposed slopes steeper than 3 horizontal to 1 vertical been roughened, with 40- to 50-in. stair-step patterns formed on slopes steeper than 2 horizontal to 1 vertical?

2. Was the soil scarified if it was heavily compacted by the roughening?

3. Was the area seeded as quickly as possible?

Maintenance checks:

1. Have rills appeared that should be regraded and reseeded?

2. Sediment trapping techniques

Trapping sediments once they are released requires slowing the transport velocity sufficiently for soil particles to settle (i.e., reducing the velocity below the settling velocity of the particles). Soil particles range over several orders of magnitude in size, from the small clays to the large sands. Settling velocity is approximately related to the square of the particle diameter; thus, halving the diameter approximately quadruples the time needed for settlement. Therefore, as particles decrease in size, they become increasingly difficult to remove from a runoff stream. This fact is largely why preventive techniques are more cost effective than sediment trapping practices and are strongly preferred.

The two basic types of sediment trapping techniques in use are sediment barriers and settling ponds. Sediment barriers include the commonly used filter fabric and straw bale fences as well as brush fences and barriers constructed of gravel. Both types trap sediments in the same way, by ponding water. Although that mechanism is more obvious in the case of ponds than of barriers, practices of the latter type actually provide only a minimum of filtering capability and primarily slow the flow of water long enough for some particles to settle. Thus, they can only trap relatively large particles, generally the larger silts and sands. The trapping ability of settling ponds depends on their size. While they can theoretically be made large enough to trap any size particle, practical sizes generally limit efficient removal to the medium silts and larger.

2.1. Sediment barriers

Several principles apply to the various types of sediment barriers. Maximizing a sediment barrier's ponding volume maximizes the amount of sediment trapped. Therefore, the barriers should be placed away from the immediate toe of slopes in order to increase the area for ponding. It is very important that sediment barriers be aligned on the contour, not up and down slopes. This alignment places them at a right angle to flow paths and also increases ponding volume. Slopes draining to sediment barriers generally should not be more than 100 ft long. Sediment barriers must be trenched in and staked to hold up under the pressure of the wall of water they will dam. Finally, sediment barriers do not provide effective sediment removal from concentrated flows. While straw bales are sometimes used in ditches, rock check dams are really a better alternative for decreasing velocity in channels.

2.1.1. Filter fabric fence (see Figure 6)

Installation checks:

1. Are filter fabric fences used only in the following applications:

   Maximum of 1 acre served by a single fence?

   Maximum 1:1 slope gradient and 100-ft slope length?

   Sheet flow situation (never in concentrated flow)?

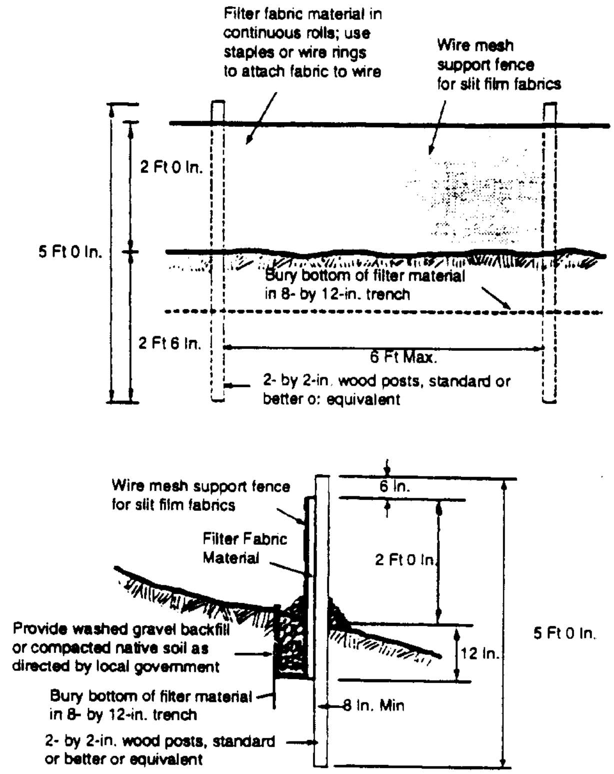


Figure 6. Filter fabric fence detail (3).

2. Is the fence aligned to slope contours as well as possible?

3. Is the fence installed so that its height above the soil is no more than 3 ft?

4. Are posts 2 x 4 in. wood or 1.33 lb/ft steel, or the equivalent?

5. Are posts buried 2.5 ft deep whenever possible and spaced no more than 6 ft apart?

6. Is fabric attached on the upslope side with staples (at least 1 in.), tie wires, or hog rings?

7. Is the end of the fabric buried in a trench sized as shown in Figure 6 and backfilled on both the upslope and downslope sides (as shown)?

8. Is splicing avoided if possible? If impossible, is splicing done only at posts and overlapped at least 6 in.?

9. Nonwoven and woven monofilament materials have the best properties for silt fencing. If a woven slit-film fabric is used, is wire mesh reinforcing (14-gauge rein-

forcing wire mesh with openings no larger than 6 in.) placed on the upslope side and fastened the same as the fabric?

Maintenance checks:

1. Is it necessary to restake, reattach, or replace the fence to maintain all of the above conditions?

2. Is sediment removal needed (before it reaches 1/3 the height of the fence)?

2.1.2. Straw bale fence (see Figure 7)

Straw bale fences tend to swell when they get wet and require frequent maintenance. They are not highly recommended but could be more effective if used according to the following guidelines.

Installation checks:

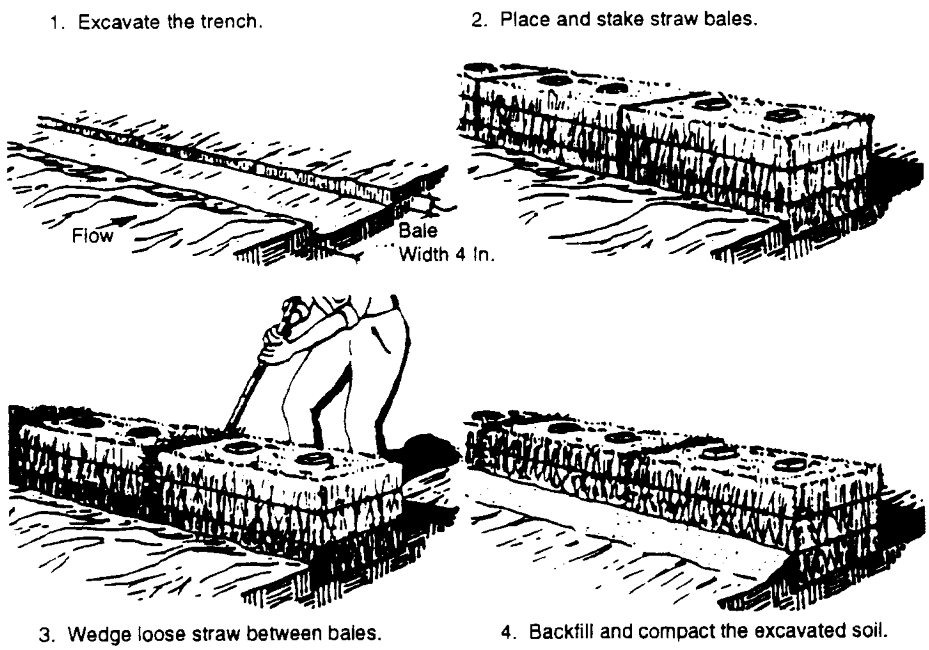
1. Are straw bale fences used only in the following applications:

   Maximum of 1/4 acre served per 100 ft of fence length?

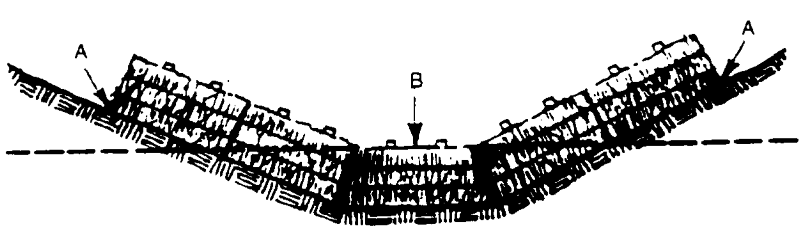
   Maximum 2:1 slope gradient and 100-ft slope length?

2. Is the fence aligned to slope contours as well as possible?

3. Are the bales bound with wire, preferably, or string placed around the sides of the bale, parallel to the ground?



CONSTRUCTION OF A STRAW BALE BARRIER



Points A should be higher than point B.

PROPER PLACEMENT OF STRAW BALE BARRIER IN DRAINAGE WAY

Figure 7. Proper installation of straw bale fences (3).

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4. Are the bales installed in a 4-in. trench, as shown in Figure 7, and backfilled with 4 in. of soil on the upslope side?

5. Are the bales forced together as tightly as possible and anchored with at least two stakes or pieces of rebar per bale driven toward the previous bale and flush with the top of the bale?

6. Are gaps wedged with straw, and is straw spread on the upslope side?

7. Are straw bale fences used in channels with concentrated flow only when velocities are low and placed as shown in Figure 7 (perpendicular to flow and extending at least one bale length above the mid-channel bale)?

Maintenance checks:

1. Is it necessary to replace the fence to maintain all of the above conditions?

2. Is sediment removal needed (before it reaches 1/2 the height of the fence)?

2.2. Settling ponds

Settling ponds have several advantages. They can function through all construction phases and have relatively low maintenance requirements. They can also be located to intercept runoff both before and after the onsite drainage system is developed.

The three types of settling ponds in use differ only in their outlet structure. The term sediment basin is used to describe a settling pond with a pipe outlet that generally serves a drainage area of 3 to 10 acres. A sediment trap is a settling pond with a stable spillway outlet and a smaller service area. The third type is a permanent water quantity control pond put in temporary service during construction; such a pond is designed to drain completely between storms in permanent service. This operating mode is not appropriate for ESC application, however, because the residence time is too short for good particle trapping and settled material becomes resuspended during draining. Therefore, a temporary riser outlet needs to be installed for use during construction.

A key point in the design and construction of a settling pond is to avoid short-circuiting by the water. Short-circuiting can cut the actual residence time far below the theoretical value and harm performance. Ways of avoiding it are to divide the pond into two or more cells, locate the inlet and outlet far apart, and install baffling to increase the flow path.

2.2.1. Sediment basin (see Figure 8)

Installation checks:

1. Is the bottom graded to be as level as possible?

2. Is the pond no deeper than 7 ft with 1 ft of freeboard?

3. Are side slopes no steeper than 3 horizontal to 1 vertical?

4. Does the pond have an emergency spillway that is 1 ft deep, with a width two to three times the number of acres served by the pond, and lined with 2 to 4 in. of rocks?

5. Does the pond discharge through a riser pipe having at least two 1-in. diameter orifices at the top of the sediment storage zone?

6. Are inlet and outlet areas protected from erosion with riprap?

7. Is baffling installed if the length-to-width ratio is less than 6 or if the entrance velocity is high?

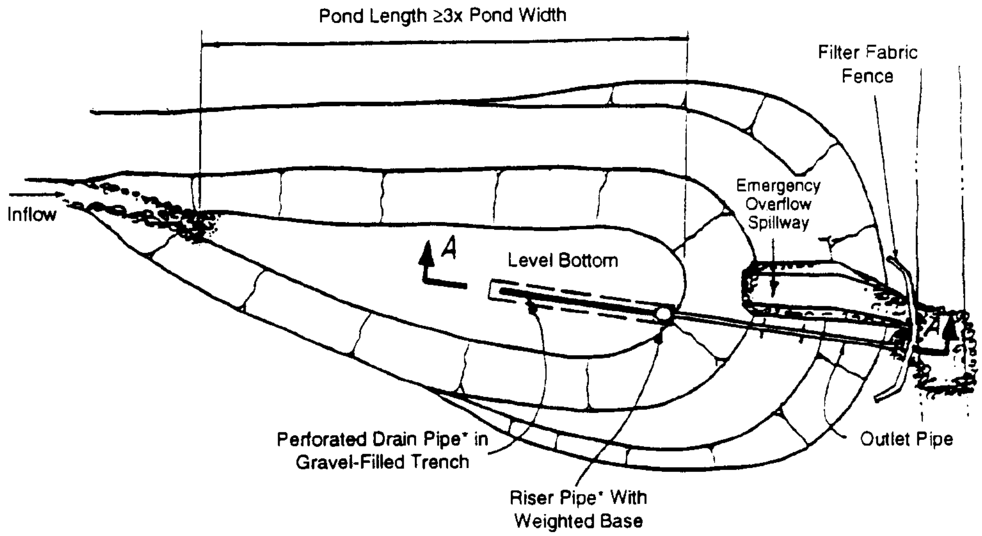
8. A good feature to prevent short-circuiting of flow is a two-celled pond, preferably with cells divided by sandbags or a rock berm and connected by a riser pipe similar to that used for the outlet. A less preferred arrangement is dividing the pond with a filter fabric fence. Is this feature installed if specified in the design?

9. Is the pond fenced if it presents any safety hazard to children?

Maintenance checks:

1. Is sediment removal needed (before 1.5 ft accumulates)?

2. Are any outlet orifices clogged and in need of cleaning?



*Sediment dewatering may be accomplished with perforated pipe in trench as shown or with a perforated riser pipe covered with filter fabric and a gravel "cone." A control structure may also be required; see Conditions Where Practice Applies.

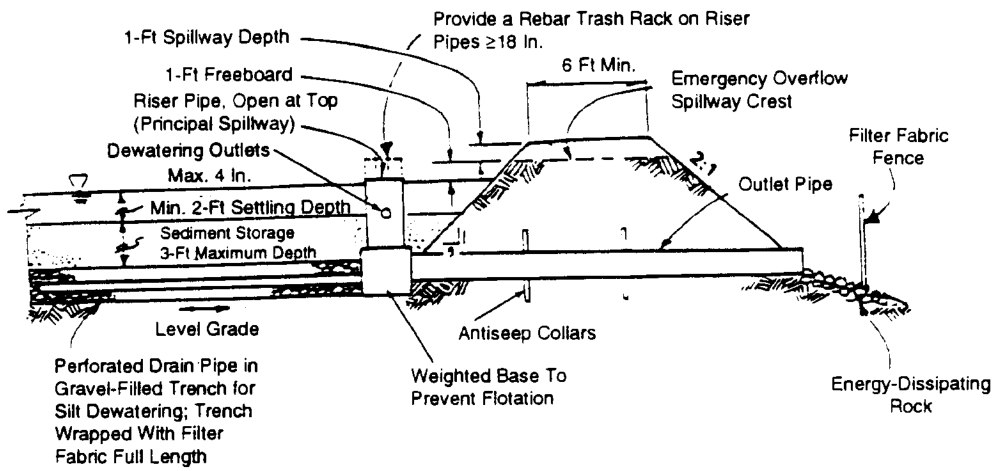


Figure 8. Typical sediment basin (3).

3. Are any embankments damaged and in need of compaction or rebuilding?
4. Has riprap or spillway lining material been lost and need to be replaced?
5. Are there signs of excessive drainage to the pond, requiring rerouting or pond enlargement?
6. Are there signs of excessive sediment loading to the pond, requiring stabilization of the drainage area?

3. Management of other construction site pollutants

Construction sites can create pollution problems over and above erosion and sediments through paving operations, handling and storage of various materials, spills, and waste handling. Inspectors should also be aware of the potential for runoff contamination from these sources and inspect the site according to the following guidelines.

3.1. Handling cement and concrete

Inspection checks:

1. Do concrete trucks have a designated washout area with a sediment trap?

2. Is exposed-aggregate driveway wash water drained toward a collection point at the side or into a sediment trap, where it cannot get into a street drainage system?

3.2. Material storage and handling

Inspection checks:

1. Are weather-resistant enclosures used for the storage and handling of materials, such as paints, coatings, wood preservatives, pesticides, fuels, lubricants, and solvents, and for potentially polluting wastes?

2. Are there designated and clearly communicated procedures for handling materials and wastes and washing containers?

3. Is a chemical inventory maintained, including Material Safety Data Sheets?

4. Are containers and enclosures inspected periodically for leakage, indicating the need for maintenance?

3.3. Spill containment

Inspection checks:

1. Has a spill control plan been developed, and have supplies been obtained to implement it? Does the plan include:

   Who to notify if a spill occurs?

   Specific instructions for different products?

   Who is in charge?

   Spill containment procedures?

   Easy to find and use spill cleanup kits?

   How a spill will be prevented from getting into a drainage system (e.g., valving, diversion, absorption)?

   A disposal plan?

   A worker education program?

3.4. Waste management

Inspection checks:

1. Have waste reduction practices been instituted (e.g., reusing solvents, substituting for toxic products, minimizing quantities of materials used)?

2. Have recycling practices been instituted (e.g., waste separation for recycling, purchasing recycled materials)?

3. Are hazardous and nonhazardous wastes separated and each disposed of properly and promptly?

4. Has an employee education program on waste management been established?

Inspection Programs for Permanent Drainage Practices and Facilities

Program Development

Program Elements

The following elements are recommended for a comprehensive inspection program for permanent drainage practices and facilities:

- Stormwater management planning
- Plan review process
- Construction inspection and enforcement process
- Followup inspection and long-term maintenance process

The stormwater management planning step ensures that each site considered for a permit receives comprehensive analysis. The extensive considerations in this portion of the recommended program are beyond the scope of this discussion. The third element refers to inspection of the stormwater management facilities themselves when they are built to determine whether installation has been consistent with the approved plans. The final element seeks to ensure that facilities continue to operate properly. The next subsection covers programmatic aspects of the followup inspection and long-term maintenance process. The discussion is then extended in the following section to examples of inspection guidelines for common practices and facilities.

Followup Inspection and Long-Term Maintenance Process

Recommended features for a followup inspection and maintenance program are:

- An ordinance designating public authority and public and private responsibilities.
- A tracking system.
- An inspection schedule.
- A maintenance schedule.
- A safety program.
- A citizen response program.
- A detailing of proper waste disposal practices.
- A maintenance contractor education program.

The discussion below elaborates on several of these features, drawing principally on experience in King County, Bellevue, Olympia, and elsewhere in the Puget Sound region of Washington. The examples in the section that follows this discussion present guidance on establishing schedules for common facilities and the specific checks to be made during inspection visits.

Public Versus Private Responsibilities. Whereas inspection is usually a public function, the question of responsibility often arises with respect to the upkeep of privately owned facilities. One model involves establishing a multiyear bonding period, during which the developer has all responsibility. Often after this period and a demonstration of effective operation, the government agency responsible for stormwater management then takes over operation and maintenance. A second model calls for leaving maintenance as a private function (performed by a commercial property owner or homeowners' association), with inspection by the public agency. In this approach, the government assumes the responsibility and assesses costs if the private party does not meet its responsibility. Effective application of this strategy requires that private maintenance contractors competently perform the needed work. The frequent lack of qualified contractors requires government agencies to consider training and certifying them.

Tracking System. King County, Washington, offers a useful model for a tracking system to organize long-term inspections and maintenance. The King County approach uses a computerized information system. Each inspector is assigned an inventory of facilities to inspect and specify maintenance and is given a laptop computer to use in the field. The information system contains an identification number for each facility, its type (e.g., wet pond, infiltration basin), location, any special needs, and data on previous experiences. At the conclusion of each visit, the inspector enters a maintenance needs assessment in the computer database. The computer then generates a maintenance work order.

Safety. Safety is a major consideration because of potentially harmful air quality in below-ground spaces, corroded supports, traffic, falling objects, sharp edges, poisonous plants and insects, and lifting. The safety portion of an inspection and maintenance program should include:

- Testing instruments for harmful atmospheres (explosive, containing hydrogen sulfide, lacking in oxygen); a tester should be capable of checking all potential conditions of concern, and all enclosed spaces should be tested before an inspector enters.
- Ventilating equipment.
- Checking for structural soundness before entering a manhole.
- Traffic warning devices.
- Ladders, safety harnesses, and hard hats.
- Removing poisonous plants and threatening insect nests.
- Adequate personnel.
- Safety training.

Waste Handling. Major maintenance on large facilities should be scheduled when the least runoff is expected. It is often a good idea to use ESC-type installations such as filter fabric fences, sandbags, grassed drainage areas, and revegetation to prevent escape of sediments during maintenance.

Although the vactor truck is the maintenance workhorse, a problem concerns mixing waste that may be relatively clean with very dirty waste. A solution, but an expensive one, is to have "clean" and "dirty" trucks. Another issue concerns disposal of both solids and separated "decant" water picked up by vactor trucks. The best solution for decant water is to discharge it to a special decant station that has sediment and oil separation equipment, before the water is discharged to a sanitary sewer. Few facilities currently operate this way, and most vactor waste is discharged directly to a sanitary sewer. This practice can result in pollutants entering surface waters because of inadequate treatment at the municipal wastewater plant. It can also deliver toxic materials that can upset biological processes at the treatment plant. Guidelines are needed but generally do not exist for disposing of solids. The best programs now send them to a lined municipal landfill, unless they fail a "looks bad and smells bad" test, in which case they are treated as hazardous waste.

Permanent Drainage Practices and Facilities and Their Inspection

Categories of Practices and Facilities

Following is the breakdown of practices used by Reinelt (2), with the number of individual practices in each category:

1. Stormwater devices—three practices
2. Detention facilities—eight practices
3. Infiltration facilities—five practices
4. Biofilters—three practices

The 19 practices represented include some variations on common devices, depending on their intended function, as specified by the Stormwater Management Manual for the Puget Sound Basin (3). For example, detention facilities include "wet ponds," which have a quantity control function, and "water quality wet ponds," which are treatment devices.

The following passages provide inspection checklists for example practices and facilities, generally the most common, in each category. The practices and facilities themselves are described only very briefly in this section. For detailed descriptions, consult a stormwater management manual or textbook. The checklists are divided into checks to make when the practice or facility is first installed and checks to be made on each followup visit to determine the need for maintenance. Many of the points are illustrated in diagrams that accompany the checklists. Also presented for a number of practices are tables of maintenance standards. These tables have been developed over time in the Puget Sound area, and several jurisdictions have contributed to them.

While much of an inspector's work is performed in the field, it is often advisable or even absolutely necessary to do some background work in the office before going out to inspect an installation. This work mainly consists of consulting the design plans to determine the specifications.

Too infrequent inspection and maintenance is one of the main reasons for poor performance by stormwater facilities. The frequency of followup inspections should be determined based on the type of device and the circumstances where it is installed. An inspection and maintenance plan should be developed before an installation goes into service. As a general rule, surface facilities should undergo a drive-by inspection at least monthly and after any rain totaling 0.5 in. or more in 24 hr.

1. Stormwater devices

This group includes devices used for collection and conveyance of stormwater, as well as special-purpose facilities. Within the category are catch basins, pipes and culverts, and oil/water separators. Inspection guidelines are given for oil/water separators as a complete example. Tables of maintenance standards are included for the other types of facilities.

1.1. Oil-Water separators

Figure 9 illustrates the three basic types of oil-water separators. The spill control unit's purpose is to catch small spills; it is not capable of separating dispersed oil. The American Petroleum Institute (API) separator is a baffled tank that can separate "free" (unemulsified) oil but requires a relatively large volume for effectiveness. The coalescing plate (CP) separator can separate free oil in a much smaller volume because of the large surface area provided for oil collection by the corrugated plate pack. The following guidelines generally apply to all types, except as noted.

Installation checks

1. Is the type appropriate for the service?
2. Is the unit sized and installed as specified in the plans?
3. Are adequate removable covers provided for observation and maintenance?
4. Is runoff excluded from roofs and other areas unlikely to contain oil?
5. Is any pump in use placed downstream to prevent mechanical emulsification?
6. Is detergent use avoided upstream to prevent chemical emulsification?
7. For API and CP separators, is a forebay provided sized at 20 ft^2 of surface area per 10,000 ft^2 of drainage area?
8. For API and CP separators, is an afterbay provided for placement of absorbents?
9. For the CP separator, are the plates no more than 3/4 in. apart and at 45 to 60 degrees from horizontal?

Maintenance checks:

1. Is weekly inspection performed by the owner?
2. Are oil and any solids removed frequently enough (at least just before the main runoff period and then after the first major runoff event)?
3. Are absorbents replaced as needed, but at least at the beginning and end of the main runoff season?
4. Is the effluent shutoff valve operational for closure during cleaning?
5. Are waste oil and solids disposed of as specified by regulations?
6. Is any standing water that is removed discharged to the sanitary sewer and then replaced with clean water?

1.2. Pipes and culverts

Refer to Table 2 for a summary of maintenance standards for conveyance facilities.

1.3. Catch basins

Catch basins are routinely placed between the drain inlets in streets and parking lots and the conveyances that transport water away to settle large solids. Refer to Table 3 for a summary of maintenance standards.

2. Detention facilities

Detention facilities include ponds that are designed and operated either to drain within hours after a

Table 2. Maintenance Standards for Pipes and Culverts

Defect	Conditions When Maintenance Needed	Maintenance Results
Sediment and debris	Accumulated sediment that exceeds 20% of the diameter of the pipe.	Pipe cleaned of all sediment and debris.
Vegetation	Vegetation that reduces free movement of water through pipes.	All vegetation removed so water flows freely through pipes.
Damage	Protective coating is damaged; rust is causing more than 50% of deterioration to any part of pipe.	Pipe repaired or replaced.
	Any dent that decreases the end area of pipe by more than 20%.	Pipe repaired or replaced.
Debris barriers	Trash or debris that is plugging more than 20% of the openings in the barrier.	Barrier clear to receive capacity flow.
Damaged/ Missing bars	Bars are bent out of shape more than 3 in.	Bars in place with no bend >3/4 in.
	Bars are missing or entire barrier is missing.	Bars in place according to design.
	Bars are loose and rust is causing 50% deterioration to any part of barrier.	Repair or replace barrier to design standards.

storm (dry ponds), to drain within a day or two (extended-detention dry ponds), or to retain a permanent or semipermanent pool (wet ponds). These ponds can have water quantity control objectives, or water quality control objectives, or both, although dry ponds offer few water quality benefits. Detention facilities also include below-ground concrete vaults and storage pipes, the latter sometimes referred to as tanks. These devices serve primarily quantity control purposes, although if they have relatively long water residence times they can collect some solids. Other facilities sometimes included in this category are parking lot and rooftop storage. Constructed wetlands can be placed in either this group or with biofilters. Inspection guidelines are given for wet ponds as a complete example. A table of maintenance standards is included for vaults and tanks as well.

2.1. Wet ponds

Figure 10 illustrates a typical wet pond. A wet pond has a "dead storage" permanent or semipermanent pool and a "live storage" zone that fills during runoff events and then drains fairly quickly. Its design basis differs depending on its purpose (quantity control or quality control, or both), but the checks made when it is installed and later while it is operating are

Table 3. Maintenance Standards for Catch Basins

Defect	Conditions When Maintenance Needed	Maintenance Results
Trash and debris (including sediment)	Trash or debris of more than 1/2 ft^3 located in front of the catch basin opening or is blocking capacity of basin by >10%.	No trash or debris located immediately in front of catch basin opening.
	Trash or debris in the basin that exceeds 1/3 to 1/2 the depth from the bottom of the basin to the invert of the lowest pipe into or out of the basin.	No trash or debris in catch basin.
	Trash or debris in any inlet or outlet pipe blocking more than 1/3 of the height.	Inlet and outlet pipes free of trash or debris.
	Dead animals or debris that could generate odors that would cause complaints or dangerous gases.	No dead animals or vegetation present.
	Deposits of garbage exceeding 1 ft^3 in volume.	No garbage in catch basin.
Structural damage to frame or top slab	Corner of frame extends more than 3/4 in. past curb face into the street (if applicable).	Frame is even with curb.
	Top slab has holes larger than 2 $in.^2$ or cracks wider than 1/4 in. (intent is to make sure all material runs in to basin).	Top slab is free of holes and cracks.
	Frame not sitting flush on top slab (i.e., separation of >3/4 in. of the frame from top of slab).	Frame is sitting flush on top of slab.
Cracks in basin walls or bottom	Cracks wider than 1/2 in. and longer than 3 ft, any evidence of soil particles entering catch basin through cracks, or structure is unsound.	Basin replaced or repaired to design standards.
	Cracks wider than 1/2 in. and longer than 1 ft at the joint of any inlet/outlet pipe or any evidence of soil particles entering catch basin through crack.	No cracks more than 1/4 in. wide at joint of inlet/outlet pipe.
Settlement/ Misalignment	Basin has settled more than 1 in. or has rotated more than 2 in. out of alignment.	Basin replaced or repaired to design standard.
Fire hazard	Presence of chemicals such as natural gas, oil, and gasoline.	No flammable chemicals present.
Vegetation	Vegetation growing across and blocking >10% of basin.	No vegetation blocking opening to basin.
	Vegetation (or roots) growing in inlet/outlet pipe joints that is >6 in. tall and <6 in. apart.	No vegetation or root growth present.
Pollution	Nonflammable chemicals of >1/2 ft^3 per 3 ft of basin length.	No pollution present other than surface film.

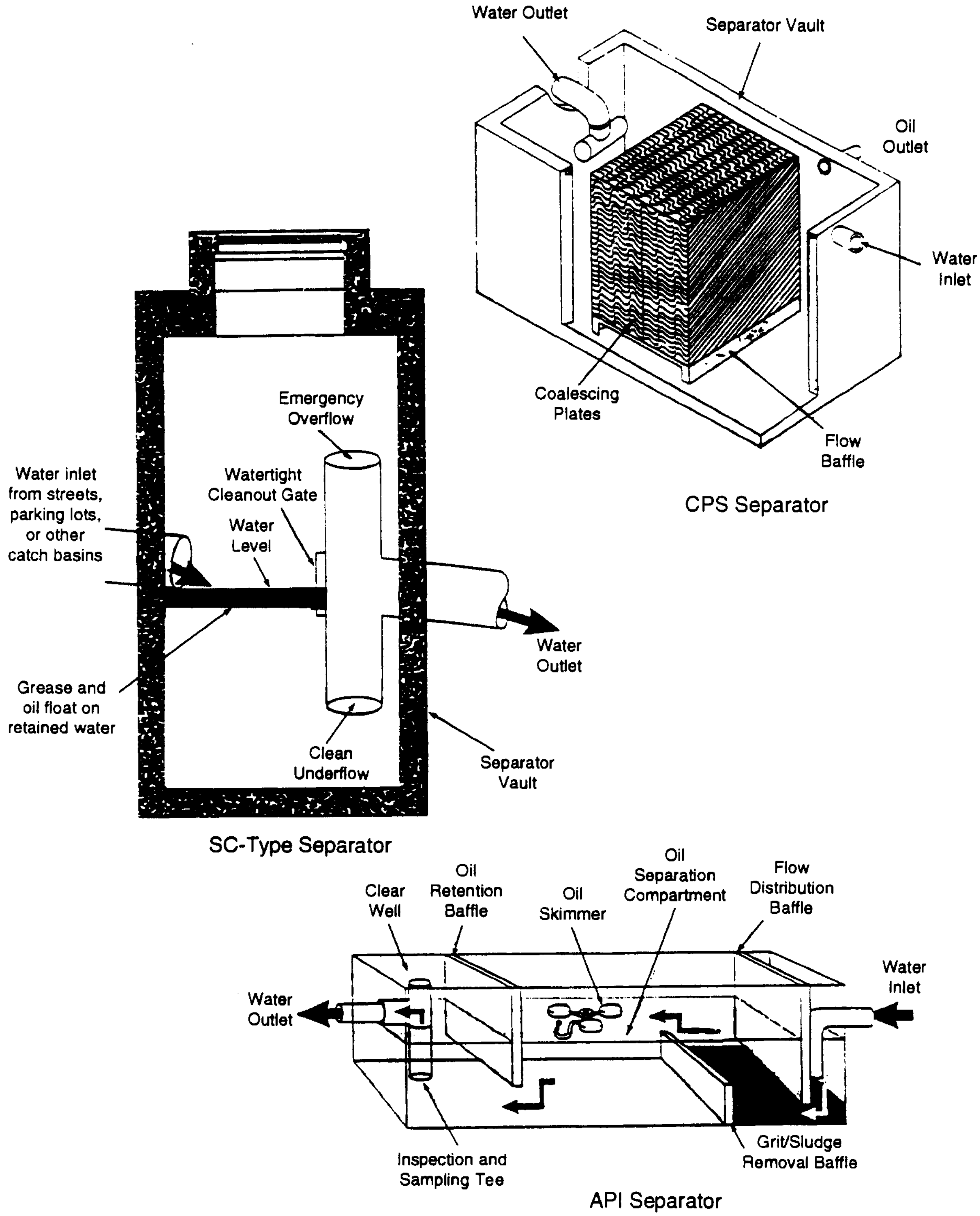


Figure 9. Types of oil/water separators (3).

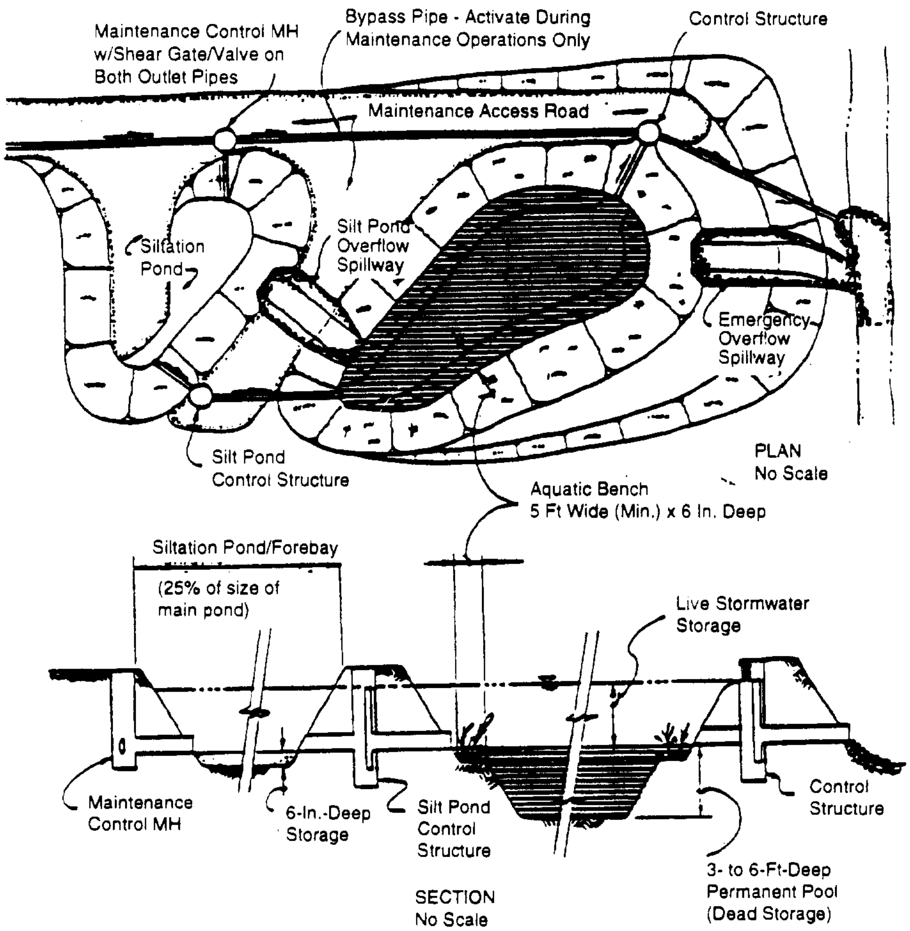


Figure 10. Typical wet pond (3).

generally the same, with the few exceptions noted.

Installation checks:

1. Does construction comply with local requirements for earthwork, concrete, other masonry, reinforcing steel, pipe, water gates, metalwork, and woodwork?
2. Are all dimensions as specified in the approved plan?
3. Are interior side slopes no steeper than 3 horizontal to 1 vertical and exterior side slopes no steeper than 2:1?
4. Is the bottom level?
5. Are the spillways (between cells, if any, and the emergency outlet spillway) sized and reinforced as specified in the approved plan?
6. Is a drain provided that can drain the dead storage zone within 4 hr if necessary?
7. Are inlet and outlet areas stabilized as necessary to avoid erosion?
8. Are safety concerns addressed, for example, with such features as a shallow bench completely around the edge of the pond, barrier plantings to discourage approach by children, and/or fencing (should not be necessary if sloped as recommended and other safety features are provided)?
9. For a water quality pond, is the effective length-to-width ratio at least 3:1 minimum, 5:1 preferably; are the inlet and outlet separated to the greatest width possible?

Maintenance checks:

1. Has a maintenance plan and schedule been developed?
2. Refer to Table 4 for specific checks and maintenance standards (these standards apply to other types of ponds as well).

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Table 4. Maintenance Standards for Detention Facilities

Defect	Conditions When Maintenance Needed	Maintenance Results
Trash and debris	Any trash or debris that exceeds 1 ft^3/ 1,000 ft^2. There should be no evidence of dumping.	Trash and debris cleared from site.
Poisonous vegetation	Presence of any poisonous vegetation that constitutes a hazard to maintenance personnel or to the public (e.g., poison oak, stinging nettles, devil's club).	No evidence of poisonous vegetation. Coordinate with health department.
Pollution	One gallon or more of oil, gas, or contaminants, or any amount that could 1) cause damage to plant, animal, or aquatic life, 2) constitute a fire hazard, 3) be flushed downstream during storms, or 4) contaminate ground water.	No contaminents present other than surface film. Coordinate with local health department.
Unmowed grass/ ground cover	In residential areas, mowing is needed when the cover exceeds 18 in. in height. Otherwise match facility cover with adjacent ground cover and terrain as long as there is no decrease in facility function.	Grass/ground cover should be mowed to 2 in. Maintain dense cover on slopes and in bottom of dry ponds.
Rodent holes	Any evidence of rodent holes if facility is acting as a dam or berm, or any evidence of water piping through dam or berm via rodent holes.	Rodents destroyed and dam or berm repaired. Coordinate with local health department.
Insects	When insects such as wasps or hornets interfere with maintenance activities.	Insects destroyed or removed from site. Coordinate with people who remove wasps for antivenom protection.
Tree growth	Tree growth does not allow maintenance access or interfere with maintenance activity. If trees are not interfering with access, leave trees alone.	Trees do not hinder maintenance activities.
Erosion of pond side slopes	Eroded damage >2 in. deep where cause of damage is still present or where there is potential for continued erosion.	Slopes stabilized with appropriate erosion control BMPs (e.g., seeding, mats, riprap).
Sediment accumulation in forebay/pond	Accumulated sediment 10% of the design forebay/pond depth, or every 3 yr.	Sediment cleaned out to design depth. Reseed if necessary for erosion control.
Dike settling	Any part of dike that has settled >4 in.	Dike is rebuilt to design elevation.
Rocks missing from overflow spillway	Only one layer of rock above native soil in an area of 5 ft^2 or greater, or any exposed soil.	Rock replaced to design standard.
Inadequate spillway size	Emergency overflow or spillway not large enough to handle flows from large storm events.	Increase capacity of spillway to current design standards.
Missing, broken, or damaged fencing	Any defect in fencing that permits easy entrance to the pond.	Fencing repaired to prevent entrance.
	Damaged fencing including posts out of plumb by >6 in., top rails bent >6 in., missing or loose tension wire, missing or sagging barbed wire, missing or bent extension arms.	Repair fencing and barbed wire to design standards
	Fencing parts that have a rusting or scaling condition that is affecting structural adequacy.	Structurally adequate posts or parts with protective coating.
	Opening in fencing that allows passage of an 8-in. diameter ball.	No opening in fence.
Erosion under fencing	Erosion >4 in. deep and 12 to 18 in. wide, permitting an opening under fence.	No opening under fence >4 in.
Missing or damaged gates	Missing or damaged gate, locking device, or hinges.	Gates, locking devices, and hinges repaired.
	Gate is out of plumb >6 in. and out of design alignment >1 ft.	Gate is aligned and vertical.
	Missing stretcher bar, bands, or ties.	Stretcher bar, bands, and ties in place.
Blocked or damaged access roads	Debris that could damage vehicle tires.	Roadway free of debris.
	Obstructions that reduce clearance above road surface to <14 ft (e.g., tree branches, wires).	Roadway clear overhead to 14 ft.
	Any obstructions restricting access to a 10- to 12-ft width for a distance of >12 ft, or any point restricting access to a width of <10 ft.	Obstructions moved to allow at least a 12-ft access route.
	Any road settlement, potholes, mushy spots, or ruts that prevent or hinder maintenance access.	Road surface repaired and smooth.
	Weeds or brush on or near road surface that hinder access, or are >6 in. tall and <6 in. apart within a 400 ft^2 area.	Weeds and brush on or near road surface cut to 2 in.
	Erosion within 1 ft of the roadway >8 in. wide and 6 in. deep.	Shoulder and road free of erosion.

2.2. Vaults and tanks

Refer to Table 5 for a summary of maintenance standards for closed detention systems.

3. Infiltration facilities

Infiltration facilities discharge most of the entering water to the ground. They include surface basins and trenches, below-ground perforated pipes, roof drain systems, and porous pavements. Inspection guidelines are given for infiltration basins as a complete example. A table of maintenance standards is included for infiltration trenches as well.

3.1. Infiltration basins (see Figure 11 for a typical basin)

Installation checks:

1. Does construction comply with local requirements for earthwork, concrete, other masonry, reinforcing steel, pipe, water gates, metalwork, and woodwork?

2. Are all dimensions as specified in the approved plan?

3. Does the timing of basin construction avoid the entrance of any runoff containing sediment from elsewhere on the site?

4. Is the basin preceded by a pretreatment device (e.g., presettling basin or biofilter) to prevent failure caused by siltation?

5. Is the basin at least 50 ft from any slope greater than 15 percent and at least 100 ft upslope and 20 ft downslope of any building?

6. Is the outlet orifice design consistent with the infiltration capacity on which the facility is based (e.g., to avoid the collection of more water than can infiltrate in 48 hr)?

7. Are the spillways (between cells, if any, and the emergency outlet spillway) sized and reinforced as specified in the approved plan?

8. Are all disturbed areas stabilized to prevent erosion?

9. After final grading, has the bed been deeply tilled to provide a well-aerated, highly porous surface texture?

Maintenance checks:

1. Has a maintenance plan and schedule been developed?

2. Refer to Table 6 for specific checks and maintenance standards.

Table 5. Maintenance Standards for Closed Detention Systems

Defect	Conditions When Maintenance Needed	Maintenance Results
Plugged air vents	Half of the end area of a vent is blocked at any point with debris and sediment.	Vents free of debris and sediment.
Debris and sediment in storage area.	Accumulated sediment depth is >10% of the diameter of the storage area for 1/2 the length of storage vault or any point exceeds 15% of the diameter. Example: 72-in. storage tank would require cleaning when sediment reaches a depth of 7 in. for more than 1/2 the tank length.	All sediment and debris removed from storage area.
Cracks in joints between tank/pipe sections	Any crack allowing material to be transported into the facility.	All joints between tanks or pipe sections are sealed.
Problems with manhole cover	Cover is missing or only partially in place. Any open manhole requires maintenance.	Manhole is closed and secured.
	Locking mechanism cannot be opened by one maintenance person with proper tools. Bolts into frame have <1/2 in. of thread (may not apply to self-locking lids).	Mechanism is repaired or replaced so it functions properly.
	Cover difficult to remove by one maintenance person applying 80 lb of lift.	Cover can be removed and reinstalled by one maintenance person.
Ladder rungs of manhole unsafe	Local government safety officer or maintenance person judges that ladder is unsafe due to missing rungs, misalignment, rust, or cracks.	Ladder meets design standards and allows for maintenance access.
Catch basins	See Table 3.	See Table 3.

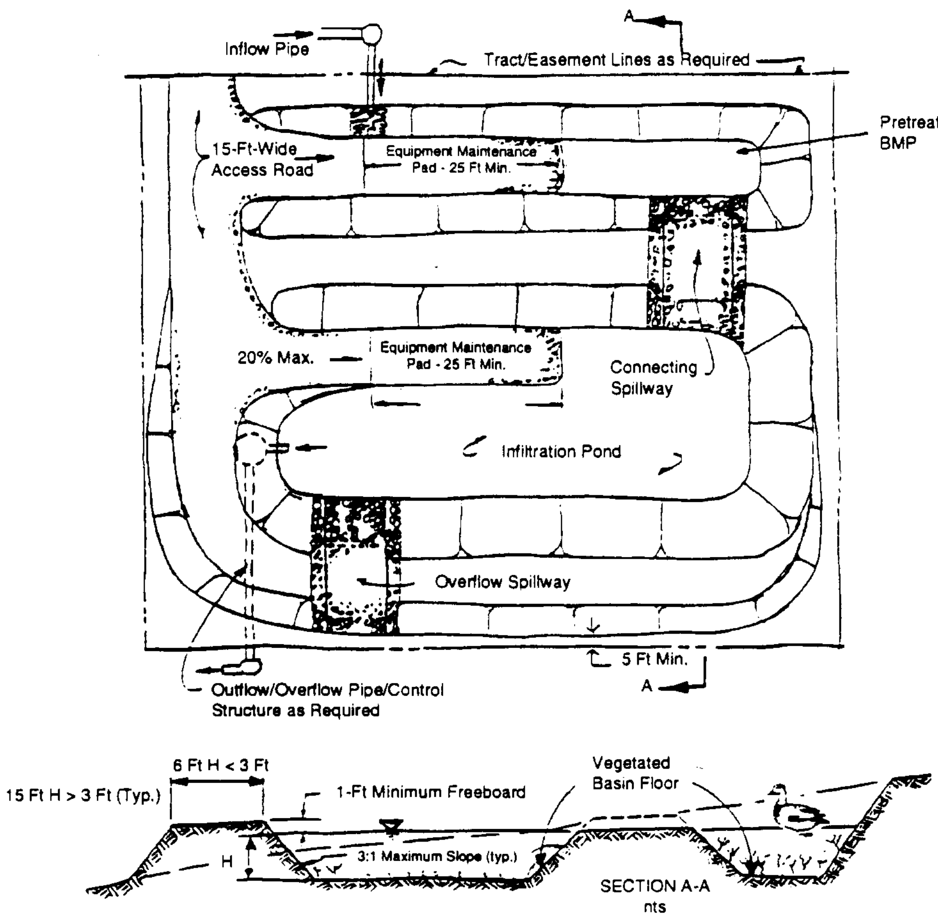

Figure 11. Typical infiltration basin (3).

3. In addition, is tilling necessary to restore infiltration capacity (regular annual tilling is recommended)?

3.2. Infiltration trenches

Refer to Table 7 for a summary of maintenance standards for infiltration trenches.

4. Biofilters

The term "biofilter" applies to vegetated land treatment systems. Biofilters can be in the form of vegetated swales, in which water flows at some measurable depth or in a thin sheet across broad surface areas, sometimes called "filter strips." Constructed wetlands are also sometimes put in this category. The guidelines given below generally pertain to swales and filter strips, although some exceptions are noted. Inspection of constructed wetlands should be conducted with reference to both these guidelines and those given above for wet ponds.

4.1. Biofiltration swales and filter strips

Installation checks:

1. Are the dimensions and plantings as specified in the approved plan?
2. Is the vegetation cover dense and uniform?
3. If the biofilter is a swale, is it parabolic or trapezoidal in shape, with side slopes no steeper than 3 horizontal to 1 vertical?
4. Is the biofilter placed relative to buildings and trees in such a way that no portion will

Table 6. Maintenance Standards for Infiltration Basins

Defect	Condition When Maintenance Needed	Maintenance Results
Sediment buildup in system	Soil texture test indicates facility is not functioning as designed.	Sediment is removed and/or facility is cleaned so that system works according to design. A forebay or presettling basin is installed to reduce sediment transport to facility.
Poor facility drainage (more than 48 hr)	Soil texture test indicates facility is not functioning as designed.	Additional volume added through excavation to provide needed storage. Soil aerated and rototilled to improve drainage.
Sediment trapping area	Sediment and debris fill >10% of sediment mapping facility or sump.	Sediment trapping facility or sump cleaned of accumulated sediment.
No sediment trapping facility	Stormwater enters infiltration area without pretreatment.	Trapping facility (presettling basin, detention pond, biofilter) is added before infiltration facility.

Table 7. Maintenance Standards for Infiltration Trenches

Defect	Condition When Maintenance Needed	Maintenance Results
Sediment and debris buildup in trench	By visual inspection, little or no water flows through the trench during large storms.	Debris blocking infiltration trench is removed. Gravel in infiltration trench is replaced or cleaned.
Observation well	Observation well buried, covered, or inaccessible.	The observation well/cap is accessible to the inspector for opening and inspection.
Water percolates up from trench	Trench water or water with dye percolating to surface.	Gravel and filter fabric in infiltration trench is replaced or cleaned. Trench functions according to design standards.
Filter fabric exposed	Filter fabric is exposed or damaged.	Filter fabric is replaced or repaired and covered with proper backfill material.

be shaded throughout the day and possibly experience poor plant growth?

5. If the longitudinal slope is less than 2 percent or if the water table can reach the root zone of vegetation, is water-resistant vegetation planted to survive a standing water condition or is an underdrain system installed to assist drainage (note: underdrains may not be practical with a large filter strip)?

6. If the longitudinal slope is in the range of 4 to 6 percent, are check dams provided approximately every 50 to 100 ft to reduce velocity (note: check dams may not be practical on a larger filter strip)?

7. If the slope on which a swale is installed exceeds 6 percent, does it traverse the slope in such a way that no reach slopes more than 4 percent, or 6 percent with check dams?

8. Is the lateral slope entirely uniform to avoid any tendency for the flow to channelize?

9. Is flow introduced in such a way that entrance velocity is dissipated quickly, flow is distributed uniformly, and erosion is avoided (e.g., by using a riprap pad or some means of level spreading)?

10. Was construction-phase runoff excluded or was the biofilter reestablished after construction, and are upslope areas stabilized to avoid erosion into the biofilter?

11. Is a bypass in place for flows larger than the flow rate for which the biofilter is designed to provide runoff treatment, or is the facility sufficiently large to pass at least the 100-yr, 24-hr storm without eroding (a bypass is preferred to maintain the treatment function and prevent resuspension of settled material)?

Maintenance checks:

1. Has a maintenance plan and schedule been developed?

2. Refer to Table 8 for specific checks and maintenance standards.

Table 8. Maintenance Standards for Biofilters

Defect	Conditions When Maintenance Needed	Maintenance Results
Trash and debris	Dumping of yard wastes. Accumulation of nondegradable materials.	Remove degradable wastes and compost. Recycle other waste when possible.
Sediment buildup	Accumulation >20% of design depth.	Cleaned or flushed to match design. Vegetation restored as necessary.
Poor vegetation cover	Vegetation sparse and/or weedy. Overgrown with woody vegetation.	Aerate soil and plant. Remove woody growth and replace.
Erosion damage to slopes	Erosion >2 in. deep where cause still present or potential exists for continued erosion.	Find cause and eliminate. Stabilize with appropriate erosion controls (e.g., seeding, mat, mulch).
Conversion to use incompatible with water quality control	Filled, planted appropriately, or blocked.	Discuss with nearby property owners and specify corrections to be made.
Poor drainage	Water stands in swale.	Determine cause. If water table is high, consider rebuilding with liner or underdrain. If slope <1%, use underdrain.

References

1. Reinelt, L.E. 1991. Construction site erosion and sediment control inspector training manual. Seattle, WA: Engineering Continuing Education, University of Washington.
2. Reinelt, L.E. 1992. Inspection and maintenance of permanent stormwater management facilities: Training manual. Seattle, WA: Engineering Continuing Education, University of Washington.
3. Washington Department of Ecology. 1992. Stormwater management manual for the Puget Sound Basin. Olympia, WA: Washington Department of Ecology.

*U.S. GOVERNMENT PRINTING OFFICE: 1995-650-006/22033

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Part XIV

Environmental Protection Agency

Final National Pollutant Discharge Elimination System Storm Water Multi-Sector General Permit for Industrial Activities; Notice

OCT 30, 2000 (Vol 65, Number 210)

FRL-6880-5

ADMINISTRATIVE RECORD INDEX-
DOCUMENTS- STORM WATER MANAGEMENT
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R0016080

98 FEB -5 PM 1:58

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ENVIRONMENTAL PROTECITON AGENCY

[FRL-5298-3]

Final National Pollutant Discharge Elimination System Storm Water Multi-Sector General Permit for Industrial Activities

AGENCY: Environmental Protection Agency.

SUMMARY: The following provides notice for a final NPDES general permit, accompanying response to comments, and fact sheets for storm water discharges associated with industrial activity in the following Regions:

Region I—the States of Maine, Massachusetts, and New Hampshire; Federal Indian Reservations located in Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont; and Federal facilities located in Vermont.

Region II—the Commonwealth of Puerto Rico and Federal facilities located in Puerto Rico.

Region III—the District of Columbia and Federal facilities located in Delaware and the District of Columbia.

Region IV—the State of Florida.

Region V—no areas.

Region VI—the States of Louisiana, New Mexico, Oklahoma, and Texas, and Federal Indian Reservations located in Louisiana, New Mexico (except Navajo Reservation lands, which are handled by Region IX, and Ute Mountain Reservation lands, which are handled by Region VIII and are not being covered by this permit), Oklahoma, and Texas.

Region VII—no areas.

Region VIII—no areas.

Region IX—the State of Arizona; the Territories of Johnston Atoll, and Midway and Wake Islands; all Federal Indian Reservations located in Arizona, California, and Nevada; those portions of the Duck Valley, Fort McDermitt, and Goshute Reservations located outside Nevada; those portions of the Navajo Reservation located outside Arizona; and Federal facilities located in Arizona, Johnston Atoll, and Midway and Wake Islands.

Region X—the State of Idaho; Federal Indian Reservations located in Alaska, Idaho (except Duck Valley Reservation lands, which are handled by Region IX), Oregon (except Fort McDermitt Reservation lands, which are handled by Region IX), and Washington: and Federal facilities located in Idaho, and Washington.

The permit covers storm water discharges associated with industrial activity to waters of the United States, including discharges through large and medium municipal separate storm sewer systems, and through other municipal separate storm sewer systems. The permit is intended to cover discharges from the following types of industrial activities: lumber and wood products facilities; paper and allied products manufacturing facilities; chemical and allied products manufacturing facilities; asphalt paving and roofing materials manufacturers and lubricants; stone, clay, glass and concrete products facilities; primary metals facilities; metal mines (ore mining and dressing); coal mines; oil and gas extraction facilities; nonmetallic mines and quarries; hazardous waste treatment, storage or disposal facilities; landfills, land application sites and open dumps; automobile salvage yards; scrap and waste material processing and recycling facilities; steam electric power generating facilities; railroad transportation facilities, local and suburban transit and interurban highway passenger transportation facilities, petroleum bulk oil stations and terminals, motor freight transportation facilities and U.S. Postal Service facilities; water transportation facilities; ship or boat building/repair facilities; airports; wastewater treatment plants; food and kindred products facilities; textile mills, apparel and other fabric manufacturing facilities; furniture and fixture manufacturing facilities; printing and publishing facilities; rubber and miscellaneous plastic product and miscellaneous manufacturing facilities; leather tanning and finishing facilities; facilities that manufacture fabricated metal products, jewelry, silverware, and plated ware; facilities that manufacture transportation equipment, industrial, or commercial machinery; and facilities that manufacture electronic equipment and components, photographic and optical goods. Military installations must comply with the permit and monitoring requirements for all sectors that describe industrial activities that such installations perform. Publication of this final general permit, fact sheets, and response to comments complies with the requirements of 40 Code of Federal Regulations (CFR) 124.10.

The language of the permit is provided as an appendix to the preamble of this notice. Most conditions of the general permit are intended to apply to all permittees, unless stated otherwise. Where conditions vary by State, these differences are indicated in the appendix.

ADDRESSES: Notices of Intent (NOIs) to be covered under this permit and Notices of Termination (NOT) to terminate coverage under this permit must be sent to Storm Water Notice of Intent (4203), 401 M Street, SW., Washington, DC 20460. The complete administrative record is available through the Water Docket MC-4101, Environmental Protection Agency, 401 M Street SW, Washington DC 20460. A reasonable fee may be charged for copying. Each Regional office (see addresses listed in Part VI.G. of this fact sheet) has an index of the complete administrative record.

DATES: This general permit shall be effective on September 29, 1995. Deadlines for submittal of Notices of Intent (NOIs) are provided in Section II.A. of the general permit. Today's general permit also provides additional dates for compliance with the terms of the permits and for submitting monitoring data where required.

FOR FURTHER INFORMATION: For further information on the NPDES storm water general permit, contact the appropriate EPA Regional Office. The name, address and phone number of the EPA Regional Storm Water Coordinators are provided in Part VI.G. of the fact sheet.

Organization of Today's Permit

Today's permit covers storm water discharges from a wide variety of industrial activities. Because the conditions which affect the presence of pollutants in storm water discharges vary among industries, today's permit contains industry-specific sections that describe the storm water pollution prevention plan requirements, the numeric effluent limitation requirements and the monitoring requirements for that industry. These industry-specific sections are contained in Part XI of today's permit and are described in Part VIII of this fact sheet. There are also a number of permit requirements that apply to all industries. These requirements may be found in Parts I through X. They include the general coverage discussion, the Notice of Intent requirements and standard permit conditions. Specifically, Parts I through VII of this fact sheet describe these common requirements. The following is an outline of this fact sheet.

Region I
Region II
Region III
Region IV
Region VI
Region IX
Region X
XI. Regulatory Flexibility Act
XII. Unfunded Mandates Reform Act

I. Background

In 1972, the Federal Water Pollution Control Act (also referred to as the Clean Water Act (CWA)) was amended to provide that the discharge of any pollutant to waters of the United States from any point source is unlawful, except if the discharge is in compliance with a National Pollutant Discharge Elimination System (NPDES) permit.

For a number of reasons, EPA and authorized NPDES States have failed to issue NPDES permits for the majority of point source discharges of storm water. Recognizing this, Congress added section 402(p) to the CWA in 1987 to establish a comprehensive framework for addressing storm water discharges under the NPDES program. Section 402(p)(4) of the CWA clarifies the requirements for EPA to issue NPDES permits for storm water discharges associated with industrial activity. On November 16, 1990 (55 FR 47990 as amended at 56 FR 12100, Mar. 21, 1991; 56 FR 56554, Nov. 5, 1991; 57 FR 11412, Apr. 2, 1992; 57 FR 60447, Dec. 18, 1992), EPA published final regulations which defined the term "storm water discharge associated with industrial activity." These regulations also set forth NPDES permit application requirements for storm water discharges associated with industrial activity and storm water discharges from certain municipal separate storm sewer systems. The regulations presented three permit application options for storm water discharges associated with industrial activity. The first option was to submit an individual application consisting of Forms 1 and 2F. The second option was to become a participant in a group application. The third option was coverage under a general permit in accordance with the requirements of an issued general permit.

The promulgation of today's general permit is in response to the second of these three options. Group applications were submitted in two parts. Part 1 of the application was due by September 30, 1991, and part 2 of the application was due by October 1, 1992. In part 1 of the application, all participants were identified and information on each facility was included, such as industrial activities, significant materials exposed to storm water, and material management activities. For part 1 of the application, groups also identified sampling subgroups to submit sampling data for part 2. Over 1,200 groups with over 60,000 member facilities submitted part 1 applications. Upon review of the part 1 application, if the EPA determined that the application was an appropriate grouping of facilities with complete information provided on each participant, and a suitable sampling subgroup was proposed, the application was approved.

Part 2 of the application consisted of sampling data from each member of the sampling subgroup identified in part 1 of the application. In drafting today's general permit, EPA reviewed both parts of the applications and formulated the permit language noticed today. NPDES authorized States were provided the data from the group applications. Authorized NPDES States may propose and finalize either individual permits for each facility included in the application located in the State, or general permits, if the State has general permit authority.[1] If the State feels additional information is needed from the applicants, the State may ask each or any of the applicants for more information on their facility and/or discharge.

EPA estimates that about 100,000 facilities nationwide discharge storm water associated with industrial activity (not including oil and gas exploration and production operations) as described under phase I of the storm water program. The large number of facilities addressed by the regulatory definition of "storm water discharge associated with industrial activity" has placed a tremendous administrative burden on EPA and States with authorized NPDES programs to issue and administer permits for these discharges.

To provide a reasonable and rational approach to addressing this permitting task, the Agency has developed a strategy for issuing permits for storm water discharges associated with industrial activity. In developing this strategy, the Agency recognized that the CWA provides flexibility in the manner in which NPDES permits are issued,[2] and has used this flexibility to design workable permitting system. In accordance with these considerations, the permitting strategy (described in more detail in 57 FR 11394) describes four-tier set of priorities for issuing permits for these discharges:

Tier I—Baseline Permitting—One or more general permits will be develope to initially cover the majority of storm water discharges associated with industrial activity.

Tier II—Watershed Permitting—Facilities within watersheds shown to be adversely impacted by storm water discharges associated with industrial activity will be targeted for individual or watershed-specific general permits.

Tier III—Industry-Specific Permitting—Specific industry categori will be targeted for individual or industry-specific general permits.

Tier IV—Facility-Specific Permitting—A variety of factors will be used to target specific facilities for individual permits.

The general permit accompanying th fact sheet will continue Phase 1 permitting activities for storm water discharges associated with industrial activity by providing industry-specific coverage to group applicants in the following areas: the States of Arizona, Florida, Idaho, Louisiana, Maine, Massachusetts, New Hampshire, New Mexico, Oklahoma, and Texas; the District of Columbia; Johnston Atoll, and Midway and Wake Islands; the Commonwealth of Puerto Rico; Federal Indian Reservations in Alaska, Arizona California, Connecticut, Idaho, Louisiana, Maine, Massachusetts, Nevada, New Hampshire, New Mexico Oklahoma, Oregon, Rhode Island, Texas, Utah (only the Navajo and Goshute Reservations), Vermont, and Washington; and Federal facilities located in Arizona, the Commonwealth of Puerto Rico, the District of Columbia Delaware, Idaho, Johnston Atoll, Midway and Wake Islands, Vermont, and Washington.[3] EPA will provide today's permit to the NPDES authorized States and encourages such States to consider this permit for their permittin needs.

II. Types of Discharges Covered

On November 16, 1990 (55 FR 47990 EPA promulgated the regulatory

[1] As of December 1993, 39 of the 40 NPDES authorized State permitting programs had the authority to issue general permits.

[2] The court in *NRDC* v. *Train*, 396 F.Supp. 1393 (D.D.C. 1975) *aff'd*, *NRDC* v. *Costle*, 568 F.2d 1369 (D.C.Cir. 1977), has acknowledged the administrative burden placed on the Agency by requiring permits for a large number of storm water discharges. The courts have recognized EPA's discretion to use certain administrative devices, such as area permits or general permits, to help manage its workload. In addition, the courts have recognized flexibility in the type of permit conditions that can be established, including the use of requirements for best management practices.

[3] In 5 of the 40 States that are authorized to issue NPDES permits for municipal and industrial sources, EPA issues permits for discharges from Federal facilities. EPA also retains authority to issu permits on Federal Indian Reservations. However, this fact sheet only addresses general permits as indicated above. Where EPA is the permit issuing authority for other storm water discharges, either individual permits or a different general permit wi be issued.

definition of "storm water discharge associated with industrial activity" which addresses point source discharges of storm water from eleven major categories of industrial activities. Industrial activities from all of these categories with the exception of construction activities participated in the group application process. The information contained in the group applications indicates that type and amount of pollutants discharged in storm water varies from industrial activity to industrial activity because of the variety of potential pollutant sources present in different industrial activities, as well as the variety of pollution prevention measures commonly practiced by each of the regulated industries. To facilitate the process of developing permit conditions for each of the 1200 group applications submitted, EPA classified groups into 29 industrial sectors where the nature of industrial activity, type of materials handled and material management practices employed were sufficiently similar for the purposes of developing permit conditions. Each of the industrial sectors were represented by one or more groups which participated in the group application process. Table 1 lists each of the industrial activities covered by today's permit, and the corresponding sections of today's fact sheet and permit which discuss the specific requirements for that industry. EPA has further divided some of the 29 sectors into subsectors in order to establish more specific and appropriate permit conditions, including best management practices and monitoring requirements.

Coverage under today's general permit is available to storm water discharges from industrial activities represented by the group application process. However, coverage under this permit is not restricted to participants in the group application process. To limit coverage under this general permit only to those who participated in the Group application process would not be appropriate for administrative, environmental, and national consistency reasons. The administrative burden for EPA to develop separate general permits for non-group members would be excessive, unnecessary, and wasteful of tax dollars. EPA would also need to use the same information in the development of such permits. The permits would be essentially the same. The time spent in this process would leave many facilities unregulated for some number of additional months. This would not address the environmental concerns of the Clean Water Act. Likewise, group members are not precluded from seeking coverage under other available storm water permits such as EPA's "baseline" general permits for Storm Water Discharges Associated with Industrial Activity, (57 FR 41175 and 57 FR 44412). Group members must consider, however, that the deadlines for preparing and implementing the pollution prevention plan required under the baseline permit have already expired for existing facilities. Therefore, group members that seek coverage under the baseline general permit must have a pollution prevention plan developed and implemented prior to NOI submittal.

Unlike the baseline general permits, today's permit does not exclude all storm water discharges subject to effluent limitation guidelines. Four types of storm water discharges subject to effluent limitation guidelines may be covered under today's permit if they are not already subject to an existing or expired NPDES permit. These discharges include contaminated storm water runoff from phosphate fertilizer manufacturing facilities, runoff associated with asphalt paving or roofing emulsion production, runoff from material storage piles at cement manufacturing facilities and coal pile runoff at steam electric generating facilities. The permit does not, however, authorize all storm water discharges subject to effluent guidelines. Storm water discharges subject to effluent guidelines under 40 CFR part 436 or for mine drainage under 40 CFR part 440 are not covered under today's permit nor are discharges subject to effluent guidelines for acid or alkaline mine drainage under 40 CFR part 434.

TABLE 1.—INDUSTRIAL ACTIVITIES COVERED BY TODAY'S GENERAL PERMIT

Industrial activity	Fact sheet section describing discharges covered	Permit section describing discharges covered
Timber Products Facilities	VIII.A	XI.A.
Paper and Allied Products Manufacturing Facilities	VIII.B	XI.B.
Chemical and Allied Products Manufacturing Facilities	VIII.C	XI.C.
Asphalt Paving and Roofing Materials Manufacturers and Lubricant Manufacturers	VIII.D	XI.D.
Glass, Clay, Cement, Concrete, and Gypsum Product Manufacturing Facilities	VIII.E	XI.E.
Primary Metals Facilities	VIII.F	XI.F.
Metal Mining (Ore Mining and Dressing) Facilities	VIII.G	XI.G.
Coal Mines and Coal Mining-Related Facilities	VIII.H	XI.H.
Oil and Gas Extraction Facilities	VIII.I	XI.I.
Mineral Mining and Processing Facilities	VIII.J	XI.J.
Hazardous Waste Treatment, Storage, or Disposal Facilities	VIII.K	XI.K.
Landfills and Land Application Sites	VIII.L	XI.L.
Automobile Salvage Yards	VIII.M	XI.M.
Scrap and Waste Recycling Facilities	VIII.N	XI.N.
Steam Electric Power Generating Facilities, Including Coal Handling Areas	VIII.O	XI.O.
Vehicle Maintenance or Equipment Cleaning Areas at Motor Freight Transportation Facilities, Passenger Transportation Facilities, Petroleum Bulk Oil Stations and Terminals, Rail Transportation Facilities, and the United States Postal Service.	VIII.P	XI.P.
Vehicle Maintenance Areas and/or Equipment Cleaning Operations at Water Transportation Facilities.	VIII.Q	XI.Q.
Ship and Boat Building or Repairing Yards	VIII.R	XI.R.
Vehicle Maintenance Areas, Equipment Cleaning Areas, or Deicing Area located at Air Transportation Facilities.	VIII.S	XI.S.
Treatment Works	VIII.T	XI.T.
Food and Kindred Products Facilities	VIII.U	XI.U.
Textile Mills, Apparel, and Other Fabric Product Manufacturing Facilities	VIII.V	XI.V.
Wood and Metal Furniture and Fixture Manufacturing Facilities	VIII.W	XI.W.

TABLE 1.—INDUSTRIAL ACTIVITIES COVERED BY TODAY'S GENERAL PERMIT—Continued

Industrial activity	Fact sheet section describing discharges covered	Permit section describing discharges covered
Printing and Publishing Facilities	VIII.X	XI.X.
Rubber, Miscellaneous Plastic Products, and Miscellaneous Manufacturing Industries	VIII.Y	XI.Y.
Leather Tanning and Finishing Facilities	VIII.Z	XI.Z.
Fabricated Metal Products Industry	VIII.AA	XI.AA.
Facilities That Manufacture Transportation Equipment, Industrial, or Commercial Machinery.	VIII.AB	XI.AB.
Facilities That Manufacture Electronic and Electrical Equipment and Components, Photographic and Optical Goods.	VIII.AC	XI.AC.

A. Limitations on Coverage

Because of the broad scope of today's permit, most industrial activities currently regulated under the storm water program could be covered by the permit. There are, however, several types of storm water discharges which are not covered under today's permit. Storm water discharges subject to an existing NPDES permit are not covered under today's permit, except facilities which are currently subject to the baseline general permit. EPA believes that in most cases these discharges are more appropriately covered under terms and conditions of their existing permit. These discharges may be covered under today's permit only when the existing permit has expired and only when the expired permit did not contain numeric effluent limitations more stringent than those in today's permit. Owners/operators of facilities currently covered under the baseline general permit who wish to obtain coverage under today's general permit must submit a Notice of Termination (NOT) to terminate coverage under the baseline general permit with a Notice of Intent (NOI) to be covered under today's permit. Storm water discharges that were subject to an NPDES permit that was terminated by the permitting authority are not eligible for coverage under today's permit. Construction activities are not eligible for coverage under this permit. Storm water discharges that were subject to a permit that was terminated as a result of the permittee's request are eligible for coverage under today's permit. Storm water discharges from industrial activities that are not addressed in the appropriate section of Part XI. (see Table 1) of the permit are not eligible for coverage under this permit. These types of industrial activities were not represented in the group application process. Therefore, EPA has no additional information with which to develop permit requirements beyond those developed for the baseline general permit.

(1) Storm Water Discharges Subject to New Source Performance Standards. Section 306 of the Clean Water Act requires EPA to develop performance standards for all new sources described in that section. These standards apply to all facilities which go into operation after the date the standards are promulgated. Section 511(c) of the Clean Water Act requires the Agency to comply with the National Environmental Policy Act prior to issuance of a permit under the authority of Section 402 of the CWA to facilities defined as a new source under Section 306.

Facilities which are subject to the performance standards for new sources as described in this section of the fact sheet must provide EPA with an Environmental Information Document pursuant to 40 CFR 6.101 prior to seeking coverage under this permit. This information shall be used by the Agency to evaluate the facility under the requirements of the National Environmental Policy Act (NEPA) in an Environmental Review. The Agency will make a final decision regarding the direct or indirect impact of the discharge. The Agency will follow all administrative procedures required in this process. The permittee must obtain a copy of the Agency's final finding prior to the submittal of a Notice of Intent to be covered by this general permit. In order to maintain eligibility, the permittee must implement any mitigation required of the facility as a result of the NEPA review process. Failure to implement mitigation measures upon which the Agency's NEPA finding is based is grounds for termination of permit coverage. In this way, EPA has established a procedure which allows for the appropriate review procedures to be completed by this Agency prior to the issuance of a permit under Section 402 of the CWA to an operator of a facility subject to the new source performance standards of Section 306 of the CWA. EPA believes that it has fulfilled its requirements under NEPA for this federal action under Section 40: of the CWA.

(2) Historic Preservation. The Nation: Historic Preservation Act (NHPA) prohibits Federal actions that would affect a property that either is listed on, or is eligible for listing, on the Nationa: Historic Register. EPA therefore cannot issue NPDES permits to discharges that will affect historic properties unless measures will be taken such as under a written agreement between the applicant and the State Historic Preservation Officer (SHPO) that outlines all measures to be undertaken by the applicant to mitigate or prevent adverse effects to the historic property. Therefore, under today's permit a storm water discharge may be covered only if the discharge will not affect a historic property that is listed or is eligible to be listed in the National Historic Register, or the operator has obtained and is in compliance with a written agreement signed by the State Historic Preservation Officer (SHPO) that outlines measures to be taken to mitigate or prevent adverse affects to the historic site.

(3) Endangered Species. The Endangered Species Act (ESA) of 1973 requires Federal Agencies such as EPA to ensure, in consultation with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service (the Services) that any actions authorized, funded, or carried out by the Agency (e.g., EPA issued NPDES permits authorizing discharges to waters of the United States) are not likely to jeopardize the continued existence of any federally-listed endangered or threatened species or adversely modify or destroy critical habitat of such species (see 16 U.S.C. 1536(a)(2), 50 CFR 402 and 40 CFR 122.49(c)). EPA completed a formal consultation with the Services on the action of issuing this permit on April 5, 1995. The terms and conditions of this permit reflect the results of that consultation.

Accordingly, storm water discharges that are likely to adversely affect species identified in Addendum H of the permit are not authorized permit coverage under this storm water multi-sector industrial general permit. Permittees are also not authorized permit coverage if the BMPs they plan to construct and operate as a part of the required storm water pollution prevention plan are likely to adversely affect a species identified in Addendum H.

To be eligible for coverage under the multi-sector storm water permit, applicants are required to review the list of species and their locations which are contained in Addendum H of this permit and which are described in the instructions for completing the application requirements under this permit. If an applicant determines that none of the species identified in the addendum are found in the county in which the facility is located, then there is no likelihood of an adverse affect and they are eligible for permit coverage. Applicants must then certify that their discharges, and the construction of storm water BMPs, are not likely to adversely affect species and will be granted multi-sector storm water permit coverage 48 hours after the date of the postmark on the envelope used to mail in the NOI form.

If species identified in Addendum H are found to be located in the same county as the facility seeking storm water permit coverage, then the applicant next must determine whether the species are in proximity to the storm water discharges at the facility, or any BMPs to be constructed to control storm water runoff. A species is in proximity to a storm water discharge when the species is located in the path or down gradient area through which or over which point source storm water flows from industrial activities to the point of discharge into the receiving water, and once discharged into the receiving water, in the immediate vicinity of, or nearby, the discharge point. A species is also in proximity if a species is located in the area of a site where storm water BMPs are planned to be constructed. If an applicant determines there are no species in proximity to the storm water discharge, or the BMPs to be constructed, then there is no likelihood of adversely affecting the species and the applicant is eligible for permit coverage.

If species are in proximity to the storm water discharges or areas of BMP construction, as long as they have been considered as part of a previous ESA authorization of the applicant's activity, and the environmental baseline established in that authorization is unchanged, the applicant may be covered under the permit. For example, an applicant's activity may have been authorized as part of a section 7 consultation under ESA, covered under a section 10 permit, or have received a clearance letter. The environmentai baseline generally includes the past and present impacts of all federal, state and private actions that were contemporaneous to an ESA authorization. Therefore, if a permit applicant has received previous authorization and nothing has changed or been added to the environmental baseline established in the previous authorization, then coverage under this permit will be provided.

In the absence of such previous authorization, if species identified in Addendum H are in proximity to the discharges, or the construction areas for the BMPs, then the applicant must determine whether there is any likely adverse effect upon the species. This is done by the applicant conducting a further examination or investigation, or an alternative procedure, described in the instructions in Addendum H of the permit. If the applicant determines there is no likely adverse effect upon the species, then the applicant is eligible for permit coverage. If the applicant determines that there likely is, or will likely be an adverse effect, then the applicant is not eligible for multi-sector storm water permit coverage.

All dischargers applying for coverage under this permit must provide in the application information on the Notice of Intent form: (1) a determination as to whether there are any species identified in Addendum H in proximity to the storm water discharges and BMPs construction areas, and (2) a certification that their storm water discharges and the construction of BMPs to control storm water are not likely to adversely affect species identified in Addendum H, or are otherwise eligible for coverage due to a previous authorization under the ESA. Coverage is contingent upon the applicant's providing truthful information concerning certification and abiding by any conditions imposed by the permit.

Dischargers who are not able to determine that there will be no likely adverse affect to species or habitats and cannot sign the certification to gain coverage under this multi-sector storm water general permit, must apply to EPA for an individual NPDES storm water permit. As appropriate, EPA will conduct ESA § 7 consultation when issuing such individual permits.

Regardless of the above conditions, EPA may require that a permittee apply for an individual NPDES permit on the basis of possible adverse effects on species or critical habitats. Where there are concerns that coverage for a particular discharger is not sufficiently protective of listed species, the Services (as well as any other interested parties) may petition EPA to require that the discharger obtain an individual NPDES permit and conduct an individual section 7 consultation as appropriate.

In addition, the Assistant Administrator for Fisheries for the National Oceanic and Atmospheric Administration, or his/her authorized representative, or the U.S. Fisheries and Wildlife Service (as well as any other interested parties) may petition EPA to require that a permittee obtain an individual NPDES permit. The permittee is also required to make the storm water pollution prevention plan, annual site compliance inspection report, or other information available upon request to the Assistant Administrator for Fisheries for the National Oceanic and Atmospheric Administration, or his/her authorized representative, or the U.S. Fisheries and Wildlife Service Regional Director, or his/her authorized representative.

These mechanisms allow for the broadest and most efficient coverage for the permittee while still providing for the most efficient protection of endangered species. It significantly reduces the number of dischargers that must be considered individually and therefore allows the Agency and the Services to focus their resources on those discharges that are indeed likely to adversely affect water-dependent listed species. Straightforward mechanisms such as these allow applicants with expedient permit coverage, and eliminates "permit limbo" for the greatest number of permitted discharges. At the same time it is more protective of endangered species because it allows both agencies to focus on the real problems, and thus, provide endangered species protection in a more expeditious manner.

(4) Storm Water Discharges Associated with Inactive Mines, Landfills, Oil and Gas Operations that Are Located on Federal Lands. The permit does not cover storm water discharges associated with industrial activity from inactive mines, inactive landfills, and inactive oil and gas operations that are located on Federal lands, unless an operator of the industrial activity can be identified. These discharges are not eligible for coverage under this permit because they would more appropriately be covered by the permit currently under development by EPA intended specifically to cover these types of discharges.

III. Pollutants in Storm Water Discharges Associated with Industrial Activities in General

The volume and quality of storm water discharges associated with industrial activity will depend on a number of factors, including the industrial activities occurring at the facility, the nature of precipitation, and the degree of surface imperviousness. A discussion of these factors is provided in the proposed general permit (see FR 58 61146 Nov. 19, 1993).

IV. Summary of Options for Controlling Pollutants

Pollutants in storm water discharges from industrial plants may be reduced using the following methods: eliminating pollution sources, implementing Best Management Practices to prevent pollution, using traditional storm water management practices, and providing end-of-pipe treatment. Each of these is discussed in the proposed general permit (see 58 FR 61146, Nov. 19, 1993).

V. The Federal/Municipal Partnership: The Role of Municipal Operators of Large and Medium Municipal Separate Storm Sewer Systems

A key issue in developing a workable regulatory program for controlling pollutants in storm water discharges associated with industrial activity is the proper use and coordination of limited regulatory resources. This is especially important when addressing the appropriate role of municipal operators of large and medium municipal separate storm sewer systems in the control of pollutants in storm water associated with industrial activity which discharge through municipal separate storm sewer systems. The proposed general permit discussed several key policy factors (see 58 FR 61146).

VI. Summary of Common Permit Conditions

The following section describes the permit conditions common to discharges from all the industrial activities covered by today's permit. These conditions were proposed on November 19, 1993 (58 FR 61146), and reflect the baseline permit requirements established for most regulated industries in EPA's General Permits for Storm Water Discharges Associated with Industrial Activity [57 FR 41344–41356 September 9, 1992, and 57 FR 44438–44470 September 25, 1992]. Permit requirements which vary from industry to industry are discussed in Part VIII of this fact sheet.

A. Notification Requirements

General permits for storm water discharges associated with industrial activity require the submittal of an NOI prior to the authorization of such discharges (see 40 CFR 122.28(b)(2)(i), April 2, 1992 [57 FR 11394]). Consistent with these regulatory requirements, today's general permit establishes NOI requirements that operate in addition to the part 1 and part 2 group application requirements. To be covered under this permit, facilities, including members of an approved group, must submit an NOI and other required information within 90 days of the effective date of this permit. The NOI form is found in Addendum B.

1. Contents of NOIs

a. The operator's name, address, telephone number, and status as Federal, State, private, public, or other entity.

b. Street address of the facility for which the notification is submitted. Where a street address for the site is not available, the location can be described in terms of the latitude and longitude of the facility to the nearest 15 seconds, or the quarter, section, township, and range (to the nearest quarter section) of the approximate center of the site.

c. An indication of whether the facility is located on Federal Indian Reservations.

d. Up to four 4-digit Standard Industrial Classification (SIC) codes that best represent the principal products or activities provided by the facility. For hazardous waste treatment, storage, or disposal facilities, land disposal facilities that receive or have received any industrial waste, steam electric power generating facilities, or treatment works treating domestic sewage, a 2-character code must be provided.

e. The permit number of any NPDES permit for any discharge (including non-storm water discharges) from the site that is currently authorized by an NPDES permit.

f. The name of the receiving water(s), or if the discharge is through a municipal separate storm sewer, the name of the municipal operator of the storm sewer and the receiving water(s) for the discharge through the municipal separate storm sewer.

g. The analytical monitoring status of the facility (monitoring or not).

h. For a co-permittee, if a storm water general permit number has been issued, it should be included.

i. A certification that the operator of the facility has read and understands the eligibility requirements for the permit and that the operator believes the facility to be in compliance with those requirements.

j. Identify type of permit requested (either baseline general, multi-sector, construction); longitude and latitude; indication of presence of endangered species; indication of historic preservation agreement; signed certification stating compliance with the National Historic Preservation Act, Endangered Species Act, and the new source performance standard requirements.

k. For any facility that begins to discharge storm water associated with industrial activity after [insert date 270 days after permit finalization], a certification that a storm water pollution prevention plan has been prepared for the facility in accordance with Part IV of this permit. (A copy of the plan should not be included with the NOI submission.)

An NOI form is provided in Addendum B. The NOI must be signed in accordance with the signatory requirements of 40 CFR 122.22. A complete description of these signatory requirements is provided in the instructions accompanying the NOI. Completed NOI forms must be submitted to the Storm Water Notice of Intent (4203), 401 M Street SW., Washington, DC 20460.

2. Deadlines

Except for the special circumstances discussed below, dischargers who intend to obtain coverage under this permit for a storm water discharge from an industrial activity that is in existence prior to the date 90 days after permit issuance must submit an NOI on or before the date 90 days after permit issuance, and facilities that begin industrial activities after the date 90 days after permit issuance are required to submit an NOI at least 2 days prior to the commencement of the new industrial activity.

A discharger is not precluded from submitting an NOI at a later date. However, in such instances, EPA may bring appropriate enforcement actions.

The storm water regulations (40 CFR 122.27) require that facilities that discharge storm water associated with an industrial activity submit an application for permit coverage on or before October 1, 1992, except industrial activities owned or operated by a medium municipality, which had until May 17, 1993. Today's permit does not extend that application deadline. EPA intends that most of the facilities that will seek coverage under the final version of today's permit are: members of groups with approved applications; facilities that submitted a Notice of

Intent to be covered by EPA's baseline general permit and now wish to switch to coverage under today's permit; or have submitted a complete individual application but have not yet received an individual permit.

EPA may deny coverage under this permit and require submittal of an individual NPDES permit application based on a review of the completeness and/or content of the NOI or other information (e.g., Endangered Species Act compliance, National Historic Preservation Act Compliance, water quality information, compliance history, history of spills, etc.). Where EPA requires a discharger authorized under this general permit to apply for an individual NPDES permit (or an alternative general permit), EPA will notify the discharger in writing that a permit application (or different NOI) is required by an established deadline. Coverage under this industry general permit will automatically terminate if the discharger fails to submit the required permit application in a timely manner. Where the discharger does submit a requested permit application, coverage under this general permit will automatically terminate on the effective date of the issuance or denial of the individual NPDES permit or the alternative general permit as it applies to the individual permittee. Compliance deadlines are discussed in Part VI.H. of this fact sheet.

Municipal Separate Storm Sewer System Operator Notification

Operators of storm water discharges associated with industrial activity that discharge through a large or medium municipal separate storm sewer system or a municipal system designated by the Director,[4] must notify the municipal operator of the system receiving the discharge and submit a copy of their NOI to the municipal operator.

4. Notice of Termination

Where a discharger is able to eliminate the storm water discharges associated with industrial activity from a facility, the discharger may submit a Notice of Termination (NOT) form (or photocopy thereof) provided by the Director.

A copy of the NOT and instructions for completing the NOT are included in Addendum C. The NOT form requires the following information:

a. Name, mailing address, and location of the facility for which the notification is submitted. Where a street address for the site is not available, the location of the approximate center of the site must be described in terms of the latitude and longitude to the nearest 15 seconds, or the section, township and range to the nearest quarter;

b. The name, address and telephone number of the operator addressed by the Notice of Termination;

c. The NPDES permit number for the storm water discharge associated with industrial activity identified by the NOT;

d. An indication of whether the storm water discharges associated with industrial activity have been eliminated or the operator of the discharges has changed; and

e. The following certification:

I certify under penalty of law that all storm water discharges associated with industrial activity from the identified facility that are authorized by an NPDES general permit have been eliminated or that I am no longer the operator of the industrial activity. I understand that by submitting this Notice of Termination I am no longer authorized to discharge storm water associated with industrial activity under this general permit, and that discharging pollutants in storm water associated with industrial activity to waters of the United States is unlawful under the Clean Water Act where the discharge is not authorized by an NPDES permit. I also understand that the submittal of this notice of termination does not release an operator from liability for any violations of this permit or the Clean Water Act.

NOTs are to be sent to the Storm Water Notice of Termination (4203), 401 M Street, SW., Washington, DC 20460.

The NOT must be signed in accordance with the signatory requirements of 40 CFR 122.22. A complete description of these signatory requirements is provided in the instructions accompanying the NOT.

B. Special Conditions

The conditions of this permit have been designed to comply with the technology-based standards of the CWA (BAT/BCT). Based on a consideration of the appropriate factors for BAT and BCT requirements, and a consideration of the factors and options discussed in this fact sheet for controlling pollutants in storm water discharges associated with industrial activity, the general permit lists a set of tailored requirements for developing and implementing storm water pollution prevention plans, and for selected discharges, effluent limitations.[5]

Part VIII. of this fact sheet summarizes the options for controlling pollutants in storm water discharges associated with industrial activity. The permit includes numeric effluent limitations for coal pile runoff, contaminated runoff from fertilizer manufacturing facilities, runoff from asphalt emulsion manufacturing facilities, and material storage pile runoff located at cement manufacturing facilities or cement kilns.

For other discharges covered by the permit, the permit conditions reflect EPA's decision to identify a number of best management practices and traditional storm water management practices which prevent pollution in storm water discharges as the BAT/BCT level of control for the majority of storm water discharges covered by this permit. The permit conditions applicable to these discharges are not numeric effluent limitations, but rather are flexible requirements for developing and implementing site specific plans to minimize and control pollutants in storm water discharges associated with industrial activity. This approach is consistent with the approach used in the baseline general permits finalized on September 9, 1992 (57 FR 41236) and September 25, 1992 (57 FR 44438). In addition, today's general permit reflects information received through the group application process.

EPA is authorized under 40 CFR 122.44(k)(2) to impose BMPs in lieu of numeric effluent limitations in NPDES permits when the Agency finds numeric effluent limitations to be infeasible. EPA may also impose BMPs which are "reasonably necessary * * * to carry out the purposes of the Act" under 40 CFR 122.44(k)(3). Both of these standards for imposing BMPs were recognized in *NRDC* v. *Costle*, 568 F.2d 1369, 1380 (D.C. Cir. 1977). The conditions in the permit are issued under the authority of both of these regulatory provisions. The pollution prevention or BMP requirements in this permit operate as limitations on effluent discharges that reflect the application of BAT/BCT. This is because the BMPs identified require the use of source

[4] The terms large and medium municipal separate storm sewer systems (systems serving a population of 100,000 or more) are defined at 40 CFR 122.26(b)(4) and (7). Some of the cities and counties in which these systems are found are listed in Appendices F, G, H, and I to 40 CFR Part 122. Other municipal systems have been designated by EPA on a case-by-case basis or have brought into the program based upon the 1990 Census.

[5] Part I.C.2 of the general permit provides that facilities with storm water discharges associated with industrial activity which, based on an evaluation of site specific conditions, believe that the appropriate conditions of this permit do not adequately represent BAT and BCT requirements for the facility may submit to the Director an individual application (Form 1 and Form 2F). A detailed explanation of the reasons why the conditions of the available general permits do not adequately represent BAT and BCT requirements for the facility as well as any supporting documentation must be included.

control technologies which, in the context of this general permit, are the best available of the technologies economically achievable (or the equivalent BCT finding). See *NRDC* v. *EPA*, 822 F.2d 104, 122–23 (D.C. Cir. 1987) (EPA has substantial discretion to impose nonquantitative permit requirements pursuant to Section 402(a)(1)).

1. Prohibition of Non-storm Water Discharges

Today's general permit does not authorize non-storm water discharges that are mixed with storm water except as provided below. The only non-storm water discharges that are intended to be authorized under today's permit include discharges from fire fighting activities; fire hydrant flushings; potable water sources, including waterline flushings; irrigation drainage; lawn watering; routine external building washdown without detergents; pavement washwaters where spills or leaks of toxic or hazardous materials have not occurred (unless all spilled material has been removed) and where detergents are not used; air conditioning condensate; compressor condensate; springs; uncontaminated ground water; and foundation or footing drains where flows are not contaminated with process materials such as solvents that are combined with storm water discharges associated with industrial activity.

To be authorized under the general permit, these sources of non-storm water (except flows from fire fighting activities) must be identified in the storm water pollution prevention plan prepared for the facility. (Plans and other plan requirements are discussed in more detail below). Where such discharges occur, the plan must also identify and ensure the implementation of appropriate pollution prevention measures for the non-storm water component(s) of the discharge.

Today's permit does not require pollution prevention measures to be identified and implemented for non-storm water flows from fire-fighting activities because these flows will generally be unplanned emergency situations where it is necessary to take immediate action to protect the public.

The prohibition of unpermitted non-storm water discharges in this permit ensures that non-storm water discharges (except for those classes of non-storm water discharges that are conditionally authorized in Part III.A.2.b.) are not inadvertently authorized by this permit. Where a storm water discharge is mixed with non-storm water that is not authorized by today's general permit or another NPDES permit, the discharger should submit the appropriate application forms (Forms 1, 2C, and/or 2E) to gain permit coverage of the non-storm water portion of the discharge.

2. Releases of Reportable Quantities of Hazardous Substances and Oil

a. This general permit provides that the discharge of hazardous substances or oil from a facility must be eliminated or minimized in accordance with the storm water pollution plan developed for the facility. Where a permitted storm water discharge contains a hazardous substance or oil in an amount equal to or in excess of a reporting quantity established under 40 CFR Part 117, or 40 CFR Part 302 during a 24-hour period, the following actions must be taken:

(1) Any person in charge of the facility that discharges hazardous substances or oil is required to notify the National Response Center (NRC) (800–424–8802; in the Washington, DC, metropolitan area, 202–426–2675) in accordance with the requirements of 40 CFR Part 117, and 40 CFR Part 302 as soon as they have knowledge of the discharge.

(2) The storm water pollution prevention plan for the facility must be modified within 14 calendar days of knowledge of the release to provide a description of the release, an account of the circumstances leading to the release, and the date of the release. In addition, the plan must be reviewed to identify measures to prevent the reoccurrence of such releases and to respond to such releases, and it must be modified where appropriate.

(3) The permittee must also submit to EPA within 14 calendar days of knowledge of the release a written description of the release (including the type and estimate of the amount of material released), the date that such release occurred, the circumstances leading to the release, and steps to be taken to modify the pollution prevention plan for the facility.

b. Anticipated discharges containing a hazardous substance in an amount equal to or in excess of reporting quantities are those caused by events occurring within the scope of the relevant operating system. Facilities that have more than 1 anticipated discharge per year containing a hazardous substance in an amount equal to or in excess of a reportable quantity are required to:

(1) Submit notifications of the first release that occurs during a calendar year (or for the first year of this permit, after submittal of an NOI); and

(2) Provide a written description in the storm water pollution prevention plan of the dates on which such releases occurred, the type and estimate of the amount of material released, and the circumstances leading to the releases. In addition, the pollution prevention plan must address measures to minimize such releases.

c. Where a discharge of a hazardous substance or oil in excess of reporting quantities is caused by a non-storm water discharge (e.g., a spill of oil into a separate storm sewer), that discharge is not authorized by this permit and the discharger must report the discharge as required under 40 CFR Part 110, 40 CFR Part 117, or 40 CFR Part 302. In the event of a spill, the requirements of Section 311 of the CWA and other applicable provisions of Sections 301 and 402 of the CWA continue to apply. This approach is consistent with the requirements for reporting releases of hazardous substances and oil that make a clear distinction between hazardous substances typically found in storm water discharges and those associated with spills that are not considered part of a normal storm water discharge (see 40 CFR 117.12(d)(2)(i)).

3. Co-located Industrial Facilities

Today's general permit addresses storm water discharges from industrial activities co-located at an industrial facility described in the coverage section of the permit. Co-located industrial activities occur when activities being conducted onsite meet more than one of the descriptions in the coverage sections of Part XI. of this permit (e.g., a landfill at a wood treatment facility or a vehicle maintenance garage at an asphalt batching plant). Co-located industrial activities are authorized under today's general permit provided that the industrial facility complies with the pollution prevention plan and monitoring requirements for each co-located activity.

Authorizing co-located discharges allows industrial facilities to develop pollution prevention plans that fully address all industrial activities at the site. For example, if a wood treatment facility has a landfill, the pollution prevention plan requirements for the wood treatment facility will differ greatly from those needed for a landfill. Therefore, by authorizing co-located industrial activities, the wood treatment facility will develop a pollution prevention plan to meet the requirements addressing the storm water discharges from the wood treatment facility and the landfill. The facility is also subject to applicable monitoring requirements for each type of industrial activity as described in the applicable sections of the permit. By monitoring the discharges from the different industrial activities, the facility can better determine the effectiveness of the pollution prevention plan requirements for controlling storm water discharges from all activities.

C. Common Pollution Prevention Plan Requirements

All facilities intended to be covered by today's general permit for storm water discharges associated with industrial activity must prepare and implement a storm water pollution prevention plan. The storm water permit addresses pollution prevention plan requirements for a number of categories of industries. The following is a discussion of the common permit requirements for all industries; special requirements for storm water discharges associated with industrial activity through large and medium municipal separate storm sewer systems; special requirements for facilities subject to EPCRA Section 313 reporting requirements; and special requirements for facilities with outdoor salt storage piles. These are the permit requirements which apply to discharges associated with any of the industrial activities covered by today's permit. These common requirements may be amended or further clarified in the industry-specific pollution prevention plan requirements. Table 2 indicates the location of the industry-specific pollution prevention plans. These industry-specific requirements are additive for facilities where co-located industrial activities occur. For example, if a facility has both a sand and gravel mining operation and a ready mix concrete manufacturing operation, then that facility is subject to the pollution prevention plan requirements in both Part XI.E.3. and Part XI.J.3. of the permit.

TABLE 2.—STORM WATER POLLUTION PREVENTION PLAN REQUIREMENTS

Industrial activity	Fact sheet section describing PPP requirements	Permit section describing PPP requirements
Timber Products Facilities	VIII.A.7	XI.A.3.
Paper and Allied Products Manufacturing Facilities	VIII.B.5	XI.B.3.
Chemical and Allied Products Manufacturing Facilities	VIII.C.6	XI.C.4.
Asphalt Paving and Roofing Materials Manufacturers and Lubricant Manufacturers	VIII.D.4	XI.D.3.
Glass, Clay, Cement, Concrete, and Gypsum Product Manufacturing Facilities	VIII.E.5	XI.E.3.
Primary Metals Facilities	VIII.F.6	XI.F.3.
Metal Mining (Ore Mining and Dressing) Facilities	VIII.G.5	XI.G.3.
Coal Mines and Coal Mining-Related Facilities	VIII.H.4	XI.H.3.
Oil and Gas Extraction Facilities	VIII.I.5	XI.I.3.
Mineral Mining and Processing Facilities	VIII.J.4	XI.J.3.
Hazardous Waste Treatment, Storage, or Disposal Facilities	VIII.K.5	XI.K.3.
Landfills and Land Application Sites	VIII.L.5	XI.L.3.
Automobile Salvage Yards	VIII.M.5	XI.M.2.
Scrap and Waste Recycling Facilities	VIII.N.5	XI.N.3.
Steam Electric Power Generating Facilities, Including Coal Handling Areas	VIII.O.5	XI.O.3.
Vehicle Maintenance or Equipment Cleaning Areas at Motor Freight Transportation Facilities, Passenger Transportation Facilities, Petroleum Bulk Oil Stations and Terminals, Rail Transportation Facilities, and the United States Postal Service Transportation Facilities.	VIII.P.5	XI.P.3.
Vehicle Maintenance Areas and/or Equipment Cleaning Operations at Water Transportation Facilities.	VIII.Q.5	XI.Q.3.
Ship and Boat Building or Repairing Yards	VIII.R.6	XI.R.3.
Vehicle Maintenance Areas, Equipment Cleaning Areas, or Deicing Areas Located at Air Transportation Facilities.	VIII.S.4	XI.S.3.
Treatment Works	VIII.T.5	XI.T.3.
Food and Kindred Products Facilities	VIII.U.4	XI.U.3.
Textile Mills, Apparel, and Other Fabric Product Manufacturing Facilities	VIII.V.5	XI.V.3.
Wood and Metal Furniture and Fixture Manufacturing Facilities	VIII.W.4	XI.W.3.
Printing and Publishing Facilities	VIII.X.5	XI.X.3.
Rubber, Miscellaneous Plastic Products, and Miscellaneous Manufacturing Industries	VIII.Y.4	XI.Y.3.
Leather Tanning and Finishing Facilities	VIII.Z.5	XI.Z.3.
Fabricated Metal Products Industry	VIII.AA.3	XI.AA.3.
Facilities That Manufacture Transportation Equipment, Industrial, or Commercial Machinery.	VIII.AB.5	XI.AB.3.
Facilities That Manufacture Electronic and Electrical Equipment and Components, Photographic and Optical Goods.	VIII.AC.5	XI.AC.3.

The pollution prevention approach in today's general permit focuses on two major objectives: (1) to identify sources of pollution potentially affecting the quality of storm water discharges associated with industrial activity from the facility; and (2) to describe and ensure implementation of practices to minimize and control pollutants in storm water discharges associated with industrial activity from the facility and to ensure compliance with the terms and conditions of this permit.

The storm water pollution prevention plan requirements in the general permit are intended to facilitate a process whereby the operator of the industrial facility thoroughly evaluates potential pollution sources at the site and selects and implements appropriate measures designed to prevent or control the discharge of pollutants in storm water runoff. The process involves the following four steps: (1) Formation of a team of qualified plant personnel who will be responsible for preparing the plan and assisting the plant manager in its implementation; (2) assessment of potential storm water pollution sources; (3) selection and implementation of appropriate management practices and controls; and (4) periodic evaluation of the effectiveness of the plan to prevent storm water contamination and comply with the terms and conditions of this permit. The authorization to include best management practices in the permit to control or abate the discharge of pollutants is derived from 40 CFR 144.45(k).

EPA believes the pollution prevention approach is the most environmentally sound and cost-effective way to control the discharge of pollutants in storm water runoff from industrial facilities. This position is supported by the results of a comprehensive technical survey EPA completed in 1979.[6] The survey found that two classes of management practices are generally employed at industries to control the nonroutine discharge of pollutants from sources such as storm water runoff, drainage from raw material storage and waste disposal areas, and discharges from places where spills or leaks have occurred. The first class of management practices includes those that are low in cost, applicable to a broad class of industries and substances, and widely considered essential to a good pollution control program. Some examples of practices in this class are good housekeeping, employee training, and spill response and prevention procedures. The second class includes management practices that provide a second line of defense against the release of pollutants. This class addresses containment, mitigation, and cleanup. Since publication of the 1979 survey, EPA has imposed management practices and controls in NPDES permits on a case-by-case basis. The Agency also has continued to review the appropriateness and effectiveness of such practices,[7] as well as the techniques used to prevent and contain oil spills.[8] Experience with these practices and controls has shown that they can be used in permits to reduce pollutants in storm water discharges in a cost-effective manner. In keeping with both the present and previous administration's objective to attain environmental goals through pollution prevention, pollution prevention has been and continues to be the cornerstone of the NPDES Permitting program for storm water. EPA has developed guidance entitled "Storm Water Management for Industrial Activities: Developing Pollution Prevention Plans and Best Management Practices," September 1992, to assist permittees in developing and implementing pollution prevention measures.

1. Pollution Prevention Team

As a first step in the process of developing and implementing a storm water pollution prevention plan, permittees are required to identify a qualified individual or team of individuals to be responsible for developing the plan and assisting the facility or plant manager in its implementation. When selecting members of the team, the plant manager should draw on the expertise of all relevant departments within the plant to ensure that all aspects of plant operations are considered when the plan is developed. The plan must clearly describe the responsibilities of each team member as they relate to specific components of the plan. In addition to enhancing the quality of communication between team members and other personnel, clear delineation of responsibilities will ensure that every aspect of the plan is addressed by a specified individual or group of individuals. Pollution Prevention Teams may consist of one individual where appropriate (e.g., in certain small businesses with limited storm water pollution potential).

2. Description of Potential Pollution Sources

Each storm water pollution prevention plan must describe activities, materials, and physical features of the facility that may contribute significant amounts of pollutants to storm water runoff or, during periods of dry weather, result in pollutant discharges through the separate storm sewers or storm water drainage systems that drain the facility. This assessment of storm water pollution risk will support subsequent efforts to identify and set priorities for necessary changes in materials, materials management practices, or site features, as well as aid in the selection of appropriate structural and nonstructural control techniques. Some operators may find that significant amounts of pollutants are running or the facility property. Such operators should identify and address the contaminated runon in the storm wa pollution prevention plan. If the runc cannot be addressed or diverted by th permittee, the permitting authority should be notified. If necessary, the permitting authority may require the operator of the adjacent facility to obt a permit.

Part XI of the permit includes speci requirements for the various industry sectors covered by today's permit. Th storm water pollution prevention plar generally must describe the following elements:

a. Drainage. The plan must contain map of the site that shows the locatio of outfalls covered by the permit (or b other NPDES permits), the pattern of storm water drainage, an indication o the types of discharges contained in t drainage areas of the outfalls, structur features that control pollutants in runoff,[9] surface water bodies (includin wetlands), places where significant materials [10] are exposed to rainfall and runoff, and locations of major spills ar leaks that occurred in the 3 years prior to the date of the submission of a Noti of Intent (NOI) to be covered under thi permit. The map also must show areas where the following activities take place: fueling, vehicle and equipment maintenance and/or cleaning, loading and unloading, material storage (including tanks or other vessels used for liquid or waste storage), material processing, and waste disposal. For areas of the facility that generate storm water discharges with a reasonable potential to contain significant amoun of pollutants, the map must indicate t probable direction of storm water flow and the pollutants likely to be in the discharge. Flows with a significant potential to cause soil erosion also mu be identified. In order to increase the readability of the map, the inventory c the types of discharges contained in each outfall may be kept as an attachment to the site map.

b. Inventory of Exposed Materials. Facility operators are required to

[6] See "Storm Water Management for Industrial Activities," EPA, September 1992, EPA-832-R-92-006.

[7] For example, see "Best Management Practices: Useful Tools for Cleaning Up," Thron, H. Rogoshewski, P., 1982, Proceedings of the 1982 Hazardous Material Spills Conference: "The Chemical Industries' Approach to Spill Prevention," Thompson, C., Goodier, J. 1980, Proceedings of the 1980 National Conference of Control of Hazardous Materials Spills; a series of EPA memorandum entitled "Best Management Practices in NPDES Permits—Information Memorandum," 1983, 1985, 1986, 1987, 1988; Review of Emergency Systems: Report to Congress," EPA, 1988; and "Analysis of Implementing Permitting Activities for Storm Water Discharges Associated with Industrial Activity," EPA, 1991.

[8] See for example, "The Oil Spill Prevention, Control and Countermeasures Program Task Force Report," EPA, 1988; and "Guidance Manual for the Development of an Accidental Spill Prevention Program," prepared by SAIC for EPA, 1986.

[9] Nonstructural features such as grass swales ar vegetative buffer strips also should be shown.

[10] Significant materials include, but are not limited to the following: raw materials; fuels; solvents, detergents, and plastic pellets; finished materials, such as metallic products; raw materia used in food processing or production; hazardous substances designated under Section 101(14) of tr Comprehensive Environmental Response, Compensation and Liability Act (CERCLA); any chemical the facility is required to report pursuan to EPCRA Section 313; fertilizers; pesticides; and waste products, such as ashes, slag, and sludge th have the potential to be released with storm water discharges. (See 40 CFR 122.26(b)(8)).

carefully conduct an inspection of the site and related records to identify significant materials that are or may be exposed to storm water. The inventory must address materials that within 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit have been handled, stored, processed, treated, or disposed of in a manner to allow exposure to storm water. Findings of the inventory must be documented in detail in the pollution prevention plan. At a minimum, the plan must describe the method and location of onsite storage or disposal; practices used to minimize contact of materials with rainfall and runoff; existing structural and nonstructural controls that reduce pollutants in runoff; and any treatment the runoff receives before it is discharged to surface waters or a separate storm sewer system. The description must be updated whenever there is a significant change in the types or amounts of materials, or material management practices, that may affect the exposure of materials to storm water.

c. Significant Spills and Leaks. The plan must include a list of any significant spills and leaks of toxic or hazardous pollutants that occurred in the 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit. Significant spills include, but are not limited to, releases of oil or hazardous substances in excess of quantities that are reportable under Section 311 of CWA (see 40 CFR 110.10 and 40 CFR 117.21) or Section 102 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (see 40 CFR 302.4). Significant spills may also include releases of oil or hazardous substances that are not in excess of reporting requirements and releases of materials that are not classified as oil or a hazardous substance.

The listing should include a description of the causes of each spill or leak, the actions taken to respond to each release, and the actions taken to prevent similar such spills or leaks in the future. This effort will aid the facility operator as she or he examines existing spill prevention and response procedures and develops any additional procedures necessary to fulfill the requirements of Part XI. of this permit.

d. Non-storm Water Discharges. Each pollution prevention plan must include a certification, signed by an authorized individual, that discharges from the site have been tested or evaluated for the presence of non-storm water discharges. The certification must describe possible significant sources of non-storm water, the results of any test and/or evaluation conducted to detect such discharges, the test method or evaluation criteria used, the dates on which tests or evaluations were performed, and the onsite drainage points directly observed during the test or evaluation. Acceptable test or evaluation techniques include dye tests, television surveillance, observation of outfalls or other appropriate locations during dry weather, water balance calculations, and analysis of piping and drainage schematics.[11]

Except for flows that originate from fire fighting activities, sources of non-storm water that are specifically identified in the permit as being eligible for authorization under the general permit must be identified in the plan. Pollution prevention plans must identify and ensure the implementation of appropriate pollution prevention measures for the non-storm water discharge.

EPA recognizes that certification may not be feasible where facility personnel do not have access to an outfall, manhole, or other point of access to the conduit that ultimately receives the discharge. In such cases, the plan must describe why certification was not feasible. Permittees who are not able to certify that discharges have been tested or evaluated must notify the Director in accordance with Part XI. of the permit.

e. Sampling Data. Any existing data on the quality or quantity of storm water discharges from the facility must be described in the plan, including data collected for part 2 of the group application process. These data may be useful for locating areas that have contributed pollutants to storm water. The description should include a discussion of the methods used to collect and analyze the data. Sample collection points should be identified in the plan and shown on the site map.

f. Summary of Potential Pollutant Sources. The description of potential pollution sources culminates in a narrative assessment of the risk potential that sources of pollution pose to storm water quality. This assessment should clearly point to activities, materials, and physical features of the facility that have a reasonable potential to contribute significant amounts of pollutants to storm water. Any such activities, materials, or features must be addressed by the measures and controls subsequently described in the plan. In conducting the assessment, the facility operator must consider the following activities: loading and unloading operations; outdoor storage activities; outdoor manufacturing or processing activities; significant dust or particulate generating processes; and onsite waste disposal practices. The assessment must list any significant pollution sources at the site and identify the pollutant parameter or parameters (i.e., biochemical oxygen demand, suspended solids, etc.) associated with each source.

[11] In general, smoke tests should not be used for evaluating the discharge of non-storm water to a separate storm sewer as many sources of non-storm water typically pass through a trap that would limit the effectiveness of the smoke test.

3. Measures and Controls

Following completion of the source identification and assessment phase, the permit requires the permittee to evaluate, select, and describe the pollution prevention measures, best management practices (BMPs), and other controls that will be implemented at the facility. BMPs include processes, procedures, schedules of activities, prohibitions on practices, and other management practices that prevent or reduce the discharge of pollutants in storm water runoff.

EPA emphasizes the implementation of pollution prevention measures and BMPs that reduce possible pollutant discharges at the source. Source reduction measures include, among others, preventive maintenance, chemical substitution, spill prevention, good housekeeping, training, and proper materials management. Where such practices are not appropriate to a particular source or do not effectively reduce pollutant discharges, EPA supports the use of source control measures and BMPs such as material segregation or covering, water diversion, and dust control. Like source reduction measures, source control measures and BMPs are intended to keep pollutants out of storm water. The remaining classes of BMPs, which involve recycling or treatment of storm water, allow the reuse of storm water or attempt to lower pollutant concentrations prior to discharge.

The pollution prevention plan must discuss the reasons each selected control or practice is appropriate for the facility and how each will address one or more of the potential pollution sources identified in the plan. The plan also must include a schedule specifying the time or times during which each control or practice will be implemented. In addition, the plan should discuss ways in which the controls and practices relate to one another and, when taken as a whole, produce an integrated and consistent approach for preventing or controlling potential storm water contamination problems. The permit requirements included for the various industry sectors in Part XI of today's permit generally require that the portion of the plan that describes the measures and controls address the following minimum components.

When "minimize/reduce" is used relative to pollution prevention plan measures, EPA means to consider and implement best management practices that will result in an improvement over the baseline conditions as it relates to the levels of pollutants identified in storm water discharges with due consideration to economic feasibility and effectiveness.

a. Good Housekeeping. Good housekeeping involves using practical, cost-effective methods to identify ways to maintain a clean and orderly facility and keep contaminants out of separate storm sewers. It includes establishing protocols to reduce the possibility of mishandling chemicals or equipment and training employees in good housekeeping techniques. These protocols must be described in the plan and communicated to appropriate plant personnel.

b. Preventive Maintenance. Permittees must develop a preventive maintenance program that involves regular inspection and maintenance of storm water management devices and other equipment and systems. The program description should identify the devices, equipment, and systems that will be inspected; provide a schedule for inspections and tests; and address appropriate adjustment, cleaning, repair, or replacement of devices, equipment, and systems. For storm water management devices such as catch basins and oil/water separators, the preventive maintenance program should provide for periodic removal of debris to ensure that the devices are operating efficiently. For other equipment and systems, the program should reveal and enable the correction of conditions that could cause breakdowns or failures that may result in the release of pollutants.

c. Spill Prevention and Response Procedures. Based on an assessment of possible spill scenarios, permittees must specify appropriate material handling procedures, storage requirements, containment or diversion equipment, and spill cleanup procedures that will minimize the potential for spills and in the event of a spill enable proper and timely response. Areas and activities that typically pose a high risk for spills include loading and unloading areas, storage areas, process activities, and waste disposal activities. These activities and areas, and their accompanying drainage points, must be described in the plan. For a spill prevention and response program to be effective, employees should clearly understand the proper procedures and requirements and have the equipment necessary to respond to spills.

d. Inspections. In addition to the comprehensive site evaluation, facilities are required to conduct periodic inspections of designated equipment and areas of the facility. Industry-specific requirements for such inspections, if any, are discussed in Section VIII. of this fact sheet. When required, qualified personnel must be identified to conduct inspections at appropriate intervals specified in the plan. A set of tracking or follow-up procedures must be used to ensure that appropriate actions are taken in response to the inspections. Records of inspections must be maintained. These periodic inspections are different from the comprehensive site evaluation, even though the former may be incorporated into the latter. Equipment, area, or other inspections are typically visual and are normally conducted on a regular basis, e.g., daily inspections of loading areas. Requirements for such periodic inspections are specific to each industrial sector in today's permit, whereas the comprehensive site compliance evaluation is required of all industrial sectors. Area inspections help ensure that storm water pollution prevention measures (e.g., BMPs) are operating and properly maintained on a regular basis. The comprehensive site evaluation is intended to provide an overview of the entire facility's pollution prevention activities. Refer to Part VI.C.4. below for more information on the comprehensive site evaluation.

e. Employee Training. The pollution prevention plan must describe a program for informing personnel at all levels of responsibility of the components and goals of the storm water pollution prevention plan. The training program should address topics such as good housekeeping, materials management, and spill response procedures. Where appropriate, contractor personnel also must be trained in relevant aspects of storm water pollution prevention. A schedule for conducting training must be provided in the plan. Several sections in Part XI. of today's permit specify a minimum frequency for training of once per year. Others indicate that training is to be conducted at an appropriate interval. EPA recommends that facilities conduct training annually at a minimum. However, more frequent training may be necessary at facilities with high turnover of employees or where employee participation is essential to the storm water pollution prevention plan.

f. Recordkeeping and Internal Reporting Procedures. The pollution prevention plan must describe procedures for developing and retaining records on the status and effectiveness of plan implementation. At a minimum records must address spills, monitoring and inspection and maintenance activities. The plan also must describe a system that enables timely reporting o storm water management-related information to appropriate plant personnel.

g. Sediment and Erosion Control. The pollution prevention plan must identify areas that, due to topography, activities, soils, cover materials, or other factors have a high potential for significant soil erosion. The plan must identify measures that will be implemented to limit erosion in these areas.

h. Management of Runoff. The plan must contain a narrative evaluation of the appropriateness of traditional storm water management practices (i.e., practices other than those that control pollutant sources) that divert, infiltrate, reuse, or otherwise manage storm water runoff so as to reduce the discharge of pollutants. Appropriate measures may include, among others, vegetative swales, collection and reuse of storm water, inlet controls, snow management infiltration devices, and wet detention/retention basins.

Based on the results of the evaluation, the plan must identify practices that the permittee determines are reasonable and appropriate for the facility. The plan also should describe the particular pollutant source area or activity to be controlled by each storm water management practice. Reasonable and appropriate practices must be implemented and maintained according to the provisions prescribed in the plan.

In selecting storm water management measures, it is important to consider the potential effects of each method on other water resources, such as ground water. Although storm water pollution prevention plans primarily focus on storm water management, facilities mus also consider potential ground water pollution problems and take appropriat steps to avoid adversely impacting ground water quality. For example, if the water table is unusually high in an area, an infiltration pond may contaminate a ground water source unless special preventive measures are taken. Under EPA's July 1991 Ground Water Protection Strategy, States are encouraged to develop Comprehensive State Ground Water Protection Programs (CSGWPP). Efforts to control storm water should be compatible with State ground water objectives as reflected in CSGWPPs.

4. Comprehensive Site Compliance Evaluation

The permit requires that the storm water pollution prevention plan describe the scope and content of the comprehensive site evaluations that qualified personnel will conduct to (1) confirm the accuracy of the description of potential pollution sources contained in the plan, (2) determine the effectiveness of the plan, and (3) assess compliance with the terms and conditions of the permit. Note that the comprehensive site evaluations are not the same as periodic or other inspections described for certain industries under Part VI.C.3.d of this fact sheet. However, in the instances when frequencies of inspections and the comprehensive site compliance evaluation overlap they may be combined allowing for efficiency, as long as the requirements for both types of inspections are met. The plan must indicate the frequency of comprehensive evaluations which must be at least once a year, except where comprehensive site evaluations are shown in the plan to be impractical for inactive mining sites, due to remote location and inaccessibility. [12] The individual or individuals who will conduct the comprehensive site evaluation must be identified in the plan and should be members of the pollution prevention team. Material handling and storage areas and other potential sources of pollution must be visually inspected for evidence of actual or potential pollutant discharges to the drainage system. Inspectors also must observe erosion controls and structural storm water management devices to ensure that each is operating correctly. Equipment needed to implement the pollution prevention plan, such as that used during spill response activities, must be inspected to confirm that it is in proper working order.

The results of each comprehensive site evaluation must be documented in a report signed by an authorized company official. The report must describe the scope of the comprehensive site evaluation, the personnel making the comprehensive site evaluation, the date(s) of the comprehensive site evaluation, and any major observations relating to implementation of the storm water pollution prevention plan. Comprehensive site evaluation reports must be retained for at least 3 years after the date of the evaluation. Based on the results of each comprehensive site evaluation, the description in the plan of potential pollution sources and measures and controls must be revised as appropriate within 2 weeks after each comprehensive site evaluation, unless indicated otherwise in Section XI of the permit. Changes in procedural operations must be implemented on the site in a timely manner for non-structural measures and controls not more than 12 weeks after completion of the comprehensive site evaluation. Procedural changes that require construction of structural measures and controls are allowed up to 3 years for implementation. In both instances, an extension may be requested from the Director.

D. Special Requirements

1. Special Requirements for Storm Water Discharges Associated With Industrial Activity Through Large and Medium Municipal Separate Storm Sewer Systems

Permittees that discharge storm water associated with industrial activity through large or medium municipal separate storm sewer systems [13] are required to submit notification of the discharge to the operator of the municipal separate storm sewer system. A list of these systems is provided in Addendum D of today's notice.

Facilities covered by this permit must comply with applicable requirements in municipal storm water management programs developed under NPDES permits issued for the discharge of the municipal separate storm sewer system that receives the facility's discharge, provided the discharger has been notified of such conditions. In addition, permittees that discharge storm water associated with industrial activity through a large or medium municipal separate storm sewer system must make their pollution prevention plans available to the municipal operator of the system upon request by the municipal operator.

2. Special Requirements for Storm Water Discharges Associated With Industrial Activity From Facilities Subject to EPCRA Section 313 Requirements

Today's permit contains special requirements for certain permittees subject to reporting requirements under Section 313 of the EPCRA (also known as Title III of the Superfund Amendments and Reauthorization Act (SARA)). EPCRA Section 313 requires operators of certain facilities that manufacture (including import), process, or otherwise use listed toxic chemicals to report annually their releases of those chemicals to any environmental media. Listed toxic chemicals include more than 500 chemicals and chemical classes listed at 40 CFR Part 372 (including the recently added chemicals published November 30, 1994).

The criteria for facilities that must report under Section 313 are given at 40 CFR 372.22. A facility is subject to the annual reporting provisions of Section 313 if it meets all three of the following criteria for a calendar year: it is included in SIC codes 20 through 39; it has 10 or more full-time employees; and it manufactures (including imports), processes, or otherwise uses a chemical listed in 40 CFR 372.65 in amounts greater than the "threshold" quantities specified in 40 CFR 372.25.

There are more than 300 individually listed Section 313 chemicals, as well as 20 categories of Toxic Release Inventory (TRI) chemicals for which reporting is required. EPA has the authority to add to and delete from this list. The Agency has identified approximately 175 chemicals that it is classifying for the purposes of this general permit as "Section 313 water priority chemicals." For the purposes of this permit, Section 313 water priority chemicals are defined as chemicals or chemical categories that (1) are listed at 40 CFR 372.65 pursuant to EPCRA Section 313; (2) are manufactured, processed, or otherwise used at or above threshold levels at a facility subject to EPCRA Section 313 reporting requirements; and (3) meet at least one of the following criteria: (i) are listed in Appendix D of 40 CFR Part 122 on either Table II (organic priority pollutants), Table III (certain metals, cyanides, and phenols), or Table V (certain toxic pollutants and hazardous substances); (ii) are listed as a hazardous substance pursuant to Section 311(b)(2)(A) of the CWA at 40 CFR 116.4; or (iii) are pollutants for which EPA has published acute or chronic toxicity criteria. A list of the water priority chemicals is provided in Addendum F to today's notice. In today's permit, EPA is not extending the special requirements to facilities that store liquid chemicals in above-ground tanks or handle liquid chemicals in areas exposed to precipitation if such facilities are not subject to EPCRA Section 313 reporting requirements.

[12] Where annual site inspections are shown in the plan to be impractical for inactive mining sites, due to remote location and inaccessibility, site inspections must be conducted at least once every 3 years.

[13] Large and medium municipal separate storm sewer systems are systems located in an incorporated city with a population of 100,000 or more, or in a county identified as having a large or medium system (see 40 CFR 122.26(b) (4) and (7) and Appendices F through I to Part 122). A list of these municipalities is provided in Addendum D to today's notice.

a. Summary of Special Requirements. The special requirements in today's permit for facilities subject to reporting requirements under EPCRA Section 313 for a water priority chemical, except those that are handled and stored only in gaseous or non-soluble liquids or solids (at atmospheric pressure and temperature) forms (see Part VI.D.2.c below), state that storm water pollution prevention plans, in addition to the baseline requirements for plans, must contain special provisions addressing areas where Section 313 water priority chemicals are stored, processed, or otherwise handled. These requirements reflect the Best Available Technology for controlling discharges of water priority chemicals in storm water. The permit provides that appropriate containment, drainage control, and/or diversionary structures must be provided for such areas. An exemption from the special provisions for Section 313 facilities will be granted if the facility can certify in the pollution prevention plan that all water priority chemicals handled or used are gaseous or non-soluble liquids or solids (at atmospheric pressure and temperature). At a minimum, one of the following preventive systems or its equivalent must be used: curbing, culverting, gutters, sewers, or other forms of drainage control to prevent or minimize the potential for storm water runon to come into contact with significant sources of pollutants; or roofs, covers, or other forms of appropriate protection to prevent storage piles from exposure to storm water and wind.

In addition, the permit establishes requirements for priority areas of the facility. Priority areas of the facility include the following: liquid storage areas where storm water comes into contact with any equipment, tank, container, or other vessel used for Section 313 water priority chemicals; material storage areas for Section 313 water priority chemicals other than liquids; truck and rail car loading and unloading areas for liquid Section 313 water priority chemicals; and areas where Section 313 water priority chemicals are transferred, processed, or otherwise handled.

The permit provides that site runoff from other industrial areas of the facility that may contain Section 313 water priority chemicals or spills of Section 313 water priority chemicals must incorporate the necessary drainage or other control features to prevent the discharge of spilled or improperly disposed material and to ensure the mitigation of pollutants in runoff or leachate. The permit also establishes special requirements for preventive maintenance and good housekeeping, facility security, and employee training.

In the proposed permit, EPA proposed to require facilities subject to EPCRA Section 313 requirements to have a Registered Professional Engineer (PE) certify their pollution prevention plans every 3 years. However, in response to commentors' concerns, EPA has revised the permit to eliminate the PE certification requirement. Instead, the permit now requires facilities subject to the special requirements to satisfy the pollution prevention plan signature requirements in Part IV.B.1. of the permit. EPA agrees with commentors that the operator is the most appropriate person to perform the certification. In addition, instead of certifying the plan every 3 years, facilities subject to EPCRA Section 313 requirements must amend the pollution prevention plan only when significant modifications are made to the facility, such as the addition of material handling areas or chemical storage units.

b. Requirements for Priority Areas. The permit provides that drainage from priority areas should be restrained by valves or other positive means to prevent the discharge of a spill or other excessive leakage of Section 313 water priority chemicals. Where containment units are employed, such units may be emptied by pumps or ejectors; however, these must be manually activated. Flapper-type drain valves must not be used to drain containment areas, as these will not effectively control spills. Valves used for the drainage of containment areas should, as far as is practical, be of manual, open-and-closed design. If facility drainage does not meet these requirements, the final discharge conveyance of all in-facility storm sewers must be equipped to be equivalent with a diversion system that could, in the event of an uncontrolled spill of Section 313 water priority chemicals, return the spilled material or contaminated storm water to the facility. Records must be kept of the frequency and estimated volume (in gallons) of discharges from containment areas.

Additional special requirements are related to the types of industrial activities that occur within the priority area. These requirements are summarized below:

(1) Liquid Storage Areas. Where storm water comes into contact with any equipment, tank, container, or other vessel used for Section 313 water priority chemicals, the material and construction of tanks or containers used for the storage of a Section 313 water priority chemical must be compatible with the material stored and conditions of storage, such as pressure and temperature. Liquid storage areas for Section 313 water priority chemicals must be operated to minimize discharges of Section 313 chemicals. Appropriate measures to minimize discharges of Section 313 chemicals may include secondary containment provided for at least the entire contents of the largest single tank plus sufficient freeboard to allow for precipitation, a strong spill contingency and integrity testing plan, and/or other equivalent measures. A strong spill contingency plan would typically contain, at a minimum, a description of response plans, personnel needs, and methods of mechanical containment (such as use of sorbents, booms, collection devices, etc.), steps to taken for removal of spill chemicals or materials, and procedures to ensure access to and availability of sorbents and other equipment. The testing component of the plan would provide for conducting integrity testing of storage tanks at set intervals such as once every 5 years, and conducting integrity and leak testing of valves and piping at a minimum frequency, such as once per year. In addition, a strong plan would include a written and actual commitment of manpower, equipment and materials required to comply with the permit and to expeditiously control and remove any quantity of spilled or leaked chemicals that may result in a toxic discharge.

(2) Other Material Storage Areas. Material storage areas for Section 313 water priority chemicals other than liquids that are subject to runoff, leaching, or wind must incorporate drainage or other control features to minimize the discharge of Section 313 water priority chemicals by reducing storm water contact with Section 313 water priority chemicals.

(3) Truck and Rail Car Loading and Unloading Areas. Truck and rail car loading and unloading areas for liquid Section 313 water priority chemicals must be operated to minimize discharges of Section 313 water priority chemicals. Appropriate measures to minimize discharges of Section 313 chemicals may include the placement and maintenance of drip pans (including the proper disposal of materials collected in the drip pans) where spillage may occur (such as hose connections, hose reels, and filler nozzles) when making and breaking hose connections; a strong spill contingency and integrity testing plan; and/or other equivalent measures.

(4) Other Transfer, Process, or Handling Areas. Processing equipment and materials handling equipment must be operated to minimize discharges of Section 313 water priority chemicals.

Materials used in piping and equipment must be compatible with the substances handled. Drainage from process and materials handling areas must minimize storm water contact with Section 313 water priority chemicals. Additional protection such as covers or guards to prevent exposure to wind, spraying or releases from pressure relief vents to prevent a discharge of Section 313 water priority chemicals to the drainage system, and overhangs or door skirts to enclose trailer ends at truck loading/unloading docks must be provided as appropriate. Visual inspections or leak tests must be provided for overhead piping conveying Section 313 water priority chemicals without secondary containment.

c. Today's permit allows facilities to provide a certification, signed in accordance with Part VII.G. (signatory requirements) of this permit, that all Section 313 water priority chemicals handled and/or stored onsite are only in gaseous or non-soluble liquid or solid (at atmospheric pressure and temperature) forms in lieu of the additional requirements in Part VI.E.2 of today's permit. By allowing such a certification, EPA hopes to limit the application of the special requirements Part IV.E.2. of the permit to those facilitios with 313 water priority chemicals that truly have the potential to contaminate storm water discharges associated with industrial activity.

3. Special Requirements for Storm Water Discharges Associated With Industrial Activity From Salt Storage Facilities

Today's general permit contains special requirements for storm water discharges associated with industrial activity from salt storage facilities. Storage piles of salt used for deicing or other commercial or industrial purposes must be enclosed or covered to prevent exposure to precipitation, except for exposure resulting from adding or removing materials from the pile. This requirement only applies to runoff from storage piles discharged to waters of the United States. Facilities that collect all of the runoff from their salt piles and reuse it in their processes or discharge it subject to a separate NPDES permit do not need to enclose or cover their piles. Permittees must comply with this requirement as expeditiously as practicable, but in no event later than 3 years from the date of permit issuance.

These special requirements have been included in today's permit based on human health and aquatic effects resulting from storm water runoff from salt storage piles compounded with the prevalence of salt storage piles across the United States.

4. Consistency With Other Plans

Storm water pollution prevention plans may reference the existence of other plans for Spill Prevention Control and Countermeasure (SPCC) plans developed for the facility under Section 311 of the CWA or Best Management Practices (BMP) Programs otherwise required by an NPDES permit for the facility as long as such requirement is incorporated into the storm water pollution prevention plan.

E. Monitoring and Reporting Requirements

The permit contains three general types of monitoring requirements: analytical monitoring or chemical monitoring; compliance monitoring for effluent guidelines compliance, and visual examinations of storm water discharges. This section provides a general description of each of these types of monitoring. Actual monitoring requirements for a given facility under the permit will vary depending upon the industrial activities that occur at a facility and the criteria for determining monitoring used to develop the permit. Table 3 lists the sections of the permit and of this fact sheet that describe the monitoring requirements as they apply to the specific industrial activities eligible for coverage under the permit. These are minimum monitoring requirements and if a permittee so chooses, he may conduct additional sampling to acquire more data to improve the statistical validity of the results. Through increased analytical or visual monitoring the permittee may be able to better ascertain the effectiveness of their pollution prevention plan.

Analytical monitoring requirements involve laboratory chemical analyses of samples collected by the permittee. The results of the analytical monitoring are quantitative concentration values for different pollutants, which can be easily compared to the results from other sampling events, other facilities, or to National benchmarks. Section VI.E.1. describes the analytical monitoring requirements and the process and criteria by which an industry sector or subsector was selected for analytical monitoring. Compliance monitoring requirements are imposed under today's permit to insure that discharges subject to numerical effluent limitations under the storm water effluent limitations guidelines are in compliance with those limitations. The compliance monitoring requirements are explained in Section VI.E.2.

Visual examinations of storm water discharges are the least burdensome type of monitoring requirement under the permit. Almost all of the industrial activities are required to perform visual examinations of their storm water discharges when they are occurring on a quarterly basis. Visual examinations are described in Section VI.E.8.

TABLE 3.—STORM WATER MONITORING REQUIREMENTS

Industrial activity	Section of fact sheet describing monitoring requirements	Permit section describing monitoring requirements
Timber Products Facilities*	VIII.A.8	XI.A.5.
Paper and Allied Products Manufacturing Facilities*	VIII.B.7	XI.B.5.
Chemical and Allied Products Manufacturing Facilities*	VIII.C.8	XI.C.5.
Asphalt Paving and Roofing Materials Manufacturers and Lubricant Manufacturers*	VIII.D.5	XI.D.5.
Glass, Clay, Cement, Concrete, and Gypsum Product Manufacturing Facilities*	VIII.E.7	XI.E.5.
Primary Metals Facilities*	VIII.F.7	XI.F.5.
Metal Mining (Ore Mining and Dressing) Facilities*	VIII.G.8	XI.G.5.
Coal Mines and Coal Mining-Related Facilities*	VIII.H.6	XI.H.5.
Oil and Gas Extraction Facilities*	VIII.I.7	XI.I.5.
Mineral Mining and Processing Facilities*	VIII.J.6	XI.J.5.
Hazardous Waste Treatment, Storage, or Disposal Facilities*	VIII.K.7	XI.K.5.
Landfills and Land Application Sites*	VIII.L6	XI.L5.

TABLE 3.—STORM WATER MONITORING REQUIREMENTS—Continued

Industrial activity	Section of fact sheet describing monitoring requirements	Permit section describing monitoring requirements
Automobile Salvage Yards*	VIII.M.6	XI.M.5.
Scrap and Waste Recycling Facilities*	VIII.N.6	XI.N.5.
Steam Electric Power Generating Facilities, Including Coal Handling Areas*	VIII.O.6	XI.O.5.
Vehicle Maintenance or Equipment Cleaning Areas at Motor Freight Transportation Facilities, Passenger Transportation Facilities, Petroleum Bulk Oil Stations and Terminals, Rail Transportation Facilities, and the United States Postal Service Transportation Facilities.	VIII.P.6	XI.P.5
Vehicle Maintenance Areas and/or Equipment Cleaning Operations at Water Transportation Facilities*	VIII.Q.6	XI.Q.5.
Ship and Boat Building or Repairing Yards	VIII.R.6	XI.R.5.
Vehicle Maintenance Areas, Equipment Cleaning Areas, or Deicing Areas Located at Air Transportation Facilities*.	VIII.S.6	XI.S.5.
Treatment Works*	VIII.T.6	XI.T.5.
Food and Kindred Products Facilities*	VIII.U.5	XI.U.5.
Textile Mills, Apparel, and Other Fabric Product Manufacturing Facilities*	VIII.V.6	XI.V.5.
Wood and Metal Furniture and Fixture Manufacturing Facilities	VIII.W.5	XI.W.5.
Printing and Publishing Facilities	VIII.X.7	XI.X.5.
Rubber, Miscellaneous Plastic Products, and Miscellaneous Manufacturing Industries*	VIII.Y.7	XI.Y.5.
Leather Tanning and Finishing Facilities	VIII.Z.7	XI.Z.5.
Fabricated Metal Products Industry*	VIII.AA.7	XI.AA.5.
Facilities That Manufacture Transportation Equipment, Industrial, or Commercial Machinery	VIII.AB.7	XI.AB.5.
Facilities That Manufacture Electronic and Electrical Equipment and Components, Photographic and Optical Goods.	VIII.AC.7	XI.AC.5.

* Denotes a sector that contains analytical monitoring requirements for an entire sector or a subsector.

1. Analytical Monitoring Requirements.

Today's permit requires analytical monitoring for discharges from certain classes of industrial facilities. EPA believes that industries may reduce the level of pollutants in storm water runoff from their sites through the development and proper implementation of a storm water pollution prevention plan discussed in today's permit. Analytical monitoring is a means by which to measure the concentration of a pollutant in a storm water discharge. Analytical results are quantitative and therefore can be used to compare results from discharge to discharge and to quantify the improvement in storm water quality attributable to the storm water pollution prevention plan, or to identify a pollutant that is not being successfully controlled by the plan. EPA realizes there are greater cost burdens associated with analytical monitoring in comparison to visual examinations. Today's permit only requires analytical monitoring for the industry sectors or subsectors that demonstrated a potential to discharge pollutants at concentrations of concern.

To determine the industry sectors and subsectors that would be subject to analytical monitoring requirements contained in the sections listed in Table 3, EPA reviewed the data submitted in the group application process. First, EPA divided the Part 1 and Part 2 application data by the industry sectors listed in Table 3. Where a sector was found to contain a wide range of industrial activities or potential pollutant sources, it was further subdivided into the industry subsectors listed in Table 4. Next, EPA reviewed the information submitted in Part 1 of the group applications regarding the industrial activities, significant materials exposed to storm water, and the material management measures employed. This information helped identify potential pollutants that may be present in the storm water discharges. Then, EPA entered into a database, the sampling data submitted in Part 2 of the group applications. That data was arrayed according to industrial sector and subsector for the purposes of determining when analytical monitoring would be appropriate. Data received by EPA prior to January 1, 1993 (three months after the application deadline) were entered into EPA's database. Some additional data that was submitted even after January 1, 1993 was also entered into the database to bolster the data set for some sectors or subsectors (e.g., the auto salvage industry). All data submitted even later by group applicants which was not loaded into the database was reviewed by EPA during development of the permit. EPA notes that preliminary copies of the database were distributed to the public upon request in advance of a complete screening of the quality of the data set. These copies of the database contained a variety of errors that were screened and removed prior to EPA statistical analysis and evaluation of the results. The results of the statistical analyses are presented in the appropriate section of the fact sheet referenced in Table 3.

TABLE 4.—SECTOR/SUBSECTOR DIVISION OF GROUP APPLICANTS FOR ANALYSES OF SAMPLING DATA

Subsector	SIC code	Activity represented
		Sector A. Timber Products
1*	2421	General Sawmills and Planning Mills.
2	2491	Wood Preserving.
3*	2411	Log Storage and Handling.
4*	2426	Hardwood Dimension and Flooring Mills.

TABLE 4.—SECTOR/SUBSECTOR DIVISION OF GROUP APPLICANTS FOR ANALYSES OF SAMPLING DATA—Continued

Subsector	SIC code	Activity represented
	2429	Special Product Sawmills, Not Elsewhere Classified.
	243X	Millwork, Veneer, Plywood, and Structural Wood.
	244X	Wood Containers.
	245X	Wood Buildings and Mobile Homes.
	2493	Reconstituted Wood Products.
	2499	Wood Products, Not Elsewhere Classified.
Sector B. Paper and Allied Products Manufacturing		
1	261X	Pulp Mills.
2	262X	Paper Mills.
3*	263X	Paperboard Mills.
4	265X	Paperboard Containers and Boxes.
5	267X	Converted Paper and Paperboard Products, Except Containers and Boxes.
Sector C. Chemical and Allied Products Manufacturing.		
1*	281X	Industrial Inorganic Chemicals.
2*	282X	Plastics Materials and Synthetic Resins, Synthetic Rubber, Cellulosic and Other Manmade Fibers Except Glass.
3	283X	Drugs.
4*	284X	Soaps, Detergents, and Cleaning Preparations; Perfumes, Cosmetics, and Other Toilet Preparations.
5	285X	Paints, Varnishes, Lacquers, Enamels, and Allied Products.
6	286X	Industrial Organic Chemicals.
7*	287X	Agricultural Chemicals.
8	289X	Miscellaneous Chemical Products.
Sector D. Asphalt Paving and Roofing Materials Manufacturers and Lubricant Manufacturers		
1*	295X	Asphalt Paving and Roofing Materials.
2	299X	Miscellaneous Products of Petroleum and Coal.
Sector E. Glass, Clay, Cement, Concrete, and Gypsum Product Manufacturing		
1	321X	Flat Glass.
	322X	Glass and Glassware, Pressed or Blown.
	323X	Glass Products Made of Purchased Glass.
2	324X	Hydraulic Cement.
3*	325X	Structural Clay Products.
	326X	Pottery and Related Products.
	3297	Non-Clay Refractories.
4*	327X	Concrete, Gypsum and Plaster Products.
	3295	Minerals and Earth's, Ground, or Otherwise Treated.
Sector F. Primary Metals		
1*	331X	Steel Works, Blast Furnaces, and Rolling and Finishing Mills.
2*	332X	Iron and Steel Foundries.
3	333X	Primary Smelting and Refining of Nonferrous Metals.
4	334X	Secondary Smelting and Refining of Nonferrous Metals.
5*	335X	Rolling, Drawing, and Extruding of Nonferrous Metals.
6*	336X	Nonferrous Foundries (Castings).
7	339X	Miscellaneous Primary Metal Products.
Sector G. Metal Mining (Ore Mining and Dressing)		
1	101X	Iron Ores.
2*	102X	Copper Ores.
3	103X	Lead and Zinc Ores.
4	104X	Gold and Silver Ores.
5	106X	Ferroalloy Ores, Except Vanadium.
6	108X	Metal Mining Services.
7	109X	Miscellaneous Metal Ores.
Sector H. Coal Mines and Coal Mining-Related Facilities		
NA*	12XX	Coal Mines and Coal Mining-Related Facilities.

TABLE 4.—SECTOR/SUBSECTOR DIVISION OF GROUP APPLICANTS FOR ANALYSES OF SAMPLING DATA—Continued

Subsector	SIC code	Activity represented
		Sector I. Oil and Gas Extraction
1*	131X	Crude Petroleum and Natural Gas.
2	132X	Natural Gas Liquids.
3*	138X	Oil and Gas Field Services.
		Sector J. Mineral Mining and Dressing
1*	141X	Dimension Stone.
	142X	Crushed and Broken Stone, Including Rip Rap.
	148X	Nonmetallic Minerals, Except Fuels.
2*	144X	Sand and Gravel.
3	145X	Clay, Ceramic, and Refractory Materials.
4	147X	Chemical and Fertilizer Mineral Mining.
		Sector K. Hazardous Waste Treatment Storage or Disposal Facilities
NA*	NA	Hazardous Waste Treatment Storage or Disposal.
		Sector L. Landfills and Land Application Sites
NA*	NA	Landfills and Land Application Sites.
		Sector M. Automobile Salvage Yards
NA*	5015	Automobile Salvage Yards.
		Sector N. Scrap Recycling Facilities
NA*	5093	Scrap Recycling Facilities.
		Sector O. Steam Electric Generating Facilities
NA*	NA	Steam Electric Generating Facilities.
		Sector P. Land Transportation
1	40XX	Railroad Transportation.
2	41XX	Local and Highway Passenger Transportation.
3	42XX	Motor Freight Transportation and Warehousing.
4	43XX	United States Postal Service.
5	5171	Petroleum Bulk Stations and Terminals.
		Sector Q. Water Transportation
NA*	44XX	Water Transportation.
		Sector R. Ship and Boat Building or Repairing Yards
NA	373X	Ship and Boat Building or Repairing Yards.
		Sector S. Air Transportation Facilities
NA*	45XX	Air Transportation Facilities.
		Sector T. Treatment Works
NA*	NA	Treatment Works.
		Sector U. Food and Kindred Products
1	201X	Meat Products.
2	202X	Dairy Products.
3	203X	Canned, Frozen and Preserved Fruits, Vegetables and Food Specialties.
4*	204X	Grain Mill Products.

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TABLE 4.—SECTOR/SUBSECTOR DIVISION OF GROUP APPLICANTS FOR ANALYSES OF SAMPLING DATA—Continued

Subsector	SIC code	Activity represented
5	205X	Bakery Products.
6	206X	Sugar and Confectionery Products.
7*	207X	Fats and Oils.
8	206X	Beverages.
9	209X	Miscellaneous Food Preparations and Kindred Products.
Sector V. Textile Mills, Apparel, and Other Fabric Product Manufacturing		
1	22XX	Textile Mill Products.
2	23XX	Apparel and Other Finished Products Made From Fabrics and Similar Materials.
Sector W. Furniture and Fixtures		
NA	25XX	Furniture and Fixtures.
	2434	Wood Kitchen Cabinets.
Sector X. Printing and Publishing		
NA	27XX	Printing and Publishing.
Sector Y. Rubber, Miscellaneous Plastic Products, and Miscellaneous Manufacturing Industries		
1*	301X	Tires and Inner Tubes.
	302X	Rubber and Plastics Footwear.
	305X	Gaskets, Packing, and Sealing Devices and Rubber and Plastics Hose and Belting.
	306X	Fabricated Rubber Products, Not Elsewhere Classified.
2	308X	Miscellaneous Plastics Products.
	393X	Musical Instruments.
	394X	Dolls, Toys, Games and Sporting and Athletic Goods.
	395X	Pens, Pencils, and Other Artists' Materials.
	396X	Costume Jewelry, Costume Novelties, Buttons, and Miscellaneous Notions, Except Precious Metal.
	399X	Miscellaneous Manufacturing Industries.
Sector Z. Leather Tanning and Finishing		
NA	311X	Leather Tanning and Finishing.
Sector AA. Fabricated Metal Products		
1*	342X	Cutlery, Handtools, and General Hardware.
	344X	Fabricated Structural Metal Products.
	345X	Screw Machine Products, and Bolts, Nuts, Screws, Rivets, and Washer.
	346X	Metal Forgings and Stampings.
	3471	Electroplating, Plating, Polishing, Anodizing, and Coloring.
	349X	Miscellaneous Fabricated Metal Products.
	391X	Jewelry, Silverware, and Plated Ware.
2*	3479	Coating, Engraving, and Allied Services.
Sector AB. Transportation Equipment, Industrial or Commercial Machinery		
NA	35XX	Industrial and Commercial Machinery.
Sector AC. Electronic, Electrical, Photographic and Optical Goods		
NA	36XX	Electronic, Electrical.
	38XX	Measuring, Analyzing and Controlling Instrument; Photographic and Optical Goods.

* Denotes subsector with analytical (chemical) monitoring requirements.
NA indicated those industry sectors in which subdivision into subsectors was determined to be not applicable.

To conduct a comparison of the results of the statistical analyses to determine when analytical monitoring would be required, EPA established "benchmark" concentrations for the pollutant parameters on which monitoring results had been received. The "benchmarks" are the pollutant concentrations above which EPA determined represents a level of concern. The level of concern is a concentration at which a storm water discharge could potentially impair, or contribute to impairing water quality or affect human health from ingestion of water or fish. The benchmarks are also viewed by EPA as a level, that if below, a facility represents little potential for water quality concern. As such, the benchmarks also provide an appropriate level to determine whether a facility's storm water pollution prevention measures are successfully implemented. The benchmark concentrations are not effluent limitations and should not be interpreted or adopted as such. These values are merely levels which EPA has used to determine if a storm water discharge from any given facility merits further monitoring to insure that the facility has been successful in implementing a storm water pollution prevention plan. As such these levels represent a target concentration for a facility to achieve through implementation of pollution prevention measures at the facility. Table 5 lists the parameter benchmark values.

As can be seen in Table 5, benchmark concentrations were determined based upon a number of existing standards or other sources to represent a level above which water quality concerns could arise. EPA has also sought to develop values which can realistically be measured and achieved by industrial facilities. Moreover, storm water discharges with pollutant concentrations occurring below these levels would not warrant further analytical monitoring due to their de minimis potential effect on water quality.

The primary source of benchmark concentrations is EPA's National Water Quality Criteria, published in 1986 (often referred to as the "Gold Book"). For the majority of the benchmarks, EPA chose to use the acute aquatic life, fresh water ambient water quality criteria. These criteria represent maximum concentration values for a pollutant, above which, could cause acute effects on aquatic life such as mortality in a short period of time. Where acute criteria values were not available, EPA used the lowest observed effect level (LOEL) acute fresh water value. The LOEL values represent the lowest concentration of a pollutant that results in an adverse effect over a short period of time. These two acute freshwater values were selected as benchmark concentrations if the value was not below the approved method detection limit as listed in 40 CFR Part 136 and the value was not substantially above the concentration which EPA believes a facility can attain through the implementation of a storm water pollution prevention plan. These acute freshwater values best represent, on a national basis, the highest concentrations at which typical fresh water species can survive exposures of pollutants for short durations (i.e., a storm discharge event).

Acute freshwater criteria do not exist for a number of parameters on which EPA received data. For these parameters, EPA selected benchmark values from several other references. The benchmark concentrations for five day biochemical oxygen demand (BOD_5) and for pH are determined based upon the secondary wastewater treatment regulations (40 CFR 133.102). EPA believes that the BOD_5 value of 30 mg/L is a reasonable concentration below which adverse effects in receiving waters under wet weather flow conditions should not occur. EPA also believes, that given group application data on BOD_5, this value should be readily achievable by industrial storm water dischargers. The benchmark value for pH is a range of 6.0–9.0 standard units. EPA believes this level, given the group application data, is reasonably achievable by industrial storm water dischargers and represents and acceptable range within which aquatic life impacts will not occur. The benchmark concentration for chemical oxygen demand (COD) is based upon the State of North Carolina benchmark values for storm water discharges, and is a factor of four times the BOD_5 benchmark concentration. EPA has concluded that COD is generally discharged in domestic wastewater at four times the concentration of BOD_5 without causing adverse impacts on aquatic life. EPA selected the median concentration from the National Urban Runoff Program as the benchmark for total suspended solids (TSS) and for nitrate plus nitrite as nitrogen. EPA believes the median concentration, which is the mid-point concentration (half the samples are above this level and half are below) represents concentration above which water quality concerns may result. For TSS a value of 100mg/L is similar to the storm water benchmark used by North Carolina for storm water permits, and given the group application data, should be readily achievable by industry with implementation of BMPs, many of which are designed for the purpose of controlling TSS. EPA also believes, given the group application data, that there is a relationship between TSS and the amount of exposed industrial activity and that industrial activities even in arid western States should be able to implement BMPs that will accomplish this benchmark. EPA selected the storm water effluent limitation guideline for petroleum refining facilities as the benchmark for oil and grease. Given the lack of an acute criteria, EPA selected the chron[ic] fresh water quality criteria as the benchmark for iron. Water quality criteria for waterbodies in the State of North Carolina were used to determin[e] benchmarks for total phosphorus and for fluoride. The concentration value [for] phosphorus was designed to prevent eutrophication of fresh waterbodies from storm water runoff. The fluoride value was designed by North Carolina [to] be protective of water quality, as was the manganese value developed by Colorado. EPA believes that each of these benchmark values represent a reasonable level below which water quality impacts should not occur and they therefore represent a useful level [to] assess whether a pollution prevention plan is controlling pollution in storm water discharges.

For several other parameters, EPA chose a benchmark value base on a numerical adjustment of the acute fresh water quality criteria. Where the acute water quality criteria was below the method detection level for a pollutant, EPA used the "minimum level" (ML) as the benchmark concentration to ensure that the benchmark levels could be measured by permittees. For a few pollutants minimum levels have been published and these were used. For other pollutants, minimum levels need to be calculated. EPA calculated the minimum levels using the methodology described in the draft "National Guidance for the Permitting, Monitoring, and Enforcement of Water Quality-based Effluent Limitations Set Below Analytical Detection/Quantitation Levels" (Michael Cook, OWEC, March 18, 1994).

Additionally, several organic compounds (ethylbenzene, fluoranthene, toluene, and trichloroethylene) have acute fresh water quality criteria at substantially high concentrations, much higher than criteria developed for the protection of human health when ingesting water or fish. In addition, trichloroethylene is a human carcinogen. Therefore, EPA selected the human health criteria as benchmarks for these parameters. For dimethyl phthalate and total phenols, EPA selected benchmark concentrations based upon existing discharge limitations and compliance data (no industry had median concentrations above the selected benchmark for these parameters and therefore no industry sector is required to monitor for these two pollutants).

EPA conducted statistical analyses of the group Part 2 data for each parameter within every industry sector or subsector listed in Table 5. The pollutants, benchmark values, and source of the benchmark values are indicated below in Table 5.

TABLE 5.—PARAMETER BENCHMARK VALUES

Parameter name	Benchmark level	Source
Biochemical Oxygen Demand(5)	30 mg/L	4
Chemical Oxygen Demand	120 mg/L	5
Total Suspended Solids	100 mg/L	7
Oil and Grease	15 mg/L	8
Nitrate + Nitrite Nitrogen	0.68 mg/L	7
Total Phosphorus	2.0 mg/L	6
pH	6.0–9.0 s.u.	4
Acrylonitrile (c)	7.55 mg/L	2
Aluminum, Total (pH 6.5–9)	0.75 mg/L	1
Ammonia	19 mg/L	1
Antimony, Total	0.636 mg/L	9
Arsenic, Total (c)	0.16854 mg/L	9
Benzene	0.01 mg/L	10
Beryllium, Total (c)	0.13 mg/L	2
Butylbenzyl Phthalate	3 mg/L	3
Cadmium, Total (H)	0.0159 mg/L	9
Chloride	860 mg/L	1
Copper, Total (H)	0.0636 mg/L	9
Dimethyl Phthalate	1.0 mg/L	11
Ethylbenzene	3.1 mg/L	3
Fluoranthene	0.042 mg/L	3
Fluoride	1.8 mg/L	6
Iron, Total	1.0 mg/L	12
Lead, Total (H)	0.0816 mg/L	1
Manganese	1.0 mg/L	13
Mercury, Total	l0.0024 mg/L	1
Nickel, Total (H)	1.417 mg/L	1
PCB–1016 (c)	0.000127 mg/L	9
PCB–1221 (c)	0.10 mg/L	10
PCB–1232 (c)	0.000318 mg/L	9
PCB–1242 (c)	0.00020 mg/L	10
PCB–1248 (c)	0.002544 mg/L	9
PCB–1254 (c)	0.10 mg/L	10
PCB–1260 (c)	0.000477 mg/L	9
Phenols, Total	1.0 mg/L	11
Pyrene (PAH,c)	0.01 mg/L	10
Selenium, Total (*)	0.2385 mg/L	9
Silver, Total (H)	0.0318 mg/L	9
Toluene	10.0 mg/L	3
Trichloroethylene (c)	0.0027 mg/L	3
Zinc, Total (H)	0.117 mg/L	1

Sources:
1. "EPA Recommended Ambient Water Quality Criteria." Acute Aquatic Life Freshwater.
2. "EPA Recommended Ambient Water Quality Criteria." LOEL Acute Freshwater.
3. "EPA Recommended Ambient Water Quality Criteria." Human Health Criteria for Consumption of Water and Organisms.
4. Secondary Treatment Regulations (40 CFR 133).
5. Factor of 4 times BOD5 concentration—North Carolina benchmark.
6. North Carolina storm water benchmark derived from NC Water Quality Standards.
7. National Urban Runoff Program (NURP) median concentration.
8. Median concentration of Storm Water Effluent Limitation Guideline (40 CFR Part 419).
9. Minimum Level (ML) based upon highest Method Detection Limit (MDL) times a factor of 3.18.
10. Laboratory derived Minimum Level (ML).
11. Discharge limitations and compliance data.
12. "EPA Recommended Ambient Water Quality Criteria." Chronic Aquatic Life Freshwater.
13. Colorado—Chronic Aquatic Life Freshwater—Water Quality Criteria.

Notes:
(*) Limit established for oil and gas exploration and production facilities only.
(c) carcinogen.
(H) hardness dependent.
(PAH) Polynuclear Aromatic Hydrocarbon.

Assumptions:
Receiving water temperature—20 C.
Receiving water pH—7.8.
Receiving water hardness CaCO3 100 mg/L.
Receiving water salinity 20 g/kg.
Acute to Chronic Ratio (ACR)—10.

EPA prepared a statistical analysis of the sampling data for each pollutant parameter reported within each sector or subsector. (Only where EPA did not subdivide an industry sector into subsectors was an analysis of the entire sector's data performed.) The statistical analysis was performed assuming a delta log normal distribution of the sampling data within each sector/subsector. The analyses calculated median, mean, maximum, minimum, 95th, and 99th percentile concentrations for each parameter. The results of the analyses may be found in the appropriate section of Part VIII of this Fact Sheet. From this analysis, EPA was able to identify pollutants for further evaluation within each sector or subsector.

EPA next compared the median concentration for each pollutant for each sector or subsector to the benchmark concentrations listed in Table 5. EPA also compared the other statistical results to the benchmarks to better ascertain the magnitude and range of the discharge concentrations to help identify the pollutants of concern. EPA did not conduct this analysis if a sector had data for a pollutant from less than three individual facilities. Under these circumstances, the sector or subsector would not have this pollutant identified as a pollutant of concern. This was done to ensure that a reasonable number of facilities represented the industry sector or subsector as a whole and that the analysis did not rely on data from only one facility.

For each industry sector or subsector, parameters with a median concentration higher than the benchmark level were considered pollutants of concern for the industry and identified as potential pollutants for analytical monitoring under today's permit. EPA then analyzed the list of potential pollutants to be monitored against the lists of significant materials exposed and industrial activities which occur within each industry sector or subsector as described in the part I application information. Where EPA could identify a source of a potential pollutant which is directly related to industrial activities of the industry sector or subsector, the permit identifies that parameter for analytical monitoring. If EPA could not identify a source of a potential pollutant which was associated with the sector/subsector's industrial activity, the permit does not require monitoring for the pollutant in that sector/subsector. Industries with no pollutants for which the median concentrations are higher than the benchmark levels are not required to perform analytical monitoring under this permit, with the exceptions explained below.

In addition to the sectors and subsectors identified for analytical monitoring using the methods described above, EPA determined, based upon a review of the degree of exposure, types of materials exposed, special studies and in some cases inadequate sampling data in the group applications, that industries in the following sections of today's fact sheet also warrant analytical monitoring not withstanding the absence of data on the presence or absence of certain pollutants in the group applications: VIII.K.7 (hazardous waste treatment storage and disposal facilities), and VIII.S.6 (airports which use more than 100,000 gallons per year of glycol-based fluids or 100 tons of urea for deicing). These industries are required to perform analytical monitoring under the permit due to the high potential for contamination of storm water discharge, which EPA believes was not adequately characterized by group applicants in the information they provided in the group application process.

All facilities within an industry sector or subsector identified for analytical monitoring must, at a minimum, monitor their storm water discharges during the second year of permit coverage, unless the facility exercises the Alternative Certification described in Section VI.E.3 of this fact sheet. At the end of the second year of permit coverage, a facility must calculate the average concentration for each parameter for which the facility is required to monitor. If the permittee collects more than four samples in this period, then they must calculate an average concentration for each pollutant of concern for all samples analyzed. Monitoring must be conducted for the same storm water discharge outfall in each sampling period. Where a given storm water discharge is addressed by more than one sector/subsector's monitoring requirements, then the monitoring requirements for the applicable sector's/subsector's activities are cumulative. Therefore, if a particular discharge fits under more than one set of monitoring requirements, the facility must comply with all sets of sampling requirements. Monitoring requirements must be evaluated on an outfall-by-outfall basis.

If the average concentration for a pollutant parameter is less than or equal to the benchmark value, then the permittee is not required to conduct analytical monitoring for that pollutant during the fourth year of the permit. If, however, the average concentration for a pollutant is greater than the benchmark value, then the permittee is required to conduct quarterly monitoring for that pollutant during the fourth year of permit coverage. Analytical monitoring is not required during the first, third, and fifth year of the permit. The exclusion from analytical monitoring in the fourth y of the permit is conditional on the facility maintaining industrial operations and BMPs that will ensure quality of storm water discharges consistent with the average concentrations recorded during the second year of the permit.

2. Compliance Monitoring

In addition to the analytical monitoring requirements for certain sectors, today's permit contains monitoring requirements for discharg which are subject to effluent limitatio These discharges must be sampled annually and tested for the parameter which are limited by the permit. Discharges subject to compliance monitoring include: coal pile runoff, contaminated runoff from phosphate fertilizer manufacturing facilities, run from asphalt paving and roofing emulsion production areas, material storage pile runoff from cement manufacturing facilities, and mine dewatering discharges from crushed stone, construction sand and gravel, a industrial sand mines located in Texa Louisiana, Oklahoma, New Mexico, ar Arizona. All samples are to be grabs taken within the first 30 minutes of discharge where practicable, but in no case later than the first hour of discharge. Where practicable, the samples shall be taken from the discharges subject to the numeric effluent limitations prior to mixing wi other discharges.

Monitoring for these discharges is required to determine compliance wit numeric effluent limitations. Furthermore, discharges covered unde today's permit which are subject to numeric effluent limitations are not eligible for the alternative certification in Part VI.E.3. of this fact sheet.

3. Alternate Certification

Throughout today's permit, EPA ha included monitoring requirements for facilities which the Agency believes have the potential for contributing significant levels of pollutants to storr water discharges. The alternative certification described below is included in the permit to ensure that monitoring requirements are only imposed on those facilities which do, fact, have storm water discharges containing pollutants at concentration of concern. EPA has determined that i there are no sources of a pollutant exposed to storm water at the site ther the potential for that pollutant to contaminate storm water discharges does not warrant monitoring.

Therefore, a discharger is not subjec to the analytical monitoring requirements provided the discharger makes a certification for a given outfall, on a pollutant-by-pollutant basis, that material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, industrial machinery or operations, significant materials from past industrial activity that are located in areas of the facility that are within the drainage area of the outfall are not presently exposed to storm water and will not be exposed to storm water for the certification period. Such certification must be retained in the storm water pollution prevention plan, and submitted to EPA in lieu of monitoring reports required under Part XI of the permit. The permittee is required to complete any and all sampling until the exposure is eliminated. If the facility is reporting for a partial year, the permittee must specify the date exposure was eliminated. If the permittee is certifying that a pollutant was present for part of the reporting period, nothing relieves the permittee from the responsibility to sample that parameter up until the exposure was eliminated and it was determined that no significant materials remained. This certification is not to be confused with the low concentration sampling waiver. The test for the application of this certification is whether the pollutant is exposed, or can be expected to be present in the storm water discharge. If the facility does not and has not used a parameter, or if exposure is eliminated and no significant materials remain, then the facility can exercise this certification.

The permit does not allow facilities with discharges subject to numeric effluent limitations to submit alternative certification in lieu of the compliance monitoring requirements in Sections VI.C., XI.C.6., XI.D.5., XI.E.5., and XI.J.5. The permit also does not allow air transportation facilities subject to the analytical monitoring requirements under Section XI.S.5. to exercise an alternative certification.

A facility is not precluded from exercising the alternative certification in lieu of analytical monitoring requirements in the fourth year of permit coverage, even if that facility failed to qualify for a low concentration waiver in year two. EPA encourages facilities to eliminate exposure of industrial activities and significant materials where practicable.

4. Reporting and Retention Requirements

Permittees are required to submit all analytical monitoring results obtained during the second and fourth year of permit coverage within three months of the conclusion of the second and fourth year of coverage of the permit. For each outfall, one Discharge Monitoring Report Form must be submitted per storm event sampled. For facilities conducting monitoring beyond the minimum requirements an additional Discharge Monitoring Report Form must be filed for each analysis. The permittee must include a measurement or estimate of the total precipitation, volume of runoff, and peak flow rate of runoff for each storm event sampled. Permittees subject to compliance monitoring requirements are required to submit all compliance monitoring results annually on the 28th day of the month following the anniversary of the publication of this permit. Compliance monitoring results must be submitted on signed Discharge Monitoring Report Forms. For each outfall, one Discharge Monitoring Report form must be submitted for each storm event sampled.

Permittees are not required to submit records of the visual examinations of storm water discharges unless specifically asked to do so by the Director. Records of the visual examinations must be maintained at the facility. Records of visual examination of storm water discharge need not be lengthy. Permittees may prepare typed or hand written reports using forms or tables which they may develop for their facility. The report need only document: the date and time of the examination; the name of the individual making the examination; and any observations of color, odor, clarity, floating solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution.

The location for submittal of all reports is contained in the permit. Consistent with Office of Management and Budget Circular A–105, facilities located on the following Federal Indian Reservations, which cross EPA Regional boundaries, should note that permitting authority for such lands is consolidated in one single EPA Region.

a. Duck Valley Reservations lands, located in Regions IX and X, are handled by Region IX.

b. Fort McDermitt Reservation lands, located in Regions IX and X, are handled by Region IX.

c. Goshute Reservation lands, located in Regions VIII and IX, are handled by Region IX.

d. Navajo Reservation lands, located in Regions VI, VIII, and IX, are handled by Region IX.

e. Ute Mountain Reservation lands, located in Regions VI and VIII, are handled Region VIII (no areas in Region VIII are receiving coverage under this permit).

Pursuant to the requirements of 40 CFR 122.41(j), today's permit requires permittees to retain all records for a minimum of 3 years from the date of the sampling, examination, or other activity that generated the data.

5. Sample Type

The discussion below is a general description of the sample type required for monitoring under today's permit. Certain industries have different requirements, however, so permittees should check the industry-specific requirements in Part XI. of today's permit to confirm these requirements. Grab samples may be used for all monitoring unless otherwise stated. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The required 72-hour storm event interval may be waived by the permittee where the preceding measurable storm event did not result in a measurable discharge from the facility. The 72-hour requirement may also be waived by the permittee where the permittee documents that less than a 72-hour interval is representative for local storm events during the season when sampling is being conducted. The grab sample must be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger must submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable. A minimum of one grab is required. Where the discharge to be sampled contains both storm water and non-storm water, the facility shall sample the storm water component of the discharge at a point upstream of the location where the non-storm water mixes with the storm water, if practicable.

6. Representative Discharge

The permit allows permittees to use the substantially identical outfalls to reduce their monitoring burden. This representative discharge provision provides facilities with multiple storm water outfalls, a means for reducing the number of outfalls that must be sampled and analyzed. This may result in a substantial reduction of the resources required for a facility to comply with analytical monitoring requirements. When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may test the effluent of one of such outfalls and report that the quantitative data also applies to the substantially identical outfalls provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explaining in detail why the outfalls are expected to discharge substantially identical effluent. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area (e.g., low (under 40 percent), medium (40 to 65 percent) or high (above 65 percent)) shall be provided in the plan. Facilities that select and sample a representative discharge are prohibited from changing the selected discharge in future monitoring periods unless the selected discharge ceases to be representative or is eliminated. Permittees do not need EPA approval to claim discharges are representative, provided they have documented their rationale within the storm water pollution prevention plan. However, the Director may determine the discharges are not representative and require sampling of all non-identical outfalls.

The representative discharge provision in the permit is available to almost all facilities subject to the analytical monitoring requirements (not including compliance monitoring for effluent guideline limit compliance purposes) and to facilities subject to visual examination requirements.

The representative discharge provisions described above are consistent with Section 5.2 of NPDES Storm Water Sampling Guidance Document (EPA 833–B–92–001, July 1992).

7. Sampling Waiver

a. Adverse Weather Conditions. The permit allows for temporary waivers from sampling based on adverse climatic conditions. This temporary sampling waiver is only intended to apply to insurmountable weather conditions such as drought or dangerous conditions such as lightning, flash flooding, or hurricanes. These events tend to be isolated incidents and should not be used as an excuse for not conducting sampling under more favorable conditions associated with other storm events. The sampling waiver is not intended to apply to difficult logistical conditions, such as remote facilities with few employees or discharge locations which are difficult to access. When a discharger is unable to collect samples within a specified sampling period due to adverse climatic conditions, the discharger shall collect a substitute sample from a separate qualifying event in the next sampling period as well as a sample for the routine monitoring required in that period. Both samples should be analyzed separately and the results of that analysis submitted to EPA. Permittees are not required to obtain advance approval for sampling waivers.

b. Unstaffed and Inactive Sites—Chemical Waiver. The permit allows for a waiver from sampling for facilities that are both inactive and unstaffed. This waiver is only intended to apply to these types of facilities when the ability to conduct sampling would be severely hindered and result in the inability to meet the time and representative rainfall sampling specifications. This sampling waiver is not intended to apply to remote facilities that are active and staffed, or typical difficult logistical conditions. When a discharger is unable to collect samples as specified in this permit, the discharger shall certify to the Director in the DMR that the facility is unstaffed and inactive and the ability to conduct samples within the specifications is not possible. Permittees are not required to obtain advance approval for this waiver.

c. Unstaffed and Inactive Sites—Visual Waiver. The permit allows for a waiver from sampling for facilities that are both inactive and unstaffed. This waiver is only intended to apply to these types of facilities when the ability to conduct visual examinations would be severely hindered and result in the inability to meet the time and representative rainfall sampling specifications. This sampling waiver is not intended to apply to remote facilities that are active and staffed, or typical difficult logistical conditions. When a discharger is unable to perform visual examinations as specified in this permit, the discharger shall maintain on site with the pollution prevention plan a certification stating that the facility is unstaffed and inactive and the ability to perform visual examinations within the specifications is not possible. Permittees are not required to obtain advance approval for visual examination waivers.

8. Quarterly Visual Examination of Storm Water Quality

In order to provide a tool for evaluating the effectiveness of the pollution prevention plan, the permit requires the majority of industries covered under today's permit to perform quarterly visual examinations of storm water discharges. EPA believes these visual examinations will assist with the evaluation of the pollution prevention plan. This section provides a general description of the monitoring and reporting requirements under today's permit. The visual examination provides a simple, low cost means of assessing the quality of storm water discharge with immediate feedback. Most facilities covered under today's permit are required to conduct a quarterly visual examination of storm water discharges associated with industrial activity from each outfall, except discharges exempted under the representative discharge provision. The visual examination of storm water outfalls should include any observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, or other obvious indicators of storm water pollution. No analytical tests are required to be performed on these samples.

The examination of the sample must be made in well lit areas. The visual examination is not required if there is insufficient rainfall or snow-melt to runoff or if hazardous conditions prevent sampling. Whenever practicable the same individual should carry out the collection and examination of discharges throughout the life of the permit to ensure the greatest degree of consistency possible in recording observations. Grab samples for the examination shall be collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 1 hour) of when the runoff begins discharging. Reports of the visual examination include: the examination date and time, examination personnel, visual quality of the storm water discharge, and probable sources of any observed storm water contamination. The visual examination reports must be maintained on site with the pollution prevention plan.

When conducting a storm water visual examination, the pollution prevention team, or team member, should attempt to relate the results of the examination to potential sources of storm water contamination on the site. For example, if the visual examination reveals an oil sheen, the facility personnel (preferably members of the pollution prevention team) should conduct an inspection of the area of the site draining to the examined discharge to look for obvious sources of spilled oil, leaks, etc. If a source can be located, then this information allows the facility operator to immediately conduct a clean-up of the pollutant source, and/or to design a change to the pollution prevention plan to eliminate or minimize the contaminant source from occurring in the future.

To be most effective, the personnel conducting the visual examination should be fully knowledgeable about the storm water pollution prevention plan, the sources of contaminants on the site, the industrial activities conducted exposed to storm water and the day to day operations that may cause unexpected pollutant releases.

Other examples include; if the visual examination results in an observation of floating solids, the personnel should carefully examine the solids to see if they are raw materials, waste materials or other known products stored or used at the site. If an unusual color or odor is sensed, the personnel should attempt to compare the color or odor to the colors or odors of known chemicals and other materials used at the facility. If the examination reveals a large amount of settled solids, the personnel may check for unpaved, unstabilized areas or areas of erosion. If the examination results in a cloudy sample that is very slow to settle-out, the personnel should evaluate the site draining to the discharge point for fine particulate material, such as dust, ash, or other pulverized, ground, or powdered chemicals.

If the visual examination results in a clean and clear sample of the storm water discharge, this may indicate that no visible pollutants are present. This would be a indication of a high quality result, however, the visual examination will not provide information about dissolved contamination. If the facility is in a sector or subsector required to conduct analytical (chemical) monitoring, the results of the chemical monitoring, if conducted on the same sample, would help to identify the presence of any dissolved pollutants and the ultimate effectiveness of the pollution prevention plan. If the facility is not required to conduct analytical monitoring, it may do so if it chooses to confirm the cleanliness of the sample.

While conducting the visual examinations, personnel should constantly be attempting to relate any contamination that is observed in the samples to the sources of pollutants on site. When contamination is observed, the personnel should be evaluating whether or not additional BMPs should be implemented in the pollution prevention plan to address the observed contaminant, and if BMPs have already been implemented, evaluating whether or not these are working correctly or need maintenance. Permittees may also conduct more frequent visual examinations than the minimum quarterly requirement, if they so choose. By doing so, they may improve their ability to ascertain the effectiveness of their plan. Using this guidance, and employing a strong knowledge of the facility operations, EPA believes that permittees should be able to maximize the effectiveness of their storm water pollution prevention efforts through conducting visual examinations which give direct, frequent feedback to the facility operator or pollution prevention team on the quality of the storm water discharge.

EPA believes that this quick and simple assessment will help the permittee to determine the effectiveness of his/her plan on a regular basis at very little cost. Although the visual examination cannot assess the chemical properties of the storm water discharged from the site, the examination will provide meaningful results upon which the facility may act quickly. EPA recommends that the visual examination be conducted at different times than the chemical monitoring, but is not requiring this. In addition, more frequent visual examinations can be conducted if the permittee so chooses. In this way, better assessments of the effectiveness of the pollution prevention plan can be achieved. The frequency of this visual examination will also allow for timely adjustments to be made to the plan. If BMPs are performing ineffectively, corrective action must be implemented. A set of tracking or follow-up procedures must be used to ensure that appropriate actions are taken in response to the examinations. The visual examination is intended to be performed by members of the pollution prevention team. This hands-on examination will enhance the staff's understanding of the site's storm water problems and the effects of the management practices that are included in the plan.

9. SARA Title III, Section 313 Facilities

Today's permit does not contain special monitoring requirements for facilities subject to the Toxic Release Inventory (TRI) reporting requirements under Section 313 of the EPCRA. EPA has reviewed data submitted by facilities in the group application and determined that storm water monitoring requirements are more appropriately based upon the industrial activity or significant material exposed than upon a facility's status as a TRI reporter under Section 313 of EPCRA. This determination is based upon a comparison of the data submitted by TRI facilities included in the group application process to data from group application sampling facilities that were not found on the TRI list. Table 6 summarizes the data comparison. The data indicate that there are no consistent differences in the level of water priority chemicals present in samples from TRI facilities when compared to the samples from facilities not subject to TRI reporting requirements.

EPA has included a revised Appendix A that lists 44 additional water priority chemicals that meet the definition of a section 313 water priority chemical or chemical categories requirements as defined by EPA in the permit under Part X, Definitions.

TABLE 6.—COMPARISON OF POLLUTANT CONCENTRATION IN GRAB SAMPLES

Pollutant	Non-TRI facility median concen-tration (mg/L)	TRI facility median concen-tration (mg/L)	Non-TRI facility mean concen-tration (mg/L)	TRI facility mean concen-tration (mg/L)	Non-TRI facility 95th percentile concen-tration (mg/L)	TRI facility 95th percentile concen-tration (mg/L)
Acrylonitrile	0.100	0.000	0.085	0.000	0.100	0.000
Aluminum	0.922	0.819	12.061	28.893	58.000	12.000
Ammonia	0.640	0.000	10.507	23.231	9.500	17.200
Antimony	0.000	0.000	0.603	0.014	2.096	0.078
Arsenic	0.000	0.000	0.231	0.008	0.170	0.033
Benzene	0.000	0.000	0.001	0.000	0.001	0.000
Beryllium	0.001	0.000	0.002	0.080	0.007	0.400
Butylbenzyl phthalate	0.000	0.000	0.007	0.000	0.018	0.000
Cadmium	0.000	0.000	0.014	0.030	0.050	0.028
Chlorine	0.000	0.000	1.590	0.052	11.000	0.300

TABLE 6.—COMPARISON OF POLLUTANT CONCENTRATION IN GRAB SAMPLES—Continued

Pollutant	Non-TRI facility median concen-tration (mg/L)	TRI facility median concen-tration (mg/L)	Non-TRI facility mean concen-tration (mg/L)	TRI facility mean concen-tration (mg/L)	Non-TRI facility 95th percentile concen-tration (mg/L)	TRI facilit 95th percer concen-trat (mg/L)
Chloroform	0.000	0.000	0.083	0.001	0.022	0.0
Chromium	0.006	0.000	1.236	0.109	0.250	0.2
Copper	0.047	0.028	1.430	0.344	2.200	1.3
Cyanide	0.000	0.000	0.021	0.007	0.008	0.0
Di-n-butyl phthalate	0.000	0.000	0.005	0.168	0.014	1.5
Dimethyl phthalate	0.000	0.000	0.005	0.000	0.016	0.0
Ethylbenzene	0.000	0.000	0.000	0.000	0.001	0.0
Hexavalent chromium	0.000	0.000	0.001	0.003	0.002	0.0
Lead	0.020	0.006	0.556	0.480	1.900	1.1
Manganese	0.150	0.090	2.015	0.273	9.550	1.2
Mercury	0.000	0.000	0.530	0.006	0.001	0.0
Naphthalene	0.000	0.000	2.998	0.001	24.000	0.0
Nickel	0.020	0.000	0.087	0.311	0.390	0.4
Phenols	0.000	0.000	0.063	0.019	0.100	0.0
Selenium	0.000	0.000	0.262	0.000	0.020	0.0
Silver	0.000	0.000	0.034	0.001	0.006	0.0
Toluene	0.000	0.000	0.052	0.011	0.037	0.0
Trichloroethylene	0.000	0.000	0.004	0.040	0.001	0.0
1,1,1-Trichloroethane	0.000	0.000	0.004	0.460	0.015	6.0
Xylene	0.000	0.000	0.000	0.004	0.003	0.0
Zinc	0.320	0.250	3.761	1.720	8.800	5.1

F. Numeric Effluent Limitations

1. Industry-specific Limitations

Part XI. of today's permit contains numeric effluent limitations for phosphate fertilizer manufacturing facilities, asphalt emulsion manufacturers, cement manufacturers, coal pile runoff from steam electric power generating facilities, and sand, gravel, and crushed stone quarries. These limitations are required under EPA's storm water effluent limitation guidelines in the Code of Federal Regulations at 40 CFR Part 418, Part 443, Part 411, Part 423, and Part 436. Parts VIII.C.6., VIII.D.5., VIII.E.6., and VIII.J.5. of this fact sheet discuss these limitations.

2. Coal Pile Runoff

Today's permit establishes effluent limitations of 50 mg/L total suspended solids and a pH range of 6.0–9.0 for coal pile runoff. Any untreated overflow from facilities designed, constructed, and operated to treat the volume of coal pile runoff associated with a 10-year, 24-hour rainfall event is not subject to the 50 mg/L limitation for total suspended solids. Steam electric generating facilities must comply with these limitations upon submittal of the NOI. EPA has adopted these technology-based pH limitations in today's general permit in accordance with setting limits on a case-by-case basis as allowed under 40 CFR 125.3 and Section 402 of the Clean Water Act. These case-by-case limits are derived by transferring the known achievable technology from an effluent guideline to a similar type of discharge. When developing these technology-based limitations, variables such as rainfall pH, sizes of coal piles, pollutant characteristics, and runoff volume were considered. Therefore, these variables need not be considered again. As discussed above, these pH limitations are technology-based and are not based on water quality. All other types of facilities must comply with this requirement as expeditiously as practicable, but in no event later than 3 years from the date of permit issuance.

The pollutants in coal pile runoff can be classified into specific types according to chemical characteristics. Each type relates to the pH of the coal pile drainage. The pH tends to be of an acidic nature, primarily as a result of the oxidation of iron sulfide in the presence of oxygen and water. The potential influence of pH on the ability of toxic and heavy metals to leach from coal piles is of particular concern. Many of the metals are amphoteric with regard to their solubility behavior. These factors affect acidity, pH, and the subsequent leaching of trace metals: concentration and form of pyritic sulfur in coal; size of the coal pile; method of coal preparation and clearing prior to storage; climatic conditions, including rainfall and temperature; concentrations of calcium carbonate and other neutralizing substances in the coal; concentration and form of trace metals in the coal; and the residence time of water in the coal pile.

Coal piles can generate runoff with low pH values, with the acid values being quite variable. The suspended solids levels can be significant, with levels of 2,500 mg/L not uncommon. Metals present in the greatest concentrations are copper, iron, aluminum, nickel, and zinc. Others present in trace amounts include chromium, cadmium, mercury, arsenic selenium, and beryllium[14].

G. Regional Offices

1. Notice of Intent Address

Notices of Intent to be authorized to discharge under this permit should be sent to: NOI/NOT Processing Center (4203), 401 M Street, S.W., Washington DC 20460.

2. Address for Other Submittals

Other submittals of information required under this permit or individu permit applications should be sent to the appropriate EPA Regional Office:

a. ME, MA, NH, Federal Indian Reservations in CT, MA, NH, ME, RI, and Federal Facilities in VT

EPA, Region I, Water Management Division, (WCP), Storm Water Sta JFK Federal Building, Boston, MA 02203

b. PR and Federal Facilities in PR

[14] A more complete description of pollutants in coal pile runoff is provided in the "Final Development Document for Effluent Limitations Guidelines and Standards and Pretreatment Standards for the Steam Electric Point Source Category," (EPA–440/1–82/029), EPA, November 1982.

R0016109

EPA, Region II, Water Management Division, (2WM-WPC), Storm Water Staff, 290 Broadway, New York, NY 10007–1866

c. DC and Federal Facilities in DC and DE

EPA, Region III, Water Management Division, (3WM55), Storm Water Staff, 841 Chestnut Building, Philadelphia, PA 19107

d. FL

EPA, Region IV, Water Management Division, Permits Section (WPEB-7), 345 Courtland Street, NE, Atlanta, GA 30365

e. LA, NM, OK, and TX and Federal Indian Reservations in LA, NM (Except Navajo and Ute Mountain Reservation Lands), OK, and TX

EPA, Region VI, Enforcement and Compliance Assurance Division, (6EN-WC), EPA SW MSGP, First Interstate Bank Tower at Fountain Place, P.O. Box 50625, Dallas, TX 75205

f. AZ, Johnston Atoll, Midway Island, Wake Island, all Federal Indian Reservations in AZ, CA, and NV; those portions of the Duck Valley, Fort McDermitt, and Goshute Reservations that are outside NV; those portions of the Navajo Reservation that are outside AZ; and Federal facilities in AZ, Johnston Atoll, Midway Island, and Wake Island.

EPA, Region IX, Water Management Division, (W–5–3), Storm Water Staff, 75 Hawthorne Street, San Francisco, CA 94105

g. ID, OR, and WA; Federal Indian Reservations in AK, ID (except the Duck Valley Reservation), OR (except the Fort McDermitt Reservation), and WA; and Federal facilities in ID, and WA

EPA, Region X, Water Division, (WD-134), Storm Water Staff, 1200 Sixth Avenue, Seattle, WA 98101

H. Compliance Deadlines

For most permittees, today's permit imposes a deadline of 270 days following date of publication of this permit for development of pollution prevention plans and for compliance with the terms of the plan.

Today's general permit provides additional time if constructing structural best management practices is called for in the plan. The portions of a plan addressing these BMP construction requirements must provide for compliance with the plan as soon as practicable, but in no case later than 3 years from the effective date of the permit. However, storm water pollution prevention plans for facilities subject to these additional requirements must be prepared within 270 days of the date of publication of this permit and provide for compliance with the baseline terms and conditions of the permit (other than the numeric effluent limitation) as expeditiously as practicable, but in no case later than 270 days after the publication date of this permit.

Facilities are not required to submit the pollution prevention plans for review unless they are requested by EPA or by the operator of a large or medium municipal separate storm sewer system. When a plan is reviewed by EPA, the Director can require the permittee to amend the plan if it does not meet the minimum permit requirements.

VII. Cost Estimates for Common Permit Requirements

The conditions of today's general permit reflects the baseline permit requirements established in EPA's NPDES permits for Storm Water Discharges Associated With Industrial Activity (57 FR 41175 and 57 FR 44412). The requirements found under today's permit are more specific to the conditions found in the industries. EPA does not consider these requirements to be more costly than the pollution prevention plan requirements established in the baseline general permit. The following section contains the estimates of the cost of compliance with the baseline permit requirements.

A. Pollution Prevention Plan Implementation

Storm water pollution prevention plans for the majority of facilities will include relatively low cost baseline controls. EPA's analysis of storm water pollution prevention plans indicates that the cost of developing and implementing these plans is variable and will depend on a number of the following factors: the size of the facility, the type and amount of significant materials stored or used at a facility, the nature of the plant operations, the plant designs (e.g., the processes used and layout of a plan), and the extent to which housekeeping measures are already employed. Table 7 provides estimates of the range of costs for preparing and implementing the common requirements for a storm water pollution prevention plan. It is expected that the low cost estimates provided in Table 7 are appropriate for the majority of smaller facilities. The high cost estimates in Table 7 are more applicable to larger, more complex facilities with more potential sources of pollutants. Please note that the costs in this table exclude special requirements, such as EPCRA 313 requirements. EPA estimated the cost of preparing a storm water pollution prevention plan for a hypothetical small business in the automobile salvage yard industry. Based on experience and best professional judgment, EPA estimates that a typical small automobile salvage yard would face a one-time cost of about $874. This cost is lower than the low end of the cost estimate provided in Table 7 because it is based on a particular (though hypothetical) small business. Table 7 estimates are based on what EPA expects are appropriate for the majority of small facilities. Some facilities are likely to face lower costs, such as the hypothetical small automobile junk yard, and other facilities are likely to face higher costs.

The cost of compliance, monitoring and preparing the PPP for the multi-sector permit are not high when compared to the site-specific requirements to comply with an individual permit. The Clean Water Act does not give EPA the authority to exempt permitted facilities from requirements designed to improve the quality of the nation's waters. The economic ability of small businesses to comply with this permit can be a factor to consider if water quality concerns are not applicable to the surface water body receiving the storm water discharge.

The operators of regulated storm water discharges have to consider the economic effects of coverage under the multi-sector permit, the baseline general permit, or an individual NPDES permit. Coverage under either of the two general permits is not required by EPA. The NPDES regulations give EPA the authority to require coverage under an individual NPDES permit, not general permits. A facility's decision to be covered under a general permit is voluntary. Individual permits can require numerical limits and more frequent monitoring and reporting, along with the development and implementation of SWPPPs. The burden of developing an SWPPP is controlled by the facility's ability to achieve the permits goal: reduce or eliminate the discharge of pollutants to the nation's waters.

TABLE 7.—SUMMARY OF ESTIMATED RANGES OF COSTS FOR COMPLIANCE WITH STORM WATER POLLUTION PREVENTION PLANS WITH BASELINE REQUIREMENTS

	Low costs		High costs	
	First year costs	Annual costs	First year costs	Annual costs
Submittal of NOI	$14		$14	
Notification of Municipality	14		14	
Plan Preparation	1,518		76,153	
Plan Implementation	90	294	35,400	9,371
Comprehensive Site Compliance Evaluation/Plan Revision		267		8,875
Reportable Quantities	(1) No Costs		8,501	
Total	1,636	561	120,082	18,246

This table identifies estimated low and high costs (in 1992 dollars) to develop and implement storm water pollution prevention plans.
Low costs of implementing program components are zero where existing programs or procedures is assumed adequate.
The estimated costs for plan preparation and plan revisions includes costs of preparing/revising plan to address baseline requirements. However, the costs of implementing special requirements, such as those for EPCRA Section 313 facilities coal piles and salt piles are not otherwise addressed in this table.

B. Cost Estimates for EPCRA Section 313

Table 8 provides estimates of the range of costs of preparing and implementing a storm water pollution prevention plan for facilities subject to the special requirements for facilities subject to EPCRA Section 313 reporting requirements for chemicals classified as "Section 313 water priority chemicals." EPA expects the majority of facilities to have existing containment systems that meet the majority of the requirements of this permit. High cost estimates correspond to facilities that are expected to be required to undertake some actions to upgrade existing containment systems to meet the requirements of this permit.

TABLE 8.—SUMMARY OF ESTIMATED ADDITIONAL COSTS FOR COMPLIANCE WITH STORM WATER POLLUTION PREVENTION PLANS FOR FACILITIES SUBJECT TO SECTION 313 OF EPCRA FOR WATER PRIORITY CHEMICALS

	Low costs		High costs	
	Costs during first 3 years	Annual costs	Costs during first 3 years	Annual costs
Plan Preparation	$630		0	
Liquid Storage Areas			$11,200	
Material Storage Areas			560	
Loading Areas			21,000	
Process Areas			11,190	
Drainage/Runoff			7,750	
Housekeeping/Maintenance				
Facility Security				$5,957
Employee Training			3,240	
Toxicity Reduction				1,403
				3,046
Totals	630	$0	54,940	10,406

This table identifies estimated additional low and high costs to develop and implement storm water pollution prevention plans for EPCRA Section 313 facilities subject to special conditions.
Low costs of implementing program components are zero where existing programs, procedures or security is assumed adequate.
The high costs for preparing pollution prevention plans to include EPCRA Section 313 additional requirement were addressed as part of the estimated high costs for preparation of baseline pollution prevention plans (see Table 7).

C. Cost Estimates for Coal Piles

The effluent limitations for coal pile runoff in the permit can be achieved by these two primary methods: limiting exposure to coal by use of covers or tarpaulins and collecting and treating the runoff. In some cases, coal pile runoff may be in compliance with the effluent limitations without covering of the pile or collection or treatment of the runoff. In these cases, the operator of the discharge would not have a control cost.

The use of covers or tarpaulins to prevent or minimize exposure of the coal pile to storm water is generally expected to be practical only for relatively small piles. Coal pile covers or tarpaulins are anticipated to have a fixed cost of $400 and annual cost of $160.

Table 9 provides estimates of the costs of treating coal pile runoff.[15] These costs are based on a consideration of a treatment train requiring equalization, pH adjustment, and settling, including the costs for impoundment (for equalization), a lime feed system and mixing tanks for pH adjustment, and a clarifier for settling. The costs for the

[15] The type and degree of treatment required to meet the effluent limitations of this permit vary depending on factors such as the amount of sulfur in the coal. This section describes a model treatment scheme for estimating costs for compliance with the effluent limitations. Dischargers may implement other less expensive treatment approaches to enable them to discharge in accordance with these limits where appropriate.

impoundment area include diking and containment around each coal pile and associated sumps and pumps and piping from runoff areas to the impoundment area. The costs for land are not included. The lime feed system employed for pH adjustment includes a storage silo, shaker, feeder, and lime slurry storage tank, instrumentation, electrical connections, piping, and controls.

Additional costs may be incurred if a polymer system is needed. In this case, costs would include impoundment for equalization, a lime feed system, mixing tank, and polymer feed system for chemical precipitation, a clarifier for settling, and an acid feeder and mixing tank to readjust the pH within the range of 6 to 9. The equipment and system design, with the exception of the polymer feeder, acid feeder, and final mixing tank, are essentially the same as shown in Table 9. Two tanks are required for a treatment train with a polymer system, one for precipitation and another for final pH adjustment with acid. The cost of mixing is therefore twice that shown in Table 9. The polymer feed system includes storage hoppers, chemical feeder, solution tanks, solution pumps, interconnecting piping, electrical connections, and instrumentation. The costs of clarification are identical to that of Table 9. A treatment train with a polymer system requires the use of an acid addition system to readjust the pH within the range of 6 to 9. The components of this system include a lined acid storage tank, two feed pumps, an acid pH control loop, and associated piping, electrical connections, and instrumentation.

Additional information regarding the cost of these technologies can be found in "Development Document for Effluent Limitations Guidelines and Standards and Pretreatment Standards for the Steam Electric Point Source Category," (EPA-440/182/029), November 1982, EPA.

TABLE 9.—SUMMARY OF ESTIMATED COSTS FOR TREATMENT OF COAL PILE RUNOFF

	30,000 cubic meter coal pile	120,000 cubic meter coal pile
IMPOUNDMENT:		
Installed Capital Cost	6,850	6,850
Operation and Maintenance ($/year)	Negligible	Negligible
LIME FEED SYSTEM:		
Installed Capital Cost ($)	138,800	255,700
Operation and Maintenance ($/year)	5,780	10,655
Energy Requirements (kwh/yr)	3.6x10**4	3.6x10**4
Land Requirements (ft**2)	5,000	5,000
MIXING EQUIPMENT:		
Installed Capital Cost ($)	65,750	91,320
Operation and Maintenance ($/year)	2,280	2,430
Energy Requirements (kwh/yr)	1.3x10**3	3.3x10**3
Land Requirements (ft**2)	2,000	2,000
CLARIFICATION:		
Installed Capital Cost ($)	182,650	237,450
Operation and Maintenance ($/year)	3,200	3,650
Energy Requirements (kwh/yr)	1.3x10**3	3.3x10**3
Land Requirements (acres)	0.1	0.1

Source: "Development Document for Effluent Limitations Guidelines and Standards and Pretreatment Standards for the Steam Electric Point Source Category" (EPA-440/182/029), November 1982, EPA). Costs estimates are in 1992 dollars.

D. Cost Estimates for Salt Piles

Salt pile covers or tarpaulins are anticipated to have a fixed cost of $400 and an annual cost of $160 for medium-sized piles and a fixed cost of $4,000 and an annual cost of $2,000 for very large piles. Structures such as salt domes are generally expected to have a fixed cost of between $30,000 for small piles ($70 to $80 per cubic yard) and $100,000 for larger piles ($18 per cubic yard) with costs depending on size and other construction parameters.

VIII. Special Requirements for Discharges Associated With Specific Industrial Activities

The industry-specific requirements allow the implementation of site-specific measures that address features, activities, or priorities for control associated with the identified storm water discharges. This framework provides the necessary flexibility to address the variable risk for pollutants in storm water discharges associated with the different types of industrial activity addressed by this permit. This approach also assures that facilities have the opportunity to identify procedures to prevent storm water pollution at a particular site that are appropriate, given processes employed, engineering aspects, functions, costs of controls, location, and age of the facility (as contemplated by 40 CFR 125.3). The approach taken also allows the flexibility to establish controls that can appropriately address different sources of pollutants at different facilities.

A. Storm Water Discharges Associated With Industrial Activity From Timber Products Facilities

1. Discharges Covered Under This Sector

Eligibility for coverage under this section is limited to those facilities in the lumber and wood products industry (primary SIC Major Group is 24), except wood kitchen cabinets manufacturers (SIC Code 2434). Permit conditions for facilities in the wood kitchen cabinets manufacturers industry (SIC Code 2434) are discussed in the wood and metal furniture and fixture manufacturing sector (Part XI.W of today's permit). SIC Major group 24 represents those "establishments engaged in cutting timber and pulpwood, merchant sawmills, lath mills, shingle mills, cooperage stock mills, planing mills, and plywood and veneer mills engaged in producing lumber and wood basic materials; and establishments engaged in wood preserving or in manufacturing finished articles made entirely of wood or related materials." [16]

[16] "Handbook of Standard Industrial Classifications," Office of Management and Budget, 1987.

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

Wood kitchen cabinet facilities (SIC Code 2434) are excluded from coverage under this section because EPA believes it is more appropriate to cover manufacturers of wood cabinets with furniture manufacturing facilities (SIC Major group 25). As indicated in the November 16, 1990, **Federal Register** (55 FR 48008), "Facilities under SIC Code 2434 and 25 are establishments engaged in furniture making." EPA believes that this grouping is more appropriate due to the typical use by cabinet makers of wood treating solutions such as mineral spirits and propenyl butyl.[17] This practice is common to wood furniture manufacturing, but is atypical of the other industrial operations performed at facilities in the lumber and wood products industry (SIC Major group 24).

Certain silvicultural activities are not required to be covered under National Pollutant Discharge Elimination System (NPDES) storm water permits (40 CFR 122.27). In accordance with 40 CFR 122.27(b), point sources that must be covered by an NPDES permit are "any discernible, confined and discrete conveyance related to rock crushing, gravel washing, log sorting, or log storage facilities, which are operated in connection with silvicultural activities and from which pollutants are discharged into waters of the United States." Discharges from nonpoint source silvicultural activities, including harvesting operations (see 40 CFR 122.27) are not required to be covered.

It is EPA's determination harvesting activities include: the felling, skidding, preparation (e.g., delimbing and trimming), loading and initial transport of forest products from an active harvest site. An active harvest site is considered to be an area where harvesting operations are actually on-going. EPA also interprets the definition of harvesting operations to include incidental stacking and temporary storage of harvested timber on the harvest site prior to its initial transport to either an intermediate storage area or other processing site. EPA considers this activity to be an inherent part of harvesting operations. However, EPA does not intend the definition of active harvesting operations to include sites that are processing, sorting, or storing harvested timber which has been transported there from one or more active harvesting sites. Consequently, EPA considers these site activities a point source under 40 CFR 122.27(b)(1) and operators of these sites must seek an NPDES permit for discharges of storm water.

Effluent guidelines have been promulgated for the Timber Products Processing Point Source Category at 40 CFR Part 429 (46 FR 8260; January 26, 1981). Under these regulations, effluent limitations and standards were set for process wastewaters from any timber products processing operation, and any plant producing insulation board with wood as the major raw material. The definition of process wastewater excluded "noncontact cooling water, material storage yard runoff (either raw material or processed wood storage) and boiler blowdown. For the dry process hardboard, veneer, finishing, particleboard, and sawmills and planing mills subcategories, fire control water is excluded from the definition." Any discharge subject to an effluent limitation guideline is not eligible for coverage under this section. Even though discharges of boiler blowdown and noncontact cooling water are not considered "process water discharges," they do not fall under the definition of storm water discharges. As such, this section does not provide for their coverage. In addition, contact cooling waters and water treatment wastewater discharges from steam operated sawmills will not be covered. Finally, material storage yard runoff, exempted from coverage under the effluent limitation guidelines, is eligible to be covered in accordance with the terms and conditions of this section.

In addition, it should be noted that certain wood preserving wastes have been listed under 40 CFR 261.31 as hazardous wastes from nonspecific sources (55 FR 50450; December 6, 1990). Storm water discharges that come in contact and/or commingle with these wastes will be considered a hazardous waste and will not be authorized for discharge under this section. Despite the listing of these wastes, however, there remains a potential for storm water to become contaminated through incidental activities such as tracking of materials, fugitive emissions, and miscellaneous other activities. These discharges are covered under today's permit. Wastewaters, process residuals, preservative or protectant drippage, and spent formulations from wood preserving processes that use chlorophenolic formulations, creosote formulations, or arsenic and chromium formulations have been listed as hazardous wastes. Wastes from wood surface protection were proposed for listing under this subpart (53 FR 53282; December 30, 1988, and 58 FR 25706; April 27, 1993) but listing the wastes was determined unnecessary in a subsequent rulemaking (59 FR 458; January 4, 1994). Storm water discharges containing these wastes are therefore covered under today's permit.

2. Industry Profile/Description of Industrial Activities

Facilities engaged in activities classified under SIC Major Group 24 use wood as their primary raw material. Although there is diversity among the types of final products that are produced at timber products facilities, there are common industrial activities performed among them. These activities are broadly classified for ease of discussion and include the following: log storage and handling; untreated wood lumber and residue generation activities, and untreated wood materials storage; wood surface protection activities, and chemicals and surface protected materials storage; wood preservation activities, and chemicals and preserved wood material storage; wood assembly/fabrication activities and final fabricated wood product storage; and equipment/vehicle maintenance, repair and storage.

In many cases, more than one of these activities may be conducted at a single facility location.

a. Log Storage and Handling. Log storage and handling activities may occur onsite at many types of facilities covered under this section of today's permit, such as wood collection yards and lumber processing and veneer manufacturing facilities. However, facilities that are primarily engaged in these activities (e.g., wood collection yards) are most appropriately classified under SIC Code 2411.

Typical industrial activities performed include loading and unloading of logs onto trucks or railroad cars for transport to other facilities, log

[17] Part 1 Storm Water Group Permit Applications. Summaries from individual applicant descriptions including Applicant No. 1156 (Westvaco), Applicant No. 92 (Bowater), and Applicant No. 866 (Louisiana-Pacific).

sorting, and storage of logs. In addition, some cutting may be performed such as chopping off tree branches and sectioning of tree trunks for easier handling during transport. Although not typically performed at wood collection facilities, chipping may be performed at facilities serving pulp industries. Residues generated at these sites may include bark, coarse sawdust, and wood chunks.

Significant materials that have the potential to come in contact with storm water discharges at facilities practicing these activities include: uncut logs (hardwood and softwoods), wood bark, wood chips, coarse saw dust, other waste wood material, petroleum and other products for equipment maintenance (fuels, motor oils, hydraulic oils, lubricant fluids, brake fluids, and antifreeze), herbicides, pesticides, and fertilizers, material handling equipment (forklifts, loaders, vehicles, chippers, debarkers, cranes, etc.).

These log storage and handling activities described above have the potential to discharge pollutants including bark and wood debris, total suspended solids (TSS), and leachates.[18] The leachate generated from these operations from the decay of wood products can contain high levels of TSS and biochemical oxygen demand (BOD_5).[19]

b. Untreated Wood Lumber and Residue Generation Activities and Untreated Wood Materials Storage. The primary product from sawmills and other cutting activities is lumber. However, residues such as debarked wood chips; whole tree chips and slab wood; bark; and sawdust constitutes approximately 25 percent of the total wood production.[20] At large saw mills, approximately 2,500 lbs of residue is generated for each 1,000 board feet of lumber derived.[21]

Facilities that produce untreated lumber and residues can be classified under most of the SIC Codes in Major group 24. These facilities include saw mill and planing mill facilities classified in group 242; millwork, veneer, plywood and structural wood member manufacturing facilities classified in group 243; wood container manufacturing facilities in group 244; wood building and mobile home manufacturing facilities in group 245; and miscellaneous wood product manufacturers in group 249.

These facilities may engage in one or more activities such as log washing, bark removal, milling, sawing, resawing edging, trimming, planing, machining, air drying, and kiln drying. In addition, there may be associated boiler operations, loading and unloading activities and storage activates.

Effluent guidelines have been established at 40 CFR Part 429 Subparts A, I, and J for discharges from log washing, debarking and wet storage, respectively. These discharges are considered process waters and are subject to the effluent limitations of each subpart.

Some facilities generate residue as a product, in lieu of lumber or other finished products, while other facilities may generate residues as a waste product. In most cases, there are markets for these residues. For example, chips and sawdust are used in the production of pulp and paper and wood products manufacturing. A summary of the residues generated and their potential uses include: bark (used in landscaping, compost, recreational applications (trails), energy recovery); wood chips (used in pulp and paper mill feed, landscaping, recreational applications, fire logs, energy recovery); planer shavings (used in particle board, livestock bedding, compost, fire logs, domestic pet litter, energy recovery); and sawdust (used in particle board, livestock bedding, compost, fire logs, domestic pet litter, energy recovery.)[22]

Storage activities at these sites include wet and dry storage of logs and storage of residuals. Wet storage, called "wet decking," is a process used when logs are to be stored for an extended period of time. Wet storage retards decaying and infestation by insects. The logs may be stored under water in ponds or may be placed in areas where water is continuously sprayed over them. Residuals are typically stored dry.

Storm water discharges from lumber and residue generation and storage may come in contact with the following types of wastes and/or materials at the facility which can then contribute pollutants to the storm water: uncut logs (hardwood and softwoods), wood bark, wood chips, wood shavings, sawdust, green lumber, rough and finished lumber, other waste wood material, nonhazardous wood ash, above and below ground fuel storage tanks for diesel, gasoline, propane and fuel oil, finishing chemicals (stain, lacquer, varnish, paints, water repellant, sealants), solvents and cleaners, petroleum and other products for equipment maintenance (fuels, motor oils, hydraulic oils, lubricant fluids, brake fluids, and antifreeze), herbicides, pesticides, and fertilizers, sawmill equipment, material handling equipment (Forklifts, loaders, vehicles, chippers, debarkers, cranes, etc.), boiler water treatment chemicals, scrap metals, scrap equipment and plastics, boiler blowdown water, and leachate from decaying organic matter.

Pollutants resulting from lumber and residue generation and storage activities are typically conventional in nature. Low pH levels can result from the leachate of decaying organic materials. TSS and BOD_5 may be elevated in this leachate.[23] In addition to leachate, washed away residue particles contribute to TSS loadings. Equipment and machinery at the facility site may result in the discharge of oil and grease.

c. Wood Surface Protection Activities, Chemicals and Surface Protected Materials Storage. At many hardwood saw mills, wood surface protection is conducted to prevent sap stain. Sap stain is the unsightly discoloration of lumber products caused by fungus.[24] Surface protection is a cosmetic fix only and differs from wood preservation which is a practice designed to enhance the wood's structural integrity.

Surface protection is accomplished by one of three methods: spraying, ranging from manual spraying with a garden hose to more sophisticated on-line high pressure spray boxes; dipping, a batch process where lumber is immersed then removed from the formulation; and green chain operations, a continuous immersion operation where lumber is pulled through the protection tanks by conveyer.[25]

Historically, the primary chemical used in surface protection has been commercial pentachlorophenate. Concentrated chemicals are diluted to 0.5 to 1 percent pentachlorophenol for surface protection. This concentration is lower than the 2 percent to 9 percent pentachlorophenol used in wood

[18] "NPDES Docket No. 1085-07-22-402, NPDES Appeal No. 86-14: In the Matter of Shee Atika, Incorporated," January 21, 1986.

[19] "Regulatory Guidance and Waste Reduction Manual for United States Sawmills (Draft)," EPA Office of Solid Waste, January 12, 1993.

[20] "Using Best Management Practices to Prevent and Control Pollution from Hardwood Residue Storage Sites," Pennsylvania Hardwoods Development Council, May 15, 1992.

[21] "Regulatory Guidance and Waste Reduction Manual for United States Sawmills (Draft)," EPA Office of Solid Waste, January 12, 1993.

[22] "Regulatory Guidance and Waste Reduction Manual for United States Sawmills (Draft)," EPA Office of Solid Waste, January 12, 1993.

[23] "Regulatory Guidance and Waste Reduction Manual for United States Sawmills (Draft)," EPA Office of Solid Waste, January 12, 1993.

[24] "Background Document Supporting the Proposed Listing of Wastes from Surface Protection Processes, Part One Final Engineering Analysis Volume 1," EPA Office of Solid Wastes, February 1993.

[25] "Regulatory Guidance and Waste Reduction Manual for United States Sawmills (Draft)," EPA Office of Solid Waste, January 12, 1993.

preserving. Producers of chlorophenolic formulations used in surface protection have recently discontinued the product due to the pending hazardous waste regulations and it is expected that stocks will soon be exhausted. Alternatives to pentachlorophenate solutions which have been developed and are currently used include: iodo-prophenyl butyl carbamate, dimethyl sulfoxide, didecyl dimethyl ammonium chloride mixtures; sodium azide mixtures; iodo-prophenyl butyl carbamate, didecyl dimethyl ammonium chloride mixture; 8-quinolinol, copper (II) chelate mixtures; iodo-prophenyl butyl carbamate mixtures; sodium ortho-phenylphenate mixtures; 2-(thiocyanomethylthio)-benzothiozole (TCMTB) and methylene bis (thiocyanate) mixture; and zinc naphthenate mixtures.[26]

Industrial activities at saw mills with the potential to contaminate storm water include spills from surface protection areas, storage and mixing tank areas, treated wood drippage, transport or storage areas, maintenance and shop areas, and areas used for treatment/disposal of wastes. Fugitive emissions from negative pressure spraying activities and hand spraying surface protection formulations may also result in the contamination of storm water.[27]

Significant materials that have the potential to come in contact with storm water discharges at facilities practicing these activities include: all of the materials stated in 3.b. above (under untreated wood lumber and residue generation activities and untreated materials storage) plus treated lumber, treatment chemicals, and treatment equipment (dipping tanks, green chain, material handling equipment, etc.).

Pollutants which result from these types of surface protection operations may include the constituents of those surface protection chemicals listed above, as well as aggregate parameters such as BOD_5, COD, and TSS.

d. Wood Preservation Activities, and Chemicals and Preserved Wood Material Storage. Wood preserving is the application of chemicals to wood and wood products to preserve the structural integrity of the wood. Wood preserving is designed to prevent/delay the deterioration/decay of wood through the addition of flame retardants, water repellents, and chemicals. Wood preserving differs from wood surface protection which is generally performed for aesthetic reasons.[28]

Wood preserving is accomplished by two steps. First, the moisture content of wood is reduced to increase its permeability (this is referred to as conditioning). Conditioning may be accomplished by: (1) allowing wood to dry at ambient temperatures; (2) kiln drying; (3) steaming the wood, then applying a vacuum; (4) dipping the wood in a heated salt bath; or (5) vapor drying, and immersing the wood in a solvent (usually naphtha or Stoddard solvent). After conditioning, wood is impregnated with a preservative for fire retardency, insecticidal resistance, and/or fungicidal resistance. Preservation may be accomplished by either nonpressurized and pressurized methods. The nonpressurized method involves dipping stock in a bath containing the preservatives (either heated or at ambient temperatures), while pressurized methods involve subjecting the wood to the preservative when under pressure. After treatment, the wood stock is often subject to cleaning in order to remove excess preservative prior to stacking treated lumber products outside.[29]

There are a number of different avenues by which wood preserving wastes may contaminate storm water. These may include: drippage of condensate or preservative after pressurized treatment; washing after preservation to remove excess preservative, which usually occurs either in the treatment or storage areas; spills and leaks from process equipment and preservative tanks; fugitive emissions from vapors in the process, as well as blow outs and emergency pressure releases; and kick-back (phenomenon where preservative leaks as it returns to normal pressure) from the lumber.[30]

A wide variety of chemicals are used in the preservation of wood, the most common are creosote, pentachlorophenol and inorganics.

Creosote-based preservatives are mixtures of coal-tar derivatives and creosote solutions (creosotes fortified with insecticide additives such as pentachlorophenol, arsenic trioxide, copper compounds or malathion). Pentachlorophenol preservatives are typically formulations using petroleum solvents and 5 percent total pentachlorophenol. Waxes and resins may also be added.[31] Inorganic preservatives consist of arsenical and chromate salts and fluorides dissolved in water. The most commonly used inorganic preservatives include:[32] chromated copper arsenate (CCA); ammoniacal copper arsenate (ACA); acid copper chromate (ACC); chromated zinc chloride (CZC); and fluor-chrome-arsenate-phenol (FCAP).

Significant materials that have the potential to come in contact with storm water discharges at facilities practicing wood preservation include: all of the materials stated in 3.b. (untreated wood lumber and residue generation activities and untreated wood materials storage) plus treated lumber, treatment chemicals, and treatment equipment (preservative, tanks, preservative contaminated material handling equipment).

Pollutants expected to be discharged from wood preserving facilities typically include conventional pollutants such as BOD_5, TSS and oil and grease, as well as toxics which are dependent upon the preserving formulations used. Organic solvent components such as benzene, toluene, xylene, and ethylbenzene can be found at pentachlorophenol preservation operations. Phenolic compounds such as phenol, chlorophenols, nitrophenols can be found at plants using pentachlorophenol and creosote preservatives. The polynuclear aromatic hydrocarbons of creosote, including anthracene, pyrene, and phenanthrene are often contained in the entrained oils. High phenolic, COD, and oil and grease concentrations have been noted to result from creosote and pentachlorophenol operations. Traces of copper, chromium, arsenic, zinc, and boron often can be found in the wastewaters of plants which use waterborne salt preservatives.[33]

e. Wood Assembly/Fabrication Activities and Final Fabricated Wood Product Storage. The industrial

[26] "Regulatory Guidance and Waste Reduction Manual for United States Sawmills (Draft)," EPA Office of Solid Waste, January 12, 1993.

[27] "Background Document Support the Proposed Listing of Wastes From Wood Preservation and Surface Protection Processes," EPA Office of Solid Waste, July 1987.

[28] "Background Document Supporting the Proposed Listing of Wastes from Surface Protection Processes, Part One Final Engineering Analysis Volume 1," EPA Office of Solid Wastes, February 1993.

[29] "Development Document for Effluent Limitations Guidelines and Standards for the Timber Products Point Source Category, Final (EPA 440/1–81/023)," EPA, Effluent Guidelines Division, January 1981.

[30] "Background Document Support the Proposed Listing of Wastes From Wood Preservation and Surface Protection Processes," EPA Office of Solid Waste, July 1987.

[31] "Background Document Support the Proposed Listing of Wastes From Wood Preservation and Surface Protection Processes," EPA Office of Solid Waste, July 1987.

[32] "Background Document Support the Proposed Listing of Wastes From Wood Preservation and Surface Protection Processes," EPA Office of Solid Waste, July 1987.

[33] "Development Document for Effluent Limitations Guidelines and Standards for the Timber Products Point Source Category, Final (EPA 440/1–81/023)," EPA, Effluent Guidelines Division, January 1981.

activities conducted as part of the assembly and fabrication process are very diverse. For the most part, industrial activities that have the potential to come in contact with precipitation are similar to those described under lumber and residue generation (see Section A.3.b). However, there are a number of additional industrial activities that differ. For example, the fabrication of fiberboard, insulation board, and hardboard may involve the use of wax emulsions, paraffin, aluminum sulfate, melamine formaldehyde, and miscellaneous thermosetting resins. These chemicals may be introduced as part of the board formation process or as a coating to maintain the board's integrity. Generally, these additives account for less than 20 percent of the board. In the formation of fiberboard/insulation board/hardboards, the digestion of pulp and fiber by mechanical, thermal, and sometimes chemical means takes place.[34] Another operation which involves resinous agents is the formation of veneer. In this process, veneer is placed in hot ponds or vats to soften the wood. Veneer strips are removed and often bound by glue or a resinous agent. Glues are also used in the assembly of wood components.[35] Other types of activities include the finishing of wood products. Stains, paints, lacquers, varnish, water repellents and sealants, etc. may be applied to some of the wood products. Many of these materials may not have the potential to come in contact with precipitation as most of these processes are performed within a covered area or building.

Pollutants expected to be found in storm water discharges at facilities that perform these types of industrial activities include BOD_5 and TSS. Oil and grease may be present due to material handling equipment and transport vehicles.

f. Equipment/Vehicle Maintenance, Repair and Storage. Many of the facilities included in the SIC Major group 24 employ the use of material handling equipment, vehicles and other machinery. These facilities store the equipment onsite and may also engage in maintenance and repair activities on them. These types of activities are performed in either covered or outdoor areas of the facility. Associated with these activities is the storage of significant materials such as petroleum products and other maintenance fluids such as fuels, motor oil, hydraulic oils, lubricant fluids, brake fluids, solvents, cleaners and antifreeze.

3. Pollutants Contributing to Storm Water Contamination

Based on the wide variety of industrial activities and significant materials at the facilities included in this sector, EPA believes it is appropriate to divide the timber products industry into subsectors to properly analyze sampling data and determine monitoring requirements. As a result, this sector has been divided into the following subsectors: general saw mills and planning mills; wood preserving; log storage and handling; and hardwood dimension and flooring mills, special products saw mills, millwork, veneer, plywood and structural wood, wood containers, wood buildings and mobile homes, reconstituted wood products and wood products not elsewhere classified. Tables A–1 through A–4 below include data for the eight pollutants that all facilities were required to monitor for under Form 2F. The tables also lists those parameters that EPA has determined may merit further monitoring.

TABLE A–1.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY GENERAL SAWMILLS AND PLANING MILLS FACILITIES SUBMITTING PART II SAMPLING DATA[i] (mg/L)

Pollutant	# of Facilities		# of Samples		Mean		Minimum		Maximum		Median		95th Percentile		99th Percentile	
Sample type	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	34	35	74	73	48.6	47.2	0.0	0.0	440.0	660.0	18.5	18.0	169.8	151.5	400.2	322.6
COD	34	34	75	72	337.0	289.6	0.0	0.0	2156.0	1804.0	115.0	165.5	1346.7	1012.2	3442.9	2170.3
Nitrate + Nitrite Nitrogen	35	34	75	71	0.47	0.47	0.00	0.00	1.50	2.00	0.40	0.40	1.82	1.92	3.57	3.87
Total Kjeldahl Nitrogen	35	34	75	71	2.80	2.42	0.00	0.00	21.00	27.00	1.40	1.40	9.41	7.01	19.18	12.99
Oil & Grease	35	N/A	79	N/A	8.5	N/A	0.0	N/A	55.0	N/A	3.8	N/A	30.5	N/A	62.0	N/A
pH	40	N/A	84	N/A	N/A	N/A	4.7	N/A	9.7	N/A	7.5	N/A	9.5	N/A	10.8	N/A
Total Phosphorus	35	35	75	72	0.61	0.57	0.00	0.00	2.80	3.97	0.30	0.38	2.78	2.34	6.78	5.34
Total Suspended Solids	34	34	74	71	1459	798	1	0	18000	6460	252	400	8998	4378	36040	12921
Zinc	5	5	13	12	0.448	0.362	0.050	0.11	1.7	1.2	0.32	0.29	1.359	0.842	2.456	1.307

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.
[ii] Composite samples.

TABLE A–2.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY WOOD PRESERVING FACILITIES SUBMITTING PART II SAMPLING DATA[i] (mg/L)

Pollutant	# of Facilities		# of Samples		Mean		Minimum		Maximum		Median		95th Percentile		99th Percentile	
Sample type	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	9	9	13	13	14.5	14.3	2.4	2.1	39.0	32.0	13.7	12.4	45.9	44.7	84.4	80.9
COD	9	9	13	13	115.2	98.7	36.0	31.0	274.0	191.0	100.0	98.0	264.3	236.1	398.4	362.7
Nitrate + Nitrite Nitrogen	9	9	13	13	1.05	1.47	0.30	0.20	2.20	5.20	0.90	1.10	2.29	4.74	3.36	9.06
Total Kjeldahl Nitrogen	9	9	13	13	2.20	2.25	1.00	0.80	4.00	3.80	2.20	2.20	3.97	4.74	5.21	6.78
Oil & Grease	9	N/A	13	N/A	7.8	N/A	0.0	N/A	80.0	N/A	0.00	N/A	60.9	N/A	380.8	N/A
pH	8	N/A	12	N/A	N/A	N/A	6.0	N/A	16.0	N/A	7.0	N/A	11.4	N/A	13.5	N/A
Total Phosphorus	9	9	13	13	0.44	0.26	0.60	0.06	1.57	0.90	0.25	0.19	1.54	0.74	3.19	1.30

[34] "Development Document for Effluent Limitations Guidelines and Standards for the Timber Products Point Source Category, Final (EPA 440/1–81/023)," EPA, Effluent Guidelines Division, January 1981.

[35] Part 1 Storm Water Group Permit Applications. Summaries from individual applicant descriptions including Applicant No. 1156 (Westvaco), Applicant No. 92 (Bowater), and Applicant No. 866 (Louisiana-Pacific).

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TABLE A-2.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY WOOD PRESERVING FACILITIES SUBMITTING PART II SAMPLING DATA[i] (mg/L)—Continued

Pollutant	# of Facilities		# of Samples		Mean		Minimum		Maximum		Median		95th Percentile		99th Percentile	
Sample type	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
Total Suspended Solids	9	9	13	13	242	107	11	12	916	260	50	99	1025	343.8	2661	638.5

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.
[ii] Composite samples.

TABLE A-3.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY LOG STORAGE AND HANDLING FACILITIES SUBMITTING PART II SAMPLING DATA[i] (mg/L)

Pollutant	# of Facilities		# of Samples		Mean		Minimum		Maximum		Median		95th Percentile		99th Percentile	
Sample type	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	22	24	52	56	18.7	22.6	0.0	0.0	260.0	130.0	8.3	7.3	66.4	89.3	150.7	206.6
COD	21	23	51	54	286.8	262.1	0.0	0.0	1500	1500	136.0	110.0	1127.8	940.5	2713.2	2110.7
Nitrate + Nitrite Nitrogen	15	17	43	46	0.17	0.19	0.0	0.0	0.82	1.10	0.09	0.11	0.74	0.74	1.61	1.48
Total Kjeldahl Nitrogen	14	17	40	45	2.30	2.14	0.0	0.0	9.30	12.2	1.46	1.30	8.12	5.98	15.63	10.49
Oil & Grease	25	N/A	57	N/A	3.8	N/A	0.0	N/A	37.0	N/A	1.8	N/A	12.9	N/A	24.5	N/A
pH	25	N/A	57	N/A	N/A	N/A	2.8	N/A	8.3	N/A	7.0	N/A	9.3	N/A	10.5	N/A
Total Phosphorus	22	24	52	55	89.49	21.38	0.0	0.0	3000.00	1160	0.20	0.23	15.63	3.86	87.17	13.49
Total Suspended Solids	22	24	52	55	1024	566.8	0.0	0.0	16520	5192	518	164	6657	3121	25663	10723

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.
[ii] Composite samples.

TABLE A-4.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY HARDWOOD DIMENSION AND FLOORING MILLS; SPECIAL PRODUCTS SAWMILLS, NOT ELSEWHERE CLASSIFIED; MILLWORK, VENEER, PLYWOOD AND STRUCTURAL WOOD; WOOD CONTAINERS; WOOD BUILDINGS AND MOBILE HOMES; RECONSTITUTED WOOD PRODUCTS; AND WOOD PRODUCTS FACILITIES NOT ELSEWHERE CLASSIFIED SUBMITTING PART II SAMPLING DATA[i] (mg/L)

Pollutant	# of Facilities		# of Samples		Mean		Minimum		Maximum		Median		95th Percentile		99th Percentile	
Sample type	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	41	42	74	74	55.8	94.9	0.0	0.0	580.0	1925.0	13.5	17	201.8	225.8	532.8	599.6
COD	41	42	74	74	366.3	239.4	636.5	0.0	3315.0	1350.0	151.5	128.0	1155.0	702.3	2417.4	1333.8
Nitrate + Nitrite Nitrogen	41	42	74	74	2.78	1.43	0.0	0.0	66.00	22.5	0.25	0.31	7.49	4.81	25.93	13.03
Total Kjeldahl Nitrogen	41	42	74	74	2.65	2.56	0.0	0.0	14.70	12.5	1.68	1.70	9.11	8.78	18.18	17.85
Oil & Grease	41	N/A	74	N/A	30.7	N/A	0.0	N/A	591.7	N/A	2.0	N/A	74.8	N/A	252.3	N/A
pH	40	N/A	74	N/A	7.0	N/A	3.6	N/A	9.8	N/A	7.0	N/A	9.1	N/A	10.2	N/A
Total Phosphorus	41	42	73	74	0.91	0.55	0.0	0.0	12.00	3.10	0.36	0.38	3.42	2.03	8.15	4.17
Total Suspended Solids	41	42	74	74	891	444	0.0	1.0	17000	3700	242	282	5555	2957	21438	9434

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.
[ii] Composite samples.

The descriptions of industrial activities and significant materials exposed submitted by the group applicants in the wood preserving subsector indicated that these facilities has a high potential to discharge wood preservatives in their storm water discharge. These preservatives typically contain copper and arsenic compounds. The monitoring data which was statistically analyzed for the wood treatment indicated the presence of both arsenic and copper in the discharges. However, data from only eight facilities had been submitted in time for EPA to perform a statistical analysis. EPA, therefore reviewed additional data submitted by wood preserving facilities,and found that copper was present in concentrations greater than the benchmark value in 22 out of 34 observations. Arsenic was higher than bench mark in 12 out of 34 observations.

4. Options for Controlling Pollutants

There are three options for controlling pollutants at timber products facilities: source reduction, best management practices (BMPs), and/or end-of-pipe treatment. In evaluating the options for controlling pollutants in discharges of storm water associated with industrial activity, EPA must provide for compliance with the Best Available Technology Economically Achievable (BAT) and Best Conventional Pollutant Control Technology (BCT) requirements of Section 402(p)(3) of the Clean Water Act. The variabilities in both the industrial activities performed on a specific site and the storm water discharges from timber product facilities, coupled with the lack of sufficient characterization data make it infeasible to develop effluent limitations at this point in time. EPA believes that enabling the owner/operator of the facility to develop BMPs based on site-specific factors such as facility size, industrial activities performed, climate, geographic location, hydrogeology and the environmental setting of each facility will provide the flexibility needed to address appropriate controls to meet the BAT/BCT requirements. Development of a storm water pollution prevention plan that addresses exposure minimization BMPs, will be required for all facilities that discharge storm water from timber product facilities. EPA believes that exposure minimization BMPs will provide appropriate levels of control for pollutants in storm water discharges while allowing relatively inexpensive BMPs to be implemented.

In some instances, however, more labor and resource intensive structural controls such as sedimentation ponds may be appropriate. EPA believes that the BMPs discussed below will help provide a sufficient level of control for the types of pollutants found in discharges associated with timber product facilities.

In developing these industry-specific BMPs both the part 1 application data for facilities that sampled were reviewed, as well as industry-specific literature sources. The BMPs provided are separated into those most appropriate for certain areas of a site where pollutants may be released such as: log, lumber, and other wood product storage areas; residue storage areas; loading and unloading and material handling areas: chemical storage areas: and equipment/vehicle maintenance, storage and repair areas. These types of activities can be found at all types of timber product facilities. Table A–5 provides a summary of the effective practices for the control of pollutants for all timber product facilities.

TABLE A–5.—EFFECTIVE POLLUTANT CONTROL OPTIONS FOR ALL TIMBER PRODUCT FACILITIES

Activity	Associated BMPs
Log, Lumber, and Other Wood Product Storage Areas.	Divert storm water around storage areas with ditches, swales and/or berms.
	Locate storage areas on stable, well-drained soils with slopes of 2–5 percent.
	Line storage areas with crushed rock or gravel or porous pavement to promote infiltration, minimize discharge and provide sediment and erosion control.
	Stack materials to minimize surface areas of materials exposed to precipitation.
	Practice good housekeeping measures such as frequent removal of debris.
	Provide collection and treatment of runoff with containment basins, sedimentation ponds and infiltration basins.
	Use ponds for collection, containment and recycle for log spraying operations.
	Use of silt fence and rip rap check dams in drainage ways.
Residue Storage Areas	Locate stored residues away from drainage pathways and surface waters.
	Avoid contamination of residues with oil, solvents, chemically treated wood, trash, etc.
	Limit storage time of residues to prevent degradation and generation of leachates.
	Divert storm water around residue storage areas with ditches, swales and/or berms.
	Assemble piles to minimize surface areas exposed to precipitation.
	Spray surfaces to reduce windblown dust and residue particles.
	Place materials on raised pads of compacted earth, clay, shale, or stone to collect and drain runoff.
	Cover and/or enclose stored residues to prevent contact with precipitation using silos, van trailers, shed, roofs, buildings or tarps.
	Limit slopes of storage areas to minimize velocities of runoff which may transport residues.
	Provide collection and treatment of runoff with containment basins, sedimentation ponds and infiltration basins.
	Use of silt fence and rip rap check dams in drainage ways.
Loading and Unloading and Material Handling Areas.	Provide diversion berms and dikes to limit runon.
	Cover loading and unloading areas.
	Enclose material handling systems for wood wastes.
	Cover materials entering and leaving areas.
	Provide good housekeeping measures to limit debris and to provide dust control.
	Provide paved areas to enable easy collection of spilled materials.
Chemical Storage Areas	Provide secondary containment around chemical storage areas.
	Provide fluid level indicators.
	Inventory of fluids to identify leakage.
	Locate storage areas away from high traffic areas and surface waters.
	Develop spill prevention, containment and countermeasure (SPCC) plans and implement.
	Cover and/or enclose chemical storage areas.
	Provide drip pads to allow for recycling of spills and leaks.

Sources:
NPDES Storm Water Group Application—Part 1. Received by EPA March 18, 1991, through December 31, 1992.
"Regulatory Guidance and Waste Reduction Manual for United States Sawmills (Draft)," EPA Office of Solid Waste, January 12, 1993.
"Background Document Supporting the Proposed Listing of Wastes From Wood Preservation and Surface Protection Processes," EPA Office of Solid Waste, July 1987.
"Chlorophenate Wood Protection, Recommendations for Design and Operation," Environment Canada, December 1983.
Wood Preserving; Identification and Listing of Hazardous Wastes; Final Rule, "FEDERAL REGISTER," Volume 55, No. 235, December 6, 1990.
Selected pages from "Texas Best Management Practices for Silviculture," Texas Forestry Association, 1989. Submitted for inclusion by American Pulpwood Association, Washington, D.C.

Wood surface protection and preserving facilities should consider additional controls for their storm water discharges because of the types of pollutants which may contaminate the discharges. Therefore, Table A–6 contains a summary of effective practices for the control of pollutants from timber product facilities that treat their wood. These BMPs are to be considered in conjunction with BMPs in Table A–5.

TABLE A–6.—ADDITIONAL EFFECTIVE POLLUTANT CONTROL OPTIONS FOR TIMBER PRODUCT FACILITIES THAT SURFACE PROTECT OR PRESERVE

Activity	Associated BMPs
Wood surface protection and preserving activities.	Extend drip time in process areas before moving to storage areas.
	Pave and berm areas used by equipment that has come in contact with treatment chemicals.
	Dedicate equipment that is used for treatment activities to that specific purpose only to prevent the tracking of treatment chemicals to other areas on the site.
	Locate treatment chemical loading and unloading areas away from high traffic areas where tracking of the chemical may occur.
	Provide drip pads under conveyance equipment from treatment process areas.
	Provide frequent visual inspections of treatment chemical loading and unloading areas during and after activities occur to identify any spills or leaks needing clean-up.
	Cover and/or enclose treatment areas.
	Provide containment in treated wood storage areas.
	Cover storage areas to prevent contact of treated wood products with precipitation.
	Elevate stored, treated wood products to prevent contact with runon/runoff.

Sources:
NPDES Storm Water Group Application—Part 1. Received by EPA March 18, 1991 through December 31, 1992.
"Regulatory Guidance and Waste Reduction Manual for United States Sawmills (Draft)," EPA Office of Solid Waste, January 12, 1993.
"Background Document Supporting the Proposed Listing of Wastes From Wood Preservation and Surface Protection Processes," EPA Office of Solid Waste, July 1987.
"Chlorophenate Wood Protection, Recommendations for Design and Operation," Environment Canada, December 1983.
Wood Preserving; Identification and Listing of Hazardous Wastes; Final Rule, "FEDERAL REGISTER," Volume 55, No. 235, December 6, 1990.
Selected pages from "Texas Best Management Practices for Silviculture," Texas Forestry Association, 1989. Submitted for inclusion by American Pulpwood Association, Washington, D.C.

Control of sediments leaving the site should also be considered by timber product facilities as sediments contribute to the total suspended solids in the storm water discharges. There are several areas of the site that may be prone to erosion due to intense industrial activities. These areas include, but are not limited to: loading and unloading areas, access roads, material handling areas, storage areas, and any other areas where heavy equipment and vehicle use is prevalent. Specific erosion and sediment controls should be implemented to minimize the discharge of sediments from the site. Measurements that timber facilities may consider include, but are not limited to: stabilization measures such as seeding, mulching, chemical stabilization, sodding, soil retaining measures and dust control and structural measures such as sediment traps, contouring, sediment basins, check dams and silt fences.

5. Special Conditions

a. Prohibition of Non-storm Water Discharges. Today's permit authorizes, in addition to the discharges described in part III.A.2., an additional non-storm water discharge specific to the timber products industry that, when combined with storm water, is authorized to be discharged under this permit. To be authorized under the permit, the sources of non-storm water must be identified in the storm water pollution prevention plan prepared for the facility. Where these discharges occur, the plan must identify and ensure the implementation of appropriate pollution prevention measures for the non-storm water components of the discharge. Authorized discharges include the following: spray down of lumber and wood product storage yards.

Spray down of lumber and wood product in storage yards is intermittently performed for fire control and pest control. Discharges from spray down activities are not storm water discharges; however, resulting discharges created as a result of spray down of raw lumber and wood product storage yards are authorized under this section where no chemical additives are used in the spray down waters and no chemicals are applied to the wood during storage. EPA believes that this practice, when performed in compliance with the terms and conditions of this section, will not pose any additional risks to human health and the environment because it is an industrial activity which is performed intermittently and within the confines of an area that should already contain controls for pollutants in storm water discharges.

It should be noted that the following discharges are not authorized under this section: noncontact cooling wastewater; contact cooling wastewater; boiler blowdown and water treatment wastewater; and storm water from areas of surface protection hand spraying activities.

This prohibition of unpermitted non-storm water discharges ensures that these discharges are not inadvertently covered under this section and requires the permittee to submit the appropriate NPDES permit applications to gain coverage for the non-storm water portion of the discharge.

6. Storm Water Pollution Prevention Plan Requirements

Several storm water pollution prevention plan requirements are added in the section of today's permit for the timber products industry, in addition to the baseline conditions described in part VI.C. of today's fact sheet. These deal with the identification and description of potential pollutant sources, and requirements to meet specific good housekeeping, inspection, and sediment/erosion control measures. EPA is also recommending that several criteria be considered during the development of the storm water pollution prevention plan.

a. Contents of the Plan

(1) Description of Potential Pollutant Sources

(a) Drainage—There are no additional requirements beyond those described in Part VI.C.2.a. of this fact sheet.

(b) Inventory of Exposed Materials—This section will require those facilities that have conducted activities associated with wood preserving and wood surface protection with pentachlorophenol formulations, creosote formulations, or arsenic/

chromium formulations in the past to identify: areas where soils are contaminated, treatment equipment, and/or stored materials which remain as a result of these operations. This section will also require the identification of any management practices being employed to minimize the contact of these materials with storm water runoff.

EPA has added these requirements because it is aware through studies performed for the hazardous waste listing process that sites where wood surface protection and wood preserving chemicals have been used in the past continue to contribute pollutants to the storm water discharges that come in contact with them, even once the industrial activity has ceased.[36] In particular, soils that have been contaminated with formulation chemicals, equipment such as dipping tanks and those used for material handling, and wastes and materials that are still stored on the site may continue to release pollutants. EPA is requiring the facility to identify these pollutant sources so that appropriate controls can be implemented.

During the EPA process to list wastes from wood preservation and surface protection processes, data were gathered that showed that the concentration of constituents (of the treatment chemicals) in storm water runoff, in some instances, were equivalent to those concentrations found in process wastewaters. These studies also found high concentrations of phenolic compounds, pentachlorodifluron and phenanthrenes, and metals in soils contaminated with process residuals at several sites. These concentrations were attributed to treated wood drippage and precipitation washoff of treated woods.[37]

Where facilities have used chlorophenolic, creosote, or chromium-copper-arsenic formulations for wood surface protection or preserving activities onsite in the past, and information is available, EPA is requiring that the facility inventory the following: areas where soils are contaminated, treatment equipment, and treated materials remain. Once these areas are identified, measures to minimize their exposure to storm water or to limit discharge of pollutants into storm water must be implemented. EPA is requiring this evaluation because soils, equipment, and other materials that are contaminated by treatment chemicals may continue to be a source of pollutants and can contribute to the contamination of storm water runoff.

(c) Non-storm Water Discharges—There are no additional requirements beyond those described in Part III.A.2. of this permit.

(d) Risk Identification and Summary of Potential Pollutant Sources—There are not additional requirements beyond those described in Part VI.C.2.f. of this fact sheet.

(2) Measures and Controls. As contained in Part VIII.A.5. of this fact sheet, EPA has set forth a number of options which are effective in controlling releases of pollutants to storm water discharges associated with industrial activity. Due to the success of BMPs as a cost effective method of pollution control, EPA is requiring that all facilities consider the implementation of BMPs in the following areas of the site: log, lumber and other wood product storage areas; residue storage areas, loading and unloading areas; material handling areas; chemical storage areas; and equipment/vehicle maintenance, storage and repair areas. The conditions of this section also require facilities that surface protect and/or preserve wood products to address specific BMPs for wood surface protection and preserving activities.

EPA believes it is appropriate to require that permittees indicate in their storm water pollution prevention plan all potential sources of pollution. Effective pollution control measures are currently being implemented at timber product facilities and/or are identified in literature sources specific to timber products facilities. Additional practices may also be found in the "Storm Water Management for Industrial Activities, Developing Pollution Prevention and Best Management Practices" (EPA 832–R–92–006), EPA, September 1992. The determination of the appropriateness or inappropriateness of a measure must be indicated in the facility's storm water management plan.

(a) Good Housekeeping—In addition to typical good housekeeping measures that require the maintenance of areas which may contribute pollutants to storm water in a clean and orderly manner, the pollution prevention plan must specifically address good housekeeping measures and the specific frequency of performance of these measures which are designed to: (1) limit the discharge of wood debris; (2) minimize the leachate generated from decaying wood materials; and (3) minimize the generation of dust.

EPA has specified that BMPs limit the discharge of solids because storm water discharges containing TSS and BOD_5 are prevalent at timber products facilities and can often be controlled by good housekeeping measures.

(b) Preventive Maintenance—This section requires periodic removal of debris from ditches, swales, diversion, containment basins, and infiltration measures. The discharge of solids at timber product facilities may inhibit the performance of storm water controls if they are not maintained properly.

(c) Spill Prevention and Response Procedures—This section requires the development of schedules for response procedures to limit the tracking of spilled materials to other areas of the site. Specifically, this section requires that leaks or spills of wood surface protection or preservation chemicals be cleaned up immediately.

Requirements have been placed in this section to limit the tracking of significant materials that have been leaked or spilled on the site from containers, facility equipment, or onsite vehicles. Of particular concern is the tracking of leaks or spills of treatment chemicals outside near where storm water controls are in place. This may occur, for example, during the filling of storage tanks. Vehicles or equipment used to transfer materials may come into contact with any materials spilled during the filling or emptying of tanks. As the vehicles move to other locations at the site, such material may be tracked and eventually lead to contamination of storm water discharges.

(d) Inspections—Facility operators must conduct visual inspections of BMPs on a quarterly basis. Inspections must be performed quarterly at processing areas, transport areas, and treated wood storage areas of facilities performing wood surface protection and preservation activities. Quarterly inspections are designed to assess the usefulness of practices in minimizing drippage of treatment chemicals on unprotected soils and in areas that will come in contact with storm water discharges. In addition, all timber products facilities must conduct daily inspections of material handling activities and unloading and loading areas whenever activities are occurring in those areas (if activities are not occurring in those areas, no inspection is required).

[36] "Background Document Supporting the Proposed Listing of Wastes from Surface Protection Processes, Part One Final Engineering Analysis Volume 1," EPA Office of Solid Wastes, February 1993.

[37] "Background Document Supporting the Proposed Listing of Wastes from Surface Protection Processes, Part One Final Engineering Analysis Volume 1," EPA Office of Solid Wastes, February 1993.

Records will be required to be maintained showing that these inspections have been performed at the required frequencies. In addition, a set of tracking or follow-up procedures must be implemented to ensure appropriate actions are taken based on the findings of the inspections. These records should be developed on a case-by-case basis depending upon the facility's needs.

(e) Employee Training—There are no additional requirements beyond those listed in Part VI.C.3.e. of this fact sheet.

(f) Sediment and Erosion Control—This section requires that the following areas of the plant be considered for sediment and erosion controls: loading and unloading areas, access roads, material handling areas, storage areas, and any other areas where heavy equipment and vehicle use is prevalent. Sediment and erosion controls include: stabilization measures such as seeding, mulching, chemical stabilization, sodding, soil retaining measures; and dust control and structural measures such as sediment traps, contouring, sediment basins, check dams, and silt fences. This requirement is added because part 2 storm water group permit application data showed that many of the sites were discharging high TSS concentrations in their storm water discharges. Identifying those areas of the site where erosion occurs will aid the permittee in determining appropriate BMPs that will achieve a reduction in TSS loadings.

(g) Storm Water Management—There are no additional requirements beyond those described in Part VI.C.3.h. of this fact sheet.

(3) Comprehensive Site Compliance Evaluation. There are no additional requirements beyond those described in Part VI.C.4. of this fact sheet.

7. Monitoring and Reporting Requirements

(a) Analytical Monitoring Requirements. Under the revised methodology for determining pollutants of concern for the timber products subsectors, all facilities must monitor their storm water discharges. EPA believes that timber product facilities may reduce the level of pollutants in storm water runoff from their sites through the development and proper implementation of the storm water pollution prevention plan requirements discussed in today's permit. In order to provide a tool for evaluating the effectiveness of the pollution prevention plan and to characterize the discharge for potential environmental impacts, today's permit requires timber products facilities to collect and analyze grab samples of their storm water discharges for the pollutants listed in the applicable Tables (A–7 through A–10). The pollutants listed in Tables A–7 through A–10 were found to be above benchmark levels for a significant portion of facilities in the subsectors that submitted quantitative data in the group application process. Because these pollutants have been reported at or above benchmark levels, EPA is requiring monitoring after the pollution prevention plan has been implemented to assess the effectiveness of the pollution prevention plan and to help ensure that a reduction of pollutants is realized.

Today's permit requires the wood preserving subsector to monitor for arsenic and copper. These parameters are commonly found in wood preservatives. The discharge data initially analyzed by EPA indicate that these parameters are found in the storm water discharges from wood preserving facilities. Review of additional sampling data revealed that there was a substantial portion of the facilities discharging these parameters in concentrations greater than the bench mark values. Therefore, EPA has determined that monitoring of arsenic and copper is necessary to ensure that the storm water pollution prevention plans developed by wood preserving facilities adequately addresses sources of these parameters.

Under the Storm Water Regulations at 40 CFR 122.26(b)(14), EPA defined "storm water discharge associated with industrial activity". The focus of today's permit is to address the presence of pollutants that are associated with the industrial activities identified in this definition and that might be found in storm water discharges. Under the methodology for determining analytical monitoring requirements, described in section VI.E.1 of this fact sheet, nitrate plus nitrite nitrogen is above the bench mark concentrations for the wood preserving subsector. After a review of the nature of industrial activities and the significant materials exposed to storm water described by facilities in this subsector, EPA has determined that the higher concentrations of nitrate plus nitrite nitrogen are not likely to be caused by the industrial activity, but may be primarily due to non-industrial activities on-site. Today's permit does not require wood preserving facilities to conduct analytical monitoring for this parameter.

At a minimum, storm water discharges from timber products facilities must be monitored quarterly during the second year of permit coverage. Samples must be collected at least once in each of the following periods: January through March; April through June; July through September; and October through December. At the end of the second year of permit coverage, a facility must calculate the average concentration for each parameter listed in the applicable Tables (A–7 through A–10). If the permittee collects more than four grab samples in this period, then they must calculate an average concentration for each pollutant of concern for all samples analyzed.

TABLE A–7.—MONITORING REQUIREMENTS FOR GENERAL SAWMILLS AND PLANING MILLS

Pollutants of concern	Cut-off concentration
Chemical Oxygen Demand (COD)	120 mg/L
Total Suspended Solids (TSS)	100 mg/L
Zinc, Total Recoverable	0.117 mg/L

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TABLE A–8.—ADDITIONAL MONITORING REQUIREMENTS FOR WOOD PRESERVATION FACILITIES WITH CHLOROPHENOLIC FORMULATIONS

Parameter of concern	Cut-off concentration
Total Recoverable Arsenic	0.16854 mg/L.
Total Recoverable Copper	0.0636 mg/L.

TABLE A–9.—MONITORING REQUIREMENTS FOR LOG STORAGE AND HANDLING FACILITIES

Parameter of concern	Cut-off concentration
Total Suspended Solids (TSS)	100 mg/L.

TABLE A–10.—MONITORING REQUIREMENTS FOR HARDWOOD DIMENSION AND FLOORING MILLS; SPECIAL PRODUCTS SAWMILLS; MILLWORK, VENEER, PLYWOOD AND STRUCTURAL WOOD; WOOD CONTAINERS; WOOD BUILDINGS AND MOBILE HOMES; RECONSTITUTED WOOD PRODUCTS; AND WOOD PRODUCTS FACILITIES NOT ELSEWHERE CLASSIFIED

Parameter of concern	Cut-off concentration
Chemical Oxygen Demand (COD)	120 mg/L.
Total Suspended Solids (TSS)	100 mg/L.

If the average concentration for a parameter is less than or equal to the value listed in the appropriate Tables (A–7 through A–10), then the permittee is not required to conduct quantitative analysis for that parameter during the fourth year of the permit. If, however, the average concentration for a parameter is greater than the cut-off concentration listed in Tables (A–7 through A–10), then the permittee is required to conduct quarterly monitoring for that parameter during the fourth year of permit coverage. Monitoring is not required during the first, third, and fifth year of the permit. The exclusion from monitoring in the fourth year of the permit is conditional on the facility maintaining industrial operations and BMPs that will ensure a quality of storm water discharges consistent with the average concentrations recorded during the second year of the permit.

TABLE A–11.—SCHEDULE OF MONITORING

2nd Year of Permit Coverage	• Conduct quarterly monitoring. • Calculate the average concentration for all parameters analyzed during this period. • If average concentration is greater than the value listed in Tables A–7 through A–10, then quarterly sampling is required during the fourth year of the permit. • If average concentration is less than or equal to the value listed in Tables A–7 through A–10, then no further sampling is required for that parameter.
4th Year of Permit Coverage	• Conduct quarterly monitoring for any parameter where the average concentration in year 2 of the permit is greater than the value listed in Tables A–7 through A–10. • If industrial activities or the pollution prevention plan have been altered such that storm water discharges may be adversely affected, quarterly monitoring is required for all parameters of concern.

In cases where the average concentration of a parameter exceeds the cut-off concentration, EPA expects permittees to place special emphasis on methods for reducing the presence of those parameters in storm water discharges. Quarterly monitoring in the fourth year of the permit will reassess the effectiveness of the adjusted pollution prevention plan.

The monitoring cut off concentrations listed in Tables A–7 through A–10 are not numerical effluent limitations. These values represent a level of pollutant discharge which facilities may achieve through the implementation of pollution prevention plans. At least half of the facilities that submitted Part 2 data from the applicable subsectors reported concentrations more than or equal to the values listed in Tables A–7 through A–10. Facilities that achieve average discharge concentrations which are less than or equal to the values in Tables A–7 through A–10 are not relieved from the pollution prevention plan requirements or any other requirements of the permit.

EPA realizes that if a facility is inactive and unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly chemical sampling.

b. Alternative Certification. Throughout today's permit, there are monitoring requirements for facilities which the Agency believes have the potential for contributing significant levels of pollutants to storm water discharges. The alternative described below is necessary to ensure that monitoring requirements are only imposed on those facilities that do, in fact, have storm water discharges containing pollutants at concentrations of concern. EPA has determined that if materials and activities are not exposed to storm water at the site, then the potential for pollutants to contaminate storm water discharges does not warrant monitoring.

Therefore, a discharger is not subject to the monitoring requirements of this Part provided the discharger makes a certification for a given outfall or on a pollutant-by-pollutant basis in lieu of monitoring reports described under paragraph (*c*) below, under penalty of law, signed in accordance with Part VII.G. (Signatory Requirements), that material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, industrial machinery or operations, and significant materials from past industrial activity that are located in areas of the facility that are within the drainage area of the outfall are not presently exposed to storm water and will not be exposed to storm water for the certification period. Such certification must be retained in the storm water pollution prevention plan and submitted to EPA in accordance with Part VI.C of this permit. In the case of certifying that a pollutant is not present, the permittee must submit the certification along with the monitoring reports required under paragraph (*c*) below. If the permittee cannot certify for an entire period, they must submit the date exposure was eliminated and any monitoring required up until that date. This certification option is not applicable to compliance monitoring requirements associated with effluent limitations. EPA does not expect facilities to be able to exercise this certification for indicator parameters such as TSS and BOD.

c. *Reporting Requirements.* Permittees are required to submit all monitoring results obtained during the second and fourth year of permit coverage within 3 months of the conclusion of each year. For each outfall, one signed Discharge Monitoring Report Form must be submitted per storm event sampled. For facilities conducting monitoring beyond the minimum requirements an additional Discharge Monitoring Report Form must be filed for each analysis.

d. *Sample Type.* All discharge data shall be reported for grab samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The required 72-hour storm event interval is waived where the preceding measurable storm event did not result in a measurable discharge from the facility. The required 72-hour storm event interval may also be waived where the permittee documents that less than a 72-hour interval is representative for local storm events during the season when sampling is being conducted. The grab sample shall be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable.

If storm water discharges associated with industrial activity commingle with process or nonprocess water, then where practicable permittees must attempt to sample the storm water discharge before it mixes with the non-storm water discharge.

e. *Representative Discharge.* When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may test the effluent of one of such outfalls and report that the quantitative data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluent. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

f. *Quarterly Visual Examination of Storm Water Quality.* Timber products facilities shall perform and document a visual examination of a storm water discharge associated with industrial activity from each outfall, except discharges exempted below. The examination(s) must be made at least once in each of the following 3-month periods: January through March, April through June, July through September, and October through December. The examination shall be made during daylight hours unless there is insufficient rainfall or snow melt to produce a runoff event.

(*1*) Examinations shall be made of grab samples collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 1 hour) of when the runoff or snowmelt begins discharging. The examinations shall document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on the samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. Where practicable, the same individual should carry out the collection and examination of discharges for entire permit term.

(*2*) Visual examination reports must be maintained onsite in the pollution prevention plan. The report shall include the examination date and time, examination personnel, the nature of the discharge (i.e., runoff or snow melt), visual quality of the storm water discharge (including observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution), and probable sources of any observed storm water contamination.

(*3*) When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may collect a sample of effluent of one of such outfalls and report that the examination data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

(*4*) When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the records of the visual examinations. Adverse weather conditions that may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(5) EPA realizes that if a facility is inactive and unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly visual examination.

B. Storm Water Discharges Associated With Industrial Activity From Paper and Allied Products Manufacturing Facilities

1. Discharges Covered Under This Section

On November 16, 1990 (55 FR 47990), EPA promulgated the regulatory definition of "storm water discharges associated with industrial activity." This definition included point source discharges of storm water from 11 categories of facilities, including paper and allied product manufacturing facilities that are commonly identified by Standard Industrial Classification (SIC) Major Group 26. Today's permit establishes special conditions for the storm water discharges associated with industrial activities at paper and allied product manufacturing facilities. Based on an evaluation of part 1 and part 2 group application data, these facilities were determined to perform similar operations, use similar raw materials, and employ similar material handling and storage practices. In light of the available information, it was determined that the storm water discharge characteristics would be similar for facilities covered by this section.

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

2. Industry Profile

SIC Major Group 26, the production of pulp, paper, and paperboard, is a highly diversified industry group which manufactures a variety of products. Products include newsprint, printing and writing papers, bleached and unbleached packaging paper, glassine, tissue papers, vegetable parchment, greaseproof papers, bleached and unbleached paperboard, special industrial papers, and pulp. Pulp, paper, and paperboard is produced from wood and nonwood products such as jute, hemp, rags, cotton linters, bagasse, and esparto. Secondary fibers, or wastepaper, is also used to produce paper and paperboard.

Four standard manufacturing processes are involved in the production of pulp, paper, and paperboard: (1) Raw material preparation, (2) pulping, (3) bleaching, and (4) papermaking.

a. Raw Material Preparation. Wood is the most widely used raw material for manufacturing pulp and paper products. Wood must be prepared for pulping by log washing, bark removal, and chipping/sawing. These activities are usually conducted outdoors and produce large amounts of wood chips, sawdust, and other wood debris. If exposed to storm water, these activities may contribute TSS and BOD_5 to the storm water discharge.

b. Pulping. Pulping involves reducing a cellulosic raw material into a form that may be further processed to produce paper or paperboard, or into a form that may be chemically converted. Two pulping methods are used to reduce the raw material: mechanical pulping and chemical pulping.

Mechanical pulping, also known as groundwood pulping, uses two processes to produce pulp, stone groundwood and refiner groundwood. Stone groundwood uses a grindstone to tear fiber from the side of short logs. Refiner groundwood passes wood chips through a disc refiner. In both processes, wood may be softened with chemicals or heat to reduce the amount of energy required for grinding. Mechanical pulp is very suitable for use in newspapers, catalogs, tissues, and one-time publications.

Chemical pulping, using cooking chemicals under controlled conditions, produces a variety of pulps for multipurposes. This process generally produces high quality paper products. Three types of chemical pulping are used: alkaline, sulfite, and semichemical.

Alkaline pulping, more commonly known as the kraft process, produces a very strong pulp and is adaptable to almost all wood species. The pulp is formed by boiling wood chips in an alkaline solution usually containing sodium sulfate. Alkaline pulping also provides for the successful recovery of chemicals used in the process. This pulping technique is the most highly used pulping process worldwide.

Sulfite pulps are generally prepared from softwoods and produce various types of paper including tissue paper and writing paper. Wood chips are boiled with calcium-based chemicals, magnesium-based chemicals, or ammonia-based chemicals. Calcium was the original sulfite liquor base, however, the spent liquor from this base was difficult and expensive to recover. Many sulfite mills have now been converted to the kraft process or have been shut down because of the problems of chemical recovery and the reduced availability of softwoods.

Semichemical pulping involves the cooking of wood chips from hardwoods with a neutral or slightly alkaline sodium sulfite solution. Both sodium and ammonia-based chemicals are used in this process. Pulps produced from semichemical pulping are used in the manufacture of corrugated paperboard. Semichemical pulping mills practice chemical recovery from the waste liquor by balancing the pH of the waste liquor. Spent liquor is then burned in a furnace.

Some facilities use secondary fibers to produce the paper products. Secondary fibers are wastepapers and may be used with little or no preparation depending on their condition. The wastepaper may be blended directly with the virgin pulps or may have to be screened and filtered to remove dirt before being added to the pulp.

Some secondary fibers must be deinked before use. In order to reclaim a useful pulp, all noncellulosic materials, such as ink, fillers, and coatings, must be removed. This process uses detergents and solvents to remove these materials. The detergents and solvents may be stored in an area exposed to storm water.

c. Bleaching. After pulping, the pulp is brown or deeply colored. The color results from the presence of lignins and resins or residue from spent cooking liquor. The pulp must be bleached to produce a light colored or white product.

A brightness scale ranging up to 100 (the brightest) is used to determine the degree of bleaching needed. For example, newspaper and food containers do not need a high degree of brightness so semibleached pulps are used. For white paper products, fully-bleached pulps are used. A bleaching sequence is followed in which specific chemicals are sequentially added. The following sequence may be used in bleaching: chlorination and washing; alkaline extraction and washing;

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chlorine dioxide addition and washing; alkaline extraction and washing, and chlorine dioxide addition and washing.

The sequence may be modified to meet specific bleaching requirements. In general, less bleaching is required for mechanical pulps because they contain all of the wood substrate and would require massive amounts of bleaching. Therefore, mechanical pulps are used to produce lower quality paper products, such as telephone directories, newsprint, and disposable products. Chemical pulps may be brightened to a higher degree. Hydrosulfite, hypochlorite, chlorine, oxygen, and peroxides are used in bleaching and may be stored in areas exposed to storm water.

d. Papermaking. After pulps have been bleached, further mixing and blending may be necessary and noncellulosic materials may be added to prepare the pulp for the papermaking stage. Different types of pulp may be blended for desired effects. Softwood pulps are very strong and are used to make high strength, tear resistant paper. These pulps may be blended with hardwood pulps which add porosity, opacity, and printability qualities to the paper. Other materials may be added to the pulp such as clay, talc, or calcium carbonate to improve the texture, brightness, or opacity of the paper. By adding resin or starch, the paper becomes more ink or water resistant. Each of these additives may be a source of contamination for storm water if stored outdoors.

After noncellulosic materials have been blended with the pulp, it is ready for papermaking. The mixture of pulp and additives is called a pulp furnish. In making paper, fiber from a dilute pulp furnish is placed on a fine screen, called a wire. The water is drained through, and the fiber layer is removed, pressed and dried.

Two basic types of processes are used in papermaking: the cylinder machine and the Fourdrinier. The cylinder machine has wire cylinders which rotate in the dilute pulp furnish and collect fibers. The cylinders deposit the collected fibers on a moving felt to form a fibrous sheet. In the Fourdrinier process, the dilute pulp furnish is placed on a continuous wire belt where the fibrous sheet is formed. The cylinder machine is usually associated with the manufacturing of heavy grades of paper and paperboard; the Fourdrinier process is mostly used for producing paper, but may also be used to make paperboard.

The pressing and drying operations are similar for the two processes. After the fibrous sheet is formed, it is transferred to two or more presses to remove water and enhance smoothness and density. The sheet is then dried by being passed through heated hollow iron or steel cylinders. For a smoother finish, the sheet may be passed through a series of rollers (calendaring) used to produce high density paper.

After the sheet is dry, coatings may be applied to increase appearance, printability, water resistance, or texture. Coatings consist of a high density water slurry of pigments and adhesives that are blended together. Mixtures of starches, latices, polyvinylacetate, and recoverable solvents are used depending on the purpose of the coating. The coating is applied using rolls, air knives, blades, or metering rods. High gloss and smoothness is achieved by using high speed rollers with alternating steel and fabric-filled rolls. The coatings, when stored exposed to storm water discharges may be a source of contamination.

e. Wastewater Treatment. Most pulp, paper, and paperboard facilities have onsite wastewater treatment systems for treating process wastewater, although some facilities may discharge to a POTW. To reduce BOD_5 and TSS loads, many facilities use biological treatment. The most common treatment process is aerated stabilization. At nonintegrated facilities (facilities that do not produce pulp) and secondary fibers facilities, however, primary treatment may be the only method used. At these facilities, primary treatment is usually very effective in reducing BOD_5.

f. Activities Contributing to Storm Water Contamination. Although there is diversity among the types of final products produced at pulp, paper, and paperboard facilities, several industrial activities are common to all. These activities are presented in Table B–1 Below.

Table B–1.—Common Industrial Activities at Paper and Allied Product Manufacturing Facilities

Industrial Activities
Bactericide use
Baghouse, cyclone, dust collectors
Coating
Corrugate
Creasing
Cutting
Equipment storage
Vehicle fueling
Gluing
Rail and Truck loading areas
Material handling sites
Printing
Access Railroads
Scoring
Stitching
Storage areas
Taping

Typical activities performed at pulp, paper, and paperboard facilities include log washing, chipping and cutting of logs, log sorting, log storage, and loading and unloading of logs onto trucks or railroad cars for transport to other facilities. These log storage and handling activities may contribute bark and wood debris, TSS, and leachates to a storm water discharge. Leachates from the decay of wood products may contain high levels of TSS and BOD_5.

Many of the facilities in SIC Major group 26 employ the use of material handling equipment (forklifts, loaders, vehicles, chippers, debarkers, cranes, etc.), vehicles, and other machinery. These facilities store the equipment onsite and may also engage in equipment maintenance and repair activities. These types of activities are performed in either covered or outdoor areas of the facility. Associated with these activities is the storage of significant materials such as petroleum products and other maintenance fluids such as fuels, motor oils, hydraulic oils, lubricant fluids, brake fluids, and antifreeze. When exposed to storm water, these materials may cause contamination of a storm water discharge.

The manufacturing processes at paper and allied product manufacturing facilities are not typically exposed to storm water. Because of the lack of industrial activities occurring outdoors, the primary sources of storm water pollutants originate from materials handling, storage of materials, and waste management or disposal activities. Sources of pollutant are most often from spills and leaks of materials at loading and unloading areas, storage areas, and waste disposal areas. Table B–2 lists the materials that may be exposed to storm water at paper and allied product manufacturing facilities.

Table B–2.—Common Significant Materials at Paper and Allied Product Manufacturing Facilities

Significant Materials Onsite
Solvents
Glues
Fuels

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TABLE B–2.—COMMON SIGNIFICANT MATERIALS AT PAPER AND ALLIED PRODUCT MANUFACTURING FACILITIES—Continued

Significant Materials Onsite
Oils
Lubricants
Alcohol
Starch
Wooden pallets
Paper rollstock
Waxes
Air emissions from solvent recovery processes
Baled waste paper
Dyes
Inks
Ammonia
Biocides
Miscellaneous materials removed during pulping
Final products
Adhesives
Paper wastes
Dust and particulates from cyclones used in paper trim activities, resins/polymers
Clay slurries.

3. Pollutants in Storm Water Discharges Associated With Industrial Activity From Paper and Allied Product Manufacturing Facilities

Few pollutants are expected in storm water discharges from the manufacturing of paper and allied products, because the majority of industrial activities occur indoors. Pollutants may be present in storm water as a result of outdoor activities associated with the industry such as discharges which come into contact with the following areas of the site: loading or unloading of materials; outdoor storage of raw materials or unpackaged products; outdoor process activities; dust or particulate generating processes; and illicit connections or inappropriate management practices.

The volume and quantity of storm water discharges associated with industrial activity depend upon a number of factors, including the nature of the industrial activities occurring at the facility, the nature of the precipitation, and the degree of surface imperviousness. Storm water may pick up pollutants from structures and other surfaces as it drains from the facility. Even within a group of facilities with similar activities and materials used, handled, stored, or produced, the quality of the storm water can vary greatly.

The regulatory deadline for submission of the part 2 data was October 1, 1992. Many part 2 data submittals remain incomplete and many of those that did submit data did not identify the significant material or industrial activity that may have contributed the pollutants to the storm water discharge. Based on the wide variety of industrial activities and significant materials at the facilities included in this sector, EPA believes it is appropriate to divide the paper and allied products manufacturing industry into subsectors to properly analyze sampling data and determine monitoring requirements. As a result, this sector has been divided into the following subsectors: paper mills; paperboard mills, paperboard containers and boxes; and converted paper and paperboard products, except containers and boxes. Tables B–2, B–3, and B–4 below include data for the eight pollutants that all facilities were required to monitor for under Form 2F. The tables also list those parameters that EPA has determined merit further monitoring. A table has not been included for paper mill facilities because less than 3 facilities submitted data in that subsector.

TABLE B–2.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY PAPERBOARD MILL FACILITIES SUBMITTING PART II SAMPLING DATA (MG/L)

Pollutant	# of Facilities		# of Samples		Mean		Minimum		Maximum		Median		95th Percentile		99th Percentile	
Sample type	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	9	9	10	10	184.2	77.7	2.0	0.0	1000.0	306.0	18.0	28.0	733.9	412.7	2708.8	1153.4
COD	9	9	10	10	402.3	228.9	50.0	31.0	1720.0	780.0	200.0	124.5	1318.6	701.4	2729.5	1301.7
Nitrate + Nitrite Nitrogen	9	9	10	10	0.86	0.84	0.00	0.13	3.19	1.85	0.50	0.62	2.83	2.78	5.38	5.31
Total Kjeldahl Nitrogen	9	9	10	10	3.72	3.88	0.52	0.31	10.20	10.8	2.19	2.47	12.88	15.88	25.84	35.33
Oil & Grease	8	N/A	9	N/A	9.3	N/A	1.0	N/A	35.0	N/A	5.0	N/A	37.8	N/A	87.8	N/A
pH	9	N/A	10	N/A	N/A	N/A	7.1	N/A	....	N/A	7.7	N/A	....	N/A	....	N/A
Total Phosphorus	9	9	10	10	0.37	0.31	0.08	0.09	1.50	0.58	0.27	0.29	1.04	0.71	1.86	1.07
Total Suspended Solids	9	9	10	10	481	54.5	9	8.0	3390	198.0	168	36	1840	184.7	5161	370.0

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.

[ii] Composite samples.

TABLE B–3.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY PAPERBOARD CONTAINERS AND BOXES FACILITIES SUBMITTING PART II SAMPLING DATA[i] (mg/L)

Pollutant	# of Facilities		# of Samples		Mean		Minimum		Maximum		Median		95th Percentile		99th Percentile	
Sample type	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	47	44	74	66	21.9	16.9	0.0	0.0	163.0	271.0	10.5	8.0	75.4	47.72	184.5	92.63
COD	47	44	74	67	184.8	115.8	0.0	0.0	2200.0	1400.0	79.5	51.00	698.5	350.8	1663.4	738.9
Nitrate + Nitrite Nitrogen	47	44	74	67	1.03	0.838	0.00	0.0	4.97	5.6	0.59	0.48	3.80	3.07	8.44	6.80
Total Kjeldahl Nitrogen	47	44	74	67	4.23	3.61	0.00	0.0	89.60	64.9	1.94	1.90	11.42	9.69	22.99	18.4
Oil & Grease	47	N/A	74	N/A	4.3	N/A	0.0	N/A	61.0	N/A	1.0	N/A	18.4	N/A	44.4	N/A
pH	47	N/A	72	N/A	N/A	N/A	3.8	N/A	9.0	N/A	6.8	N/A	8.8	N/A	9.9	N/A
Total Phosphorus	46	43	73	66	0.45	0.41	0.00	0.0	10.30	10.8	0.17	0.15	1.12	0.94	2.23	1.79
Total Suspended Solids	47	44	74	66	141	39.55	0	0.0	2340	550	47	12.5	658	157.88	1987	413.3

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.

[ii] Composite samples.

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TABLE B-4.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY CONVERTED PAPER AND PAPERBOARD PRODUCTS, EXCEPT CONTAINERS AND BOXES MANUFACTURING FACILITIES SUBMITTING PART II SAMPLING DATA[i] (mg/L)

Pollutant	# of Facilities		# of Samples		Mean		Minimum		Maximum		Median		95th Percentile		99th Percentile	
Sample type	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	19	17	37	35	26.8	24.2	0.0	0.0	152.0	367.0	6.7	8.0	98.8	70.7	239.9	157.2
COD	19	17	37	36	159.1	154.1	8.0	0.0	1300.0	1486.0	49.0	43.5	484.9	503.4	1137.2	1220.7
Nitrate + Nitrite Nitrogen	19	17	37	34	0.93	0.74	0.00	0.0	5.20	2.44	0.40	0.46	3.17	2.19	6.72	3.98
Total Kjeldahl Nitrogen	19	17	37	35	3.28	2.40	0.00	0.0	38.70	23.1	1.00	1.03	10.95	8.45	25.02	18.1
Oil & Grease	19	N/A	39	N/A	1.9	N/A	0.0	N/A	18.0	N/A	0.6	N/A	7.5	N/A	15.9	N/A
pH	19	N/A	39	N/A	N/A	N/A	4.2	N/A	8.9	N/A	7.0	N/A	8.8	N/A	9.8	N/A
Total Phosphorus	19	17	37	35	0.30	0.28	0.00	0.0	2.58	1.25	0.18	0.15	0.92	0.86	1.76	1.56
Total Suspended Solids	19	17	37	35	89	42.9	0	0.0	1240	761	16	9.0	319	160.0	893	500.8

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.

[ii] Composite samples.

4. Options for Controlling Pollutants

There are two options for reducing pollutants in storm water discharge; end-of-pipe treatment, and implementing best management practices (BMPs) to prevent and/or eliminate the contact between significant materials and storm water. A comprehensive storm water management program for a given plant may include controls from each of these categories and should be based on a consideration of site and facility plant characteristics. End-of-pipe treatment is effective for the control of process waters when the types of pollutants and the volume of water to be treated is known. However, storm water discharges from any industry, including the paper and allied product manufacturing industry, can be numerous, intermittent, and of various volumes. Therefore, the channelization of storm water that comes into contact with significant materials into a single treatment facility, or construction of numerous treatment devices for each discharge, may be burdensome and ineffective for treating pollutants contained in storm water from these types of facilities. EPA believes that the most appropriate means of storm water management at paper and allied product manufacturing facilities can be sufficiently determined by the operator of the facility.

EPA believes that the most effective storm water management control for limiting the offsite discharge of pollutants in storm water is a combination of passive and active BMPs.

Examples of BMPs range from simple housekeeping, material handling practices, preventive maintenance, diversions practices, to more advanced structural control such as detention and retention ponds and infiltration devices.

The selection of the most effective BMPs will be based on site-specific considerations such as: facility size, climate, geographic location, hydrogeology and the environmental setting of each facility, volume and type of discharge generated, and number of outfalls. Each facility will be unique in that the source, type and volume of contaminated storm water discharges will differ. In addition, the fate and transport of pollutants in these discharges will vary. EPA believes that the management practices discussed herein are well suited mechanisms to prevent or control the contamination of storm water discharges associated with the paper and allied product manufacturing industry.

As part of the group application review process, a review of the part 1 data was analyzed. The applications indicated that numerous BMPs were already being implemented at many of the representative sites. Table B-5 provides the most common practices presently being employed and the relative percentage of facilities who are implementing them. Table B-6 provides an additional list of BMPs that may be appropriate for the industry. Many of the BMPs identified are examples of practices intended to limit the exposure of significant materials and industrial activities to storm water. Facility operators should review their current operations and consider implementing these BMPs if they are applicable to the site and are expected to reduce the discharge of pollutants from the site in storm water.

TABLE B-5.—BEST MANAGEMENT PRACTICES DISCUSSED IN PART 1 GROUP APPLICATIONS[i]

BMP	Percent of facilities
Catch Basins	22.2
Diversion structures around potential contaminants	43.8
Spill Control Procedures, Contingency Plans (SPCC)	67.4
Swales, ditches, trench or graded surfaces	51.4
Employee training	62.5

[i] Material Management Practices were identified in over 20 percent of the 144 facilities in the sampling subset.

TABLE B-6.—SUGGESTED BEST MANAGEMENT PRACTICES AT PULP AND ALLIED PRODUCTS MANUFACTURING FACILITIES

Activity	Suggested BMPs
Outdoor loading and unloading	• Confine loading/unloading activities to a designated response and control area. • Avoid loading/unloading materials in the rain. • Cover loading/unloading area/or conduct these activities indoors. • Develop and implement spill plans. • Use berms or dikes around area.

TABLE B–6.—SUGGESTED BEST MANAGEMENT PRACTICES AT PULP AND ALLIED PRODUCTS MANUFACTURING FACILITIES—Continued

Activity	Suggested BMPs
Raw and/or waste material storage areas	• Inspect containers for leaks or damage prior to loading. • Use catch buckets, drop cloths, and other spill prevention measures where liquid materials are loaded/unloaded. • Provide paved areas to enable easy collection of spilled materials. • Confine storage to a designated area. • Store materials inside. • Cover storage areas with a roof or tarp. • Use dikes or berms for storage tanks and drum storage. • Cover dumpsters used for waste paper and other materials. • Store materials on concrete pads to allow for recycling and spills of leaks. • Expedite recycling process for exposed scrap paper. • Develop and implement spill plans. • Provide paved areas to enable easy collection of spilled materials. • Provide good housekeeping (i.e., dust and debris collection) where cyclones are utilized.
Log, lumber and other wood product storage areas.	• Divert storm water around storage areas with ditches, swales, and/or berms. • Practice good housekeeping measures such as frequent removal of debris. • Line storage areas with crushed rock or gravel or porous pavement to promote infiltration, minimize discharge and provide sediment and erosion control. • Use ponds for collection, containment and recycle for log spraying operations.

5. Special Conditions

There are no requirements beyond those described in Part VI.B. of this fact sheet.

6. Storm Water Pollution Prevention Plan Requirements

There are no requirements beyond those described in Part VI.C. of this fact sheet.

a. Description of Potential Pollutant Sources. There are no requirements beyond those described in Part VI.C. of this fact sheet.

b. Measures and Controls. There are no requirements beyond those described in Part VI.C. of this fact sheet.

c. Comprehensive Site Compliance Evaluation. There are no requirements beyond those described in Part VI.C. of this fact sheet.

7. Numeric Effluent Limitation.

There are no effluent limits beyond those described in Part VI.B. of this permit.

8. Monitoring and Reporting Requirements

a. Analytical Monitoring Requirements. Under the revised methodology for determining pollutants of concern for the various industrial sectors, only one subsector, paperboard mills, is required to monitor storm water discharges. As discussed previously, the median value for COD of 124.5 mg/L is higher than the benchmark value for COD of 120 mg/L for the paperboard subsector, thus triggering monitoring for COD. The monitoring requirements are presented in Table B–7 for paperboard mills.

At a minimum, storm water discharges from paperboard mills must be monitored quarterly during the second year of permit coverage. Monitoring must be performed during each of the following periods: January through March; April through June; July through September; and October through December. At the end of the second year of permit coverage, a facility must calculate the average concentration for each parameter listed in Table B–7. If the permittee collects more than four samples in this period, then they must calculate an average concentration for each pollutant of concern for all samples analyzed.

TABLE B–7.—PAPERBOARD MILLS MONITORING REQUIREMENTS

Pollutants of concern	Cut-off concentration
Chemical Oxygen Demand	120 mg/L.

If the average concentration for a parameter is less than or equal to the cut-off concentration, then the permittee is not required to conduct quantitative analysis for that parameter during the fourth year of the permit. If, however, the average concentration for a parameter is greater than the cut-off concentration, then the permittee is required to conduct quarterly monitoring for that parameter during the fourth year of permit coverage. Monitoring is not required during the first, third, and fifth year of the permit. The exclusion from monitoring in the fourth year of the permit is conditional on the facility maintaining industrial operations and BMPs that will ensure a quality of storm water discharges consistent with the average concentrations recorded during the second year of the permit. The schedule for monitoring is presented in Table B–8.

TABLE B–8.—SCHEDULE OF MONITORING

2nd Year of Permit Coverage	• Conduct quarterly monitoring. • Calculate the average concentration for all parameters analyzed during this period. • If average concentration is greater than the value listed in Table B–7, then quarterly sampling is required during the fourth year of the permit. • If average concentration is less than or equal to the value listed in Table B–7, then no further sampling is required for that parameter.

TABLE B–8.—SCHEDULE OF MONITORING—Continued

4th Year of Permit Coverage	• Conduct quarterly monitoring for any parameter where the average concentration in year 2 of the permit is greater than the value listed in Table B–7. • If industrial activities or the pollution prevention plan have been altered such that storm water discharges may be adversely affected, quarterly monitoring is required for all parameters of concern.

In cases where the average concentration of a parameter exceeds the cut-off concentration, EPA expects permittees to place special emphasis on methods for reducing the presence of those parameters in storm water discharges. Quarterly monitoring in the fourth year of the permit will be used to reassess the effectiveness of the adjusted pollution prevention plan.

EPA realizes that if a facility is inactive and unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly chemical sampling.

(1) Sample Type. All discharge data shall be reported for grab samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The required 72-hour storm event interval is waived where the preceding measurable storm event did not result in a measurable discharge from the facility. The required 72-hour storm event interval may also be waived where the permittee documents that less than a 72-hour interval is representative for local storm events during the season when sampling is being conducted. The grab sample shall be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable.

If storm water discharges associated with industrial activity commingle with process or nonprocess water, then where practicable permittees must attempt to sample the storm water discharge before it mixes with the non-storm water discharge.

(2) Representative Discharge. When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may test the effluent of one of such outfalls and report that the quantitative data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluent. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

(3) Alternative Certification. Throughout today's permit, EPA has included monitoring requirements for facilities which the Agency believes have the potential for contributing significant levels of pollutants to storm water discharges. The alternative certification described below is necessary to ensure that monitoring requirements are only imposed on those facilities that do, in fact, have storm water discharges containing pollutants at concentrations of concern. EPA has determined that if materials and activities are not exposed to storm water at the site, then the potential for pollutants to contaminate storm water discharges does not warrant monitoring.

Therefore, a discharger is not subject to the monitoring requirements of this Part provided the discharger makes a certification for a given outfall on a pollutant-by-pollutant basis in lieu of monitoring described in Table B–8 under penalty of law, signed in accordance with Part VII.G. (Signatory Requirements) of the permit, that material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, industrial machinery or operations, significant materials from past industrial activity, and that are located in areas of the facility that are within the drainage area of the outfall are not presently exposed to storm water and will not be exposed to storm water for the certification period. Such certification must be retained in the storm water pollution prevention plan and submitted to EPA in lieu of monitoring reports required under paragraph b. The permittee is required to complete any and all sampling until the exposure is eliminated. If the facility is reporting for a partial year, the permittee must specify the date exposure was eliminated. If the permittee is certifying that a pollutant was present for part of the reporting period, nothing relieves the permittee from the responsibility to sample that parameter up until the exposure was eliminated and it was determined that no significant materials remained. This certification option is not applicable to compliance monitoring requirements associated with effluent guidelines. EPA does not expect facilities to be able to exercise this certification for indicator parameters, such as TSS and BOD.

b. Reporting Requirements. Permittees are required to submit all monitoring results obtained during the second and fourth year of permit coverage within 3 months of the conclusion of each year. For each outfall, one Discharge Monitoring Report Form must be submitted per storm event sampled. For facilities conducting monitoring beyond the minimum requirements an additional Discharge Monitoring Report Form must be filed for each analysis. The permittee must include a measurement or estimate of the total precipitation, volume of runoff, and peak flow rate of runoff for each storm event sampled.

c. Quarterly Visual Examination of Storm Water Quality. Quarterly visual examinations of a storm water discharge from each outfall are required at all paper and allied products manufacturing facilities. The examination must be of a grab sample collected from each storm water outfall. The examination of storm water grab samples shall include any observations of color, odor, turbidity, floating solids, foam, oil sheen, or other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on these samples.

The examination must be made at least once in each designated period during daylight hours unless there is insufficient rainfall or snow-melt to runoff. Whenever practicable, the same individual should carry out the collection and examination of discharges throughout the life of the permit to ensure the greatest degree of consistency possible. Examinations shall be conducted in each of the following periods for the purposes of inspecting storm water quality associated with storm water runoff and snow melt: January through March; April through June; July through September; October through December. Grab samples shall be collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 60 minutes) of when the runoff begins discharging. Reports of the visual examination include: the examination date and time, examination personnel, visual quality of the storm water discharge, and probable sources of any observed storm water contamination. The visual examination reports must be maintained onsite with the pollution prevention plan.

EPA believes that this quick and simple assessment will help the permittee to determine the effectiveness of his/her plan on a regular basis at very little cost. Although the visual examination cannot assess the chemical properties of the storm water discharged from the site, the examination will provide meaningful results upon which the facility may act quickly. The frequency of this visual examination will also allow for timely adjustments to be made to the plan. If BMPs are performing ineffectively, corrective action must be implemented. A set of tracking or follow-up procedures must be used to ensure that appropriate actions are taken in response to the examinations. The visual examination is intended to be performed by members of the pollution prevention team. This hands-on examination will enhance the staff's understanding of the storm water problems on that site and the effects of the management practices that are included in the plan.

When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may collect a sample of effluent from one such outfall and report that the examination data also apply to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination. Adverse weather conditions which may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

EPA realizes that if a facility is inactive and unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly visual examination.

C. Storm Water Discharges Associated With Industrial Activity From Chemical and Allied Products Manufacturing Facilities

1. Discharges Covered Under This Section

EPA regulations define "storm water discharges associated with industrial activity" at 40 CFR 122.26(b)(14) in order to specify those discharges that are required to be permitted under the NPDES program. Category (ii) of this definition includes facilities classified as Standard Industrial Classification (SIC) code 28, Chemical and Allied Products Manufacturing, with the exception of facilities classified as SIC code 285—Paints, Varnishes, Lacquers, Enamels, and Allied Products Manufacturing, which are included in category (xi) of the definition. EPA did not receive any group applications from facilities with primary SIC code 283 (Drugs Manufacturing). Therefore, as EPA had no data on such facilities, they are not eligible for coverage under this section of today's permit. The following section describes facilities covered by Part XI.C. of today's permit and the conditions and requirements of facilities covered by Part XI.C.

For additional information on the subsectors and their industrial activities, please see the following documents:

"Development Document for Effluent Limitations Guidelines and Standards for the Paint Formulating Point Source Category." EPA–440/1–79/049–b. 1979.

"Development Document for Interim Final Effluent Limitations Guidelines for the Pesticide Chemicals Manufacturing Point Source Category." EPA–440/1–75/060d. 1976.

"Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Major Organic Products Segment of the Organic Chemicals Manufacturing Point Source Category." EPA–440/1–74–009a. 1974.

"Development Document for Effluent Limitations Guidelines, New Source Performance Standards and Pretreatment Standards for Organic Chemicals and the Plastics and Synthetic Fibers Point Source Category." EPA–440/1–87/009. 1987.

"Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Basic Fertilizer Chemicals Segment of the Fertilizer Manufacturing Point Source Category." 1974.

"Development Document for Final Effluent Limitations Guidelines, New Source Performance Standards and Pretreatment Standards for the Pharmaceutical Manufacturing Point Source Category." EPA–440/1–83/084. 1983.

"Development Document for Effluent Limitations Guidelines, New Source Performance Standards and Pretreatment Standards for the Inorganic Chemicals Manufacturing Point Source Category, Phase 2." EPA–440/1–84/007. 1984.

Part XI.C. of today's permit has been developed for storm water discharges at facilities primarily engaged in the manufacture of chemicals and allied products. This sector of industry includes facilities which manufacture a broad range of products including plastic and synthetic materials, detergents, paints and varnishes, drugs, fertilizers and pesticides, adhesives, inks, explosives, artist's inks and paints, and organic and inorganic chemicals used for industrial purposes. Specifically, Part XI.C. of today's permit applies to establishments primarily engaged in manufacturing:

a. Industrial inorganic chemicals (including SIC 281).

b. Plastic materials and synthetic resins, synthetic rubbers, and cellulosic and other humanmade fibers, except glass (including SIC 282).

c. Soaps and detergents; specialty cleaning, polishing, and sanitation preparations; surface active preparations used as emulsifiers, wetting agents, and finishing agents, including sulfonated oils; perfumes, cosmetics, and other toilet preparations; glycerin made from vegetable and animal fats and oils (including SIC 284).

d. Paints (in paste and ready-mixed form), varnishes, lacquers, enamels, shellac, putties, wood fillers, and sealers, paint and varnish removers, paint brush cleaners, and allied paint products (including SIC 285).

e. Industrial organic chemicals (including SIC 286).

f. Nitrogenous fertilizers; phosphatic fertilizers; fertilizers, mixing only; pesticides; and other agricultural chemicals, not elsewhere classified (including SIC 287).

g. Industrial and household adhesives, glues, caulking compounds, sealants, and linoleum, tile, and rubber cements from vegetable, animal, or synthetic plastics materials (including SIC 2891).

h. Explosives (including SIC 2892).

i. Printing ink, including gravure, screen process, and lithographic ink, and carbon black (including SIC 2893 and 2895); and, due to the nature of manufacturing activities, EPA has included industrial facilities represented by SIC 3952 in this category, but only those primarily engaged in the manufacturing of ink and paints, including china painting enamels, india and drawing ink, platinum paints for burnt wood or leather work, paints for china painting, artists' paints and artists' water colors.

j. Miscellaneous that are not in Sections a. through i. of this part, such as fatty acids, essential oils, nonvegetable gelatin, sizes, bluing, laundry sours, writing and stamp pad ink, industrial compounds, such as boiler and heat insulating compounds, metal, oil, and water treatment compounds, waterproofing compounds, and chemical supplies for foundries (including SIC 2899).

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

2. Pollutants Found in Storm Water Discharges

Water quality impacts caused by storm water discharges associated with an industrial activity from Chemical and Allied Products Manufacturing facilities are expected to vary depending on several factors. Such factors include the geographic location and hydrology of the site, the type of manufacturing and/or industrial activities, the amount and type of operations and material storage occurring outside, imperviousness of surfaces at the site, and the impact of a given precipitation event. In addition, sources of pollutants from non-storm water discharges such as washwaters from industrial areas, illicit connections, and spills may increase the pollutant loading to waters of the United States. Because there is wide variety of products and manufacturing activities in this sector of today's permit, EPA has subdivided the chemicals and allied products manufacturing industry into "subsectors."

Part 1 of the group application required a summary of industrial activities and the significant materials stored exposed to precipitation. This provided useful qualitative information to EPA, but information that is not possible to quantify reliably due to differences in terminology and thoroughness. For the summary of industrial activities, some participants reported their industrial activity as "manufacture of product X," rather than listing the components of that main activity. Other participants listed some or all general industrial actions, e.g., "shredding" or "wastewater treatment." (Products listed represent most of the industrial classifications which are subject to this section of today's permit). Table C.1. lists the general industrial actions occurring at facilities according to part 1 of their group applications.

TABLE C–1.—INDUSTRIAL ACTIVITIES OCCURRING AT CHEMICAL AND ALLIED PRODUCT MANUFACTURERS (AS REPORTED IN PART 1 OF GROUP APPLICATIONS)

1. Storage of materials in tanks, either below or above ground.
2. Wastewater treatment, use of activated sludge process, or land application of wastewaters.
3. Bagging of materials/products.
4. Blending and mixing of chemicals.
5. Packaging of chemicals.
6. Cooling towers.
7. Crushing, Milling, Shredding, Granulation and Grinding of materials.
8. Storage of cylinders used to contain industrial gases.
9. Distribution of products.
10. Storage of empty or full drums.
11. Equipment storage and maintenance, including vehicles.
12. Application of fertilizers or pesticides.
13. Operation of a foundry.
14. Fueling of vehicles.
15. Hazardous waste temporary storage or operation of RCRA treatment, storage, or disposal facility.
16. Hot oil system for cooling/heat exchange.
17. Landfills or temporary refuse site.
18. Application of lime.
19. Loading/Unloading.
20. Use of machinery to process materials.
21. Material handling and warehousing.
22. Plant yard and areas of past industrial activity.
23. Access roads and rail tracks.
24. Steam boilers.

TABLE C–1.—INDUSTRIAL ACTIVITIES OCCURRING AT CHEMICAL AND ALLIED PRODUCT MANUFACTURERS (AS REPORTED IN PART 1 OF GROUP APPLICATIONS)—Continued

25. Thermal oxidation of lead.
26. Washing of drums.
27. Waste dumpster or compactor.

Table C–2 shows the subsectors and their corresponding SIC codes and letters (from discharges covered under this section in this fact sheet).

Part 2 of the storm water group application required that quantitative data be submitted by a representative sampling subgroup. Based on the wide variety of industrial activities and significant materials at the facilities included in this sector, EPA believes it is appropriate to divide the chemical and allied products industry into subsectors to properly analyze sampling data and determine monitoring requirements. As a result, this sector has been divided into the following subsectors: industrial inorganic chemicals; plastics, synthetics, and resins; drugs; soaps, detergents, cosmetics, perfumes; paints, varnishes, lacquers, enamels, and allied products; industrial organic chemicals; agricultural chemicals; and miscellaneous chemical products. Tables C–2, C–3, C–4, C–5, C–6, C–7, and C–8 below include data for the eight pollutants that all facilities were required to monitor for under Form 2F. The tables also list those parameters that EPA has determined merit further monitoring. A table has not been included for industrial organic chemical manufacturing facilities because less than 3 facilities submitted data in that subsector.

TABLE C–2.—SUBSECTOR INDEX

Subsector		SIC Code(s)
1	....	281
2	....	282
3	....	284
4	....	285
5	....	286
6	....	287
7	....	289, 2891, 2892, 2893, 2894, 2899, 3952
8	....	28[i]

[i] Subsector 8 includes those facilities that indicated their SIC code only as 28, without the following 1 or 2 digits.

TABLE C–3.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY INDUSTRIAL INORGANIC CHEMICALS MANUFACTURING FACILITIES SUBMITTING PART II SAMPLING DATA[i] (mg/L)

Pollutant	# of Facilities		# of Samples		Mean		Minimum		Maximum		Median		95th Percentile		99th Percentile	
Sample type	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	10	10	16	16	12.1	8.872	0.0	0.0	67.0	26.0	7.0	7.5	35.0	22.8	60.4	34.3
COD	10	10	16	16	101.4	63.6	20.0	0.0	350.0	320.0	80.0	36.5	269.2	185.1	453.4	334.2
Nitrate + Nitrite Nitrogen	10	10	16	16	2.79	1.92	0.60	0.07	7.30	7.1	2.40	1.25	14.72	6.24	37.34	18.7
Total Kjeldahl Nitrogen	10	10	16	16	18.71	7.09	0.00	0.0	132.00	19.4	4.09	3.15	110.69	30.8	392.86	68.3
Oil & Grease	9	N/A	15	N/A	1.9	N/A	0.0	N/A	18.0	N/A	0.1	N/A	9.5	N/A	39.7	N/A
pH	9	N/A	15	N/A	N/A	N/A	5.4	N/A	10.4	N/A	7.6	N/A	11.2	N/A	13.1	N/A
Total Phosphorus	10	10	16	16	0.98	0.83	0.00	0.0	6.59	6.14	0.34	0.40	3.32	3.19	7.55	7.61
Total Suspended Solids	10	10	16	16	156	80.4	6	0.82	790	320	99	21.5	769	658.5	2043	3258.4
Aluminum	7	7	13	13	2.41	1.7	0.49	0.06	7.82	7.87	1.06	0.77	7.02	6.83	12.8	16.47
Iron	5	5	11	11	3.0	2	0.5	0.1	8.8	7.6	2.2	1.2	10.6	8.7	21.7	21.7

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.
[ii] Composite samples.

TABLE C–4.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY PLASTICS MATERIALS AND SYNTHETIC RESINS, SYNTHETIC RUBBERS, CELLULOSIC AND OTHER MANMADE FIBERS EXCEPT GLASS MANUFACTURING FACILITIES SUBMITTING PART II SAMPLING DATA[i] (mg/L)

Pollutant	# of Facilities		# of Samples		Mean		Minimum		Maximum		Median		95th Percentile		99th Percentile	
Sample type	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	16	14	41	36	11.5	11.4	0.0	1.0	66.0	66.0	6.0	6.6	34.1	34.2	62.8	64.8
COD	17	15	42	38	58.1	52.6	0.0	0.0	162.0	169.0	36.5	35.5	191.7	142.6	360.6	237.7
Nitrate + Nitrite Nitrogen	17	15	43	39	4.31	5.35	0.00	0.0	140.30	158.0	0.76	0.95	7.67	8.88	20.81	23.1
Total Kjeldahl Nitrogen	17	15	42	38	3.51	3.96	0.20	0.0	47.20	56.8	1.50	1.40	9.67	10.6	20.29	22.9
Oil & Grease	16	N/A	42	N/A	2.0	N/A	0.0	N/A	15.0	N/A	0.0	N/A	10.2	N/A	22.4	N/A
pH	15	N/A	42	N/A	N/A	N/A	3.6	N/A	7.7	N/A	6.8	N/A	8.4	N/A	9.4	N/A
Total Phosphorus	17	15	43	39	0.40	0.41	0.00	0.0	4.20	4.40	0.11	0.07	1.45	1.56	3.60	4.27
Total Suspended Solids	17	15	42	38	157	94.6	0.0	0.0	2708	816	40	26.5	570	345.4	1665	845.5
Zinc	14	12	36	31	0.391	0.425	0	0	2.1	2.07	0.19	0.23	1.427	1.712	3.183	4.031

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.
[ii] Composite samples.

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TABLE C–5.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY SOAPS, DETERGENTS, AND CLEANING PREPARATIONS; PERFUMES, COSMETICS, AND OTHER TOILET PREPARATIONS FACILITIES SUBMITTING PART II SAMPLING DATA[i] (mg/L)

Pollutant	# of Facilities		# of Samples		Mean		Minimum		Maximum		Median		95th Percentile		99th Percentile	
Sample type	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	12	13	19	20	53.2	23.2	0.0	0.0	340.0	108.0	16.0	6.5	286.2	99.8	892.7	253.6
COD	12	12	19	19	245.3	132.5	28.0	0.0	1200.0	530.0	120.0	80.0	834.2	486.8	1803.7	1015.5
Nitrate + Nitrite Nitrogen	12	12	19	19	1.40	0.97	0.00	0.0	5.00	4.2	1.16	0.76	5.60	3.17	12.16	5.97
Total Kjeldahl Nitrogen	12	12	19	19	3.48	2.3	0.80	0.0	11.40	9.0	2.60	1.4	8.90	6.93	14.73	12.2
Oil & Grease	12	N/A	19	N/A	4.6	N/A	0.0	N/A	40.0	N/A	0.0	N/A	21.1	N/A	42.8	N/A
pH	12	N/A	19	N/A	N/A	N/A	3.5	N/A	8.0	N/A	7.1	N/A	9.1	N/A	10.5	N/A
Total Phosphorus	12	12	19	19	1.60	0.57	0.02	0.0	9.00	1.9	0.40	0.40	8.93	2.34	28.97	5.20
Total Suspended Solids	13	13	20	20	313	154	6	0.0	1522	880	74	39	1519	633.2	4714	1744
Zinc	6	6	7	7	1.584	0.941	0.13	0.15	4.8	2.7	0.41	0.26	7.438	3.761	20.20	99.146

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.

[ii] Composite samples.

TABLE C–6.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY PAINTS, VARNISHES, LACQUERS, ENAMELS, AND ALLIED PRODUCTS FACILITIES SUBMITTING PART II SAMPLING DATA[i] (mg/L)

Pollutant	# of Facilities		# of Samples		Mean		Minimum		Maximum		Median		95th Percentile		99th Percentile	
Sample type	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	3	3	3	3	4.7	20.7	0.0	12.0	11.0	36.0	3.0	14.0	21.6	48.5	42.2	72.7
COD	3	3	3	3	50.3	42.3	0.0	0.0	84.0	72.0	67.0	55.0	94.4	82.8	106.1	95.1
Nitrate + Nitrite Nitrogen	3	3	3	3	0.43	0.53	0.00	0.0	1.20	1.3	0.09	0.28	4.59	2.88	17.50	6.36
Total Kjeldahl Nitrogen	3	3	3	3	1.27	1.56	0.30	0.60	1.90	2.78	1.62	1.30	5.24	4.57	10.52	7.70
Oil & Grease	3	N/A	3	N/A	4.7	N/A	0.0	N/A	9.6	N/A	4.6	N/A	14.1	N/A	20.6	N/A
pH	3	N/A	3	N/A	N/A	N/A	6.7	N/A	7.7	N/A	7.1	N/A	8.0	N/A	8.4	N/A
Total Phosphorus	3	3	3	3	0.24	0.23	0.22	0.13	0.26	0.30	0.24	0.25	0.28	0.44	0.29	0.59
Total Suspended Solids	3	3	3	3	433	47.0	4	2.0	824	130	470	9.0	14276	429.9	104964	1815.8

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.

[ii] Composite samples.

TABLE C–7.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY AGRICULTURAL CHEMICALS MANUFACTURING FACILITIES SUBMITTING PART II SAMPLING DATA[i] (mg/L)

Pollutant	# of Facilities		# of Samples		Mean		Minimum		Maximum		Median		95th Percentile		99th Percentile	
Sample type	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	17	17	27	27	4.2	6.00	0.0	0.0	13.0	43.5	4.0	4.0	10.6	19.5	15.2	35.9
COD	17	17	27	27	70.3	45.3	0.0	0.0	400.0	138	55.0	36.0	239.5	166.3	472.2	325.4
Nitrate + Nitrite Nitrogen	12	12	22	22	43.88	19.47	0.00	0.00	315.00	85.0	3.78	3.86	220.52	119.0	898.55	409.7
Total Kjeldahl Nitrogen	17	17	27	27	75.70	92.1	0.00	0.8	1020.00	1460.0	10.00	12.90	214.61	250.0	710.55	777.61
Oil & Grease	17	N/A	28	N/A	8.6	N/A	0.0	N/A	95.0	N/A	0.0	N/A	36.6	N/A	121.2	N/A
pH	15	N/A	2	5N/A	N/A	N/A	5.3	N/A	7.8	N/A	7.1	N/A	8.0	N/A	8.5	N/A
Total Phosphorus	17	17	27	27	15.80	54.96	0.13	0.19	110.00	982.0	5.00	11.0	80.24	180.16	252.70	693.3
Total Suspended Solids	17	15	27	25	434	113	0	0	5182	593.0	103	58	1734	510.8	5506	1251.8
Iron	4	4	9	9	5.3	3.6	0.6	0.6	22	11	1.8	1.5	19	13.2	42.6	28.3
Lead	4	4	6	6	0.094	0.042	0	0	0.167	0.104	0.1	0.03	0.348	0.119	0.652	0.193
Zinc	5	5	10	10	1.527	0.862	0.075	0.063	7.7	4.2	0.58	0.40	6.997	3.116	19.075	6.915

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.

[ii] Composite samples.

TABLE C–8.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY MISCELLANEOUS CHEMICAL PRODUCTS MANUFACTURING FACILITIES SUBMITTING PART II SAMPLING DATA[i] (mg/L)

Pollutant	# of Facilities		# of Samples			Grab	Minimum		Maximum		Median		95th Percentile		99th Percentile	
Sample type	Grab	Comp[ii]	Grab	Comp	Mean	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	18	14	26	21	143.2	11.3	0.0	0.0	3420.0	98.0	9.0	6.0	128.6	29.3	353.6	51.4
COD	19	15	28	23	70.4	63.3	0.0	19.0	394.0	382.0	42.5	41.0	180.6	150.1	300.5	247.1
Nitrate + Nitrite Nitrogen	19	14	28	22	0.97	1.00	0.00	0.0	4.88	3.12	0.57	0.60	3.37	3.22	6.79	6.18
Total Kjeldahl Nitrogen	19	15	31	23	1.61	1.34	0.00	0.0	5.50	4.1	1.40	1.10	5.83	4.25	11.27	7.45
Oil & Grease	20	N/A	29	N/A	4.4	N/A	0.0	N/A	23.0	N/A	2.0	N/A	16.8	N/A	32.9	N/A
pH	20	N/A	29	N/A	N/A	N/A	4.8	N/A	9.3	N/A	7.3	N/A	9.2	N/A	10.1	N/A
Total Phosphorus	20	15	29	23	0.18	0.11	0.00	0.0	1.63	0.39	0.07	0.10	0.65	0.32	1.29	0.46

TABLE C–8.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY MISCELLANEOUS CHEMICAL PRODUCTS MANUFACTURING FACILITIES SUBMITTING PART II SAMPLING DATA[i] (mg/L)—Continued

Pollutant	# of Facilities		# of Samples			Grab	Minimum		Maximum		Median		95th Percentile		99th Percentile	
Sample type	Grab	Comp[ii]	Grab	Comp	Mean	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
Total Suspended Solids	19	15	28	23	50	47.8	0	0.0	415	350	13	8.0	246	220.5	728	687.3

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.

[ii] Composite samples.

3. Options for Controlling Pollutants

As required in part 1 of the storm water group permit application, participants were required to provide information regarding existing storm water management practices and controls. Table C–9 below identifies the material management practices for the identified sampling facilities.

TABLE C–9.—CURRENT STORM WATER MANAGEMENT PRACTICES USED BY THE CHEMICAL AND ALLIED PRODUCTS MANUFACTURING INDUSTRY (AS REPORTED IN PART 1 OF THE GROUP APPLICATIONS)[i]

Subsector	Current management practices
1	Unloading Boot, Catch Basin, Containment, Covering, Curbing, Dike Diversion, Housekeeping, Inspection of Equipment, Infiltration, Oil/Water Separator, Roof, SPCC, Sump, Storm Water Collector for Water Reuse, Training, Indoor Storage.
2	Catch Basin, Covering, Dike, Indoor Storage, Pond, SPCC, Swale, Vegetation Strip.
3	Caps on Tank Vents, Concrete Pad, Containment, Covering, Curbing, Dike, Diversion, Drain, Hazardous Waste Management, Hazardous Waste Pad, Holding Tank, Indoor Storage, Infiltration, Pond, Roof, Sealed Drums, SPCC, Storm Water Collector, Tarp, Vaulted.
4	Containment, Covering, Dike, Holding Tank, Infiltration, Pond, Roof Drain, Site Inspection, SPCC, Swale, Training, Waste Minimization.
5	Curbing, Dike, Pond, SPCC.
6	Catch Basin, Covering, Dike, Housekeeping, Indoor Storage, Infiltration, Oil/Water Separator, Pond, Roof, Site Inspection, SPCC, Sump, Swale, Sweep, Valves.
7	Absorbent Materials, BMP Plan, Catch Basin, Concrete Pad, Containment, Covering, Curbing, Dike, Drain, Drip Pan, Housekeeping, Indoor Storage, Infiltration, Oil/Water Separator, Pond, Roof, Inspection, Sloped Containment, SPCC, Sump, Swale, Training, Valves.
8	Catch basin, Containment, Covering, Dike, Indoor Storage, Pond, Roof, Site Inspection, SPCC, Swale, Training.

[i] The information presented in this table was received from part 1 group applications for Sector 3.

In order to develop achievable storm water management practices and controls, EPA has evaluated all existing management practices as well as practices developed and implemented under the September 9, 1992, storm water general permit. For a detailed explanation regarding specific storm water controls and management practices, the reader may refer to the pollution prevention plan requirements section below.

4. Special Conditions

a. Prohibition of Non-storm Water Discharges. In addition to the discharges prohibited under Part III.A.2 of today's permit, EPA has specified that the following types of discharges are not authorized by this section:

(1) Inks, paints or substances (hazardous, nonhazardous, etc.) resulting from an onsite spill including materials collected in drip pans.

(2) Washwaters from material handling and processing areas. This includes areas where containers, equipment, industrial machinery, and any significant materials are exposed to storm water.

(3) Washwaters from drum, tank or container rinsing and cleaning.

EPA has included these prohibitions in order to emphasize that spilled materials should be cleaned up and properly disposed, and that washwaters constitute process wastewater and not storm water. These types of discharges contribute excessive amounts of pollutants to water bodies and must be permitted by an NPDES permit for process wastewater, as they are not authorized by this section.

5. Storm Water Pollution Prevention Plan Requirements

a. Contents of the Plan. Today's permit requires that all facilities covered under this section prepare a Drainage and Site Plan. Based on the information contained in the part 1 application, EPA has identified and specified areas where materials are commonly handled. EPA is requiring that the site plan detail the drainage patterns of the runoff and identify the outfall and receiving water body. [Language on site map not included.]

(1) Description of Potential Pollutant Sources. The Inventory of Exposed Materials as well as Risk Identification and Summary of Potential Pollutants Sources requirements were further defined to avoid confusion. In addition, EPA is requiring that the information submitted in the group application regarding pollutant sources and current management practices be evaluated and considered when developing the plan.

Measures and Controls. EPA has divided this section of the permit into two parts. The first part addresses nonstructural pollution prevention controls, while the second part addresses structural controls.

The following requirements were established by EPA under the nonstructural conditions to identify specific practices that must be implemented by all permittees:

(a) Good Housekeeping—In addition to the information provided in the group application process, EPA conducted a series of inspections to identify areas of concern, materials exposed to storm water and current management practices used by the chemicals and allied products manufacturing industry. EPA also reviewed a series of existing pollution prevention plans that were developed under the requirements of the baseline general permit. Based on this information, EPA is requiring that at a minimum, permittees shall consider establishing the following good housekeeping practices:

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(i) Schedule regular pickup and disposal of garbage and waste materials or other measures to dispose of waste. This schedule may be included in the plan. Individuals responsible for waste management and disposal should be informed of the procedures established under the plan.

(ii) Routinely inspect for leaks and conditions of drums, tanks and containers. Ensure that spill cleanup procedures are understood by employees.

(iii) Keep an up-to-date inventory of all materials present at the facility. While preparing the inventory, all containers should be clearly labeled. Hazardous containers that require special handling, storage, use and disposal considerations should be clearly marked and readily recognizable.

(iv) Maintain clean ground surfaces by using brooms, shovels, vacuum cleaners or cleaning machines.

(b) Employee Training—Training should also address procedures for equipment and containers cleaning and washing. The training should emphasize the human hazards and the potential environmental impacts from the discharges of washwaters. In addition, today's permit requires that the pollution prevention plan for chemical and allied products manufacturing facilities identify periodic dates for such training of at least once per year. EPA recommends that facilities conduct training annually at a minimum. However, more frequent training may be necessary at facilities with high turnover of employees or where employee participation is essential to the storm water pollution prevention plan.

(c) Inspections—Qualified personnel shall conduct quarterly inspections. A wet weather inspection (during a rainfall event) shall be conducted in the second (April to June) and third quarters (July to September) of each year. A dry weather inspection (no precipitation) shall be conducted in the first (January to April) and fourth quarters (October to December).

However, where a seasonal arid period is sustained for more than 3 months, a dry weather inspection will satisfy the wet weather inspection requirement. This requirement will assure that permittees conduct at least one inspection every quarter.

EPA believes that this requirement will satisfy the requirements of this section by measuring the effectiveness of the pollution prevention plan during dry and wet weather conditions. These inspections will increase awareness and responsibility for storm water pollution. Moreover, conducting these dry and wet weather inspections on a quarterly basis will provide permittees with a tool for evaluating best management practices, structural and nonstructural measures, good housekeeping and spill cleaning procedures, among other pollution prevention activities.

(d) Facility Security—Facilities should consider evaluating existing security systems such as fencing, lighting, vehicular traffic control, and securing of equipment and buildings and should include existing and new system into the plan to prevent accidental or intentional entry which could cause a discharge of pollutants to waters of the United States.

(e) Structural Storm Water Management Controls—Under the structural conditions, EPA has identified specific practices that should be considered by all permittees. These structural practices are divided into four activities/areas: material handling and storage; management of runoff; sediment and erosion control; and sampling.

(f) Practices for Material Handling and Storage Areas—Under material handling and storage, EPA is recommending a series of management practices to minimize materials exposed to precipitation. These areas were selected after evaluation of part 1 data and current practices used by the group participants. For areas where liquid or powdered materials are stored, facilities shall consider providing either diking, curbing, or berms. For all other outside storage areas including storage of used containers, machinery, scrap and construction materials, and pallets, facilities shall consider preventing or minimizing storm water runon to the storage area by using curbing, culverting, gutters, sewers or other forms of drainage control. For all storage areas, roofs, covers or other forms of appropriate protection shall be considered to prevent exposure to weather. In areas where liquid or powdered materials are transferred in bulk from truck or rail cars, permittees shall consider appropriate measures to minimize contact of material with precipitation. Permittees shall consider providing for hose connection points at storage containers to be inside containment areas and drip pans to be used in areas which are not in a containment area, where spillage may occur (e.g., hose reels, connection points with rail cars or trucks) or equivalent measures. In areas of transfer of contained or packaged materials and loading/unloading areas, permittees shall consider providing appropriate protection such as overhangs or door skirts to enclose trailer ends at truck loading/unloading docks or an equivalent.

In order to prevent facilities from discharging contaminated storm water from areas where precipitation is contained, contained areas should be restrained by valves or other positive means to prevent the discharge of a spill or leak. Containment units may be emptied by pumps or ejectors; however, these should be manually activated. Flapper-type drain valves should not be used to drain containment areas. Valves used for the drainage of containment areas should, as far as is practical, be of manual, open-or-closed design. If facility drainage is not engineered as above, the final discharge point of all in-facility sewers should be equipped to prevent the discharge in the event of an uncontrolled spill of materials.

(g) Management of Runoff—Under management of runoff conditions, EPA is requiring that the plan contain a description of storm water management practices used and/or to be used to divert, infiltrate, reuse, or otherwise manage storm water runoff in a manner that reduces pollutants in storm water discharges from the site.

(h) Sediment and Erosion Control—For areas with a potential for significant soil erosion, the permittee should describe permanent stabilization practices to be used in order to stabilize disturbed areas. The measures will minimize the amount of sediment materials in the discharge.

(i) Non-storm Water Discharges—There are no additional requirements beyond those described in Part VI.C of this fact sheet.

(j) Comprehensive Site Compliance Evaluation—In accordance with 40 CFR 122.24(i)(4)(i), EPA has established that comprehensive site compliance evaluations be conducted at least once every year. Members of the pollution prevention team or a qualified professional designated by the team must conduct the evaluation. Requirements for the evaluation are listed under Part VI.C.4 of this fact sheet.

6. Numeric Effluent Limitations

a. Phosphate Fertilizer Manufacturing Runoff. Part XI.C.5.a. of today's permit establishes numeric effluent limitations for storm water discharges from facilities identified by SIC 287, the Phosphate Subcategory of the Fertilizer Manufacturing Point Source Category, which are subject to effluent limitations guidelines at 40 CFR Part 418. The term contaminated storm water runoff shall mean precipitation runoff, which during manufacturing or processing, comes into incidental contact with any raw materials, intermediate product, finished product, by-products or waste product. The concentration of pollutants in storm water discharges shall not exceed the following effluent limitations included in Table C–10 below:

TABLE C–10

Effluent characteristics	Effluent limitations (mg/L)	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed
Total Phosphorus (as P)	105.0	35.0
Fluoride	75.0	25.0

Facilities with discharges as described above must be in compliance with these effluent limitations upon commencement of coverage and for the entire term of this permit. Discharges that are associated with industrial activities that do not contain runoff from the areas or activities specified above are not subject to the effluent limitation in Table C–10 above.

7. Monitoring and Reporting Requirements

a. Analytical Monitoring Requirements. EPA believes that chemical manufacturing facilities may reduce the level of pollutants in storm water runoff from their sites through the development and proper implementation of the storm water pollution prevention plan requirements discussed in today's permit. Under the revised methodology for determining pollutants of concern for the various industrial sectors, four subsectors in the chemical and allied products manufacturing sector must monitor their storm water discharges. The monitoring requirements are presented in Tables C–11, C–12, C–13, and C–14 for agricultural chemical manufacturing facilities; industrial inorganic chemical facilities; soaps, detergents, cosmetics, and perfume manufacturing facilities; and plastics, synthetics, and resin manufacturing facilities. The pollutants listed in Tables C–11, C–12, C–13, and C–14 were found to be above benchmark levels. Because these pollutants have been reported at benchmark levels from agricultural chemical facilities; industrial inorganic chemical facilities; soaps, detergents, synthetics, and resin manufacturing facilities, EPA is requiring monitoring after the pollution prevention plan has been implemented to assess the effectiveness of the pollution prevention plan and to help ensure that a reduction of pollutants is realized.

Under the Storm Water Regulations at 40 CFR 122.26(b)(14), EPA defined "storm water discharge associated with industrial activity". The focus of today's permit is to address the presence of pollutants that are associated with the industrial activities identified in this definition and that might be found in storm water discharges. Under the methodology for determining analytical monitoring requirements, described in section VI.E.1 of this fact sheet, nitrate plus nitrite nitrogen is above the bench mark concentrations for the plastics, synthetics, and resins subsector. After a review of the nature of industrial activities and the significant materials exposed to storm water described by facilities in this subsector, EPA has determined that the higher concentrations of nitrate plus nitrite nitrogen are not likely to be caused by the industrial activity, but may be primarily due to non-industrial activities on-site. Today's permit does not require plastics, synthetics, and resins facilities to conduct analytical monitoring for this parameter.

At a minimum, storm water discharges from agricultural chemical facilities; industrial inorganic chemical facilities; soaps, detergents, cosmetics, and perfume manufacturing facilities; and plastics, synthetics, and resin manufacturing facilities must be monitored quarterly during the second year of permit coverage. Samples must be collected at least once in each of the following periods: January through March; April through June; July through September; and October through December. At the end of the second year of permit coverage, a facility must calculate the average concentration for each parameter listed in Tables C–11, C–12, C–13, and C–14. If the permittee collects more than four samples in this period, then they must calculate an average concentration for each pollutant of concern for all samples analyzed.

TABLE C–11.—AGRICULTURAL CHEMICALS MONITORING REQUIREMENTS

Pollutants of concern	Cut-off concentration
Nitrate plus Nitrite Nitrogen	0.68 mg/L
Total Recoverable Lead	0.0816 mg/L
Total Recoverable Iron	1.0 mg/L
Total Recoverable Zinc	0.117 mg/L
Phosphorus	2.0 mg/L

TABLE C–12.—INDUSTRIAL INORGANIC CHEMICALS MONITORING REQUIREMENTS

Pollutants of concern	Cut-off concentration
Total Recoverable Aluminum	0.75 mg/L
Total Recoverable Iron	1.0 mg/L
Nitrate plus Nitrite Nitrogen	0.68 mg/L

TABLE C–13.—SOAPS, DETERGENTS, COSMETICS, AND PERFUMES MONITORING REQUIREMENTS

Pollutants of concern	Cut-off concentration
Nitrate plus Nitrite Nitrogen	0.68 mg/L
Total Recoverable Zinc	0.117 mg/L

TABLE C–14.—PLASTICS, SYNTHETICS, AND RESIN MANUFACTURING MONITORING REQUIREMENTS

Pollutants of concern	Cut-off concentration
Total Recoverable Zinc	0.117 mg/L

If the average concentration for a parameter is less than or equal to the cut-off concentration, then the permittee is not required to conduct quantitative analysis for that parameter during the fourth year of the permit. If, however, the average concentration for a parameter is greater than the cut-off concentration, then the permittee is required to conduct quarterly monitoring for that parameter during the fourth year of permit coverage. Monitoring is not required during the first, third, and fifth year of the permit. The exclusion from monitoring in the fourth year of the permit is conditional on the facility maintaining industrial operations and BMPs that will ensure a quality of storm water discharges consistent with the average concentrations recorded during the second year of the permit. The schedule for monitoring is presented in Table C–15.

TABLE C–15.—SCHEDULE OF MONITORING

2nd Year of Permit Coverage	• Conduct quarterly monitoring. • Calculate the average concentration for all parameters analyzed during this period. • If average concentration is greater than the value listed in Tables C–11, C–12, C–13, and C–14, then quarterly sampling is required during the fourth year of the permit. • If average concentration is less than or equal to the value listed in Tables C–11, C–12, C–13, and C–14, then no further sampling is required for that parameter.
4th Year of Permit Coverage	• Conduct quarterly monitoring for any parameter where the average concentration in year 2 of the permit is greater than the value listed in Tables C–11, C–12, C–13, and C–14. • If industrial activities or the pollution prevention plan have been altered such that storm water discharges may be adversely affected, quarterly monitoring is required for all parameters of concern.

In cases where the average concentration of a parameter exceeds the cut-off concentration, EPA expects permittees to place special emphasis on methods for reducing the presence of those parameters in storm water discharges. Quarterly monitoring in the fourth year of the permit will be used to reassess the effectiveness of the adjusted pollution prevention plan.

EPA realizes that if a facility is inactive and unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly chemical sampling.

(b). Alternative Certification. Throughout today's permit, EPA has included monitoring requirements for facilities which the Agency believes have the potential for contributing significant levels of pollutants to storm water discharges. The alternative certification described below is necessary to ensure that monitoring requirements are only imposed on those facilities that do, in fact, have storm water discharges containing pollutants at concentrations of concern. EPA has determined that if materials and activities are not exposed to storm water at the site, then the potential for pollutants to contaminate storm water discharges does not warrant monitoring.

Therefore, a discharger is not subject to the monitoring requirements of this Part provided the discharger makes a certification for a given outfall or on a pollutant-by-pollutant basis in lieu of monitoring described in Tables C–11, C–12, C–13, and C–14, that material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, industrial machinery or operations, significant materials from past industrial activity, and that are located in areas of the facility that are within the drainage area of the outfall are not presently exposed to storm water and will not be exposed to storm water for the certification period. Such certification must be retained in the storm water pollution prevention plan and submitted to EPA in lieu of monitoring reports required under paragraph c. below. The permittee is required to complete any and all sampling until the exposure is eliminated. If the facility is reporting for a partial year, the permittee must specify the date exposure was eliminated. If the permittee is certifying that a pollutant was present for part of the reporting period, nothing relieves the permittee from the responsibility to sample that parameter up until the exposure was eliminated and it was determined that no significant materials remained. This certification option is not applicable to compliance monitoring requirements associated with effluent limitations. EPA does not expect facilities to be able to exercise this certification for indicator parameters, such as TSS and BOD.

c. Reporting Requirements. Permittees are required to submit all monitoring results obtained during the second and fourth year of permit coverage within 3 months of the conclusion of each year. For each outfall, one signed Discharge Monitoring Report Form must be submitted to the Director per storm event sampled. For facilities conducting monitoring beyond the minimum requirements, an additional signed Discharge Monitoring Report Form must be filed for each analysis. The permittee must include a measurement or estimate of the total precipitation, volume of runoff, and peak flow rate of runoff for each storm event sampled.

d. Sample Type. All discharge data shall be reported for grab samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The required 72-hour storm event interval is waived where the preceding measurable storm event did not result in a measurable discharge from the facility. The required 72-hour storm event interval may also be waived where the permittee documents that less than a 72-hour interval is representative for local storm events during the season when sampling is being conducted. The grab sample shall be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable.

If storm water discharges associated with industrial activity commingle with process or nonprocess water, then where practicable, permittees must attempt to sample the storm water discharge before it mixes with the non-storm water discharge.

e. Representative Discharge. When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may test the effluent of one of such outfalls and report that the quantitative data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluent. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

f. Compliance Monitoring Requirements. Today's permit requires permittees with phosphate fertilizer manufacturing facilities with contaminated storm water discharges to monitor for the presence of phosphorus and fluoride. These monitoring requirements are necessary to evaluate compliance with the numeric effluent limitation for these discharges. Monitoring shall be performed upon a minimum of one grab sample. All samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The grab sample shall be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable. Monitoring results shall be submitted on Discharge Monitoring Report Form(s) postmarked no later than the 31st day of the month following collection of the sample. Facilities which discharge through a large or medium municipal separate storm sewer system (systems serving a population of 100,000 or more) must also submit signed copies of discharge monitoring reports to the operator of the municipal separate storm sewer system. Alternative Certification provisions described in Section XI.C.5 of the permit do not apply to facilities subject to compliance monitoring requirements in this section. Compliance monitoring is required at least annually for discharges subject to effluent limitations. Therefore, EPA cannot permit a facility to waive compliance monitoring.

Phosphate fertilizer manufacturing facilities are not required to collect and analyze separate samples for the presence of total phosphorus to satisfy the Compliance Monitoring requirements of Section XI.C.6.c. during a year in which the facilities have collected and analyzed samples for total phosphorus in accordance with the Analytical Monitoring Requirements of Section XI.C.6.a. The results of all Analytical Monitoring analyses may be reported as Compliance Monitoring results in accordance with Section XI.C.5.d.(3) where the monitoring methodologies are consistent.

g. Quarterly Visual Examination of Storm Water Quality. Chemical and allied products manufacturing facilities shall perform and document a visual examination of a storm water discharge associated with industrial activity from each outfall, except discharges exempted below. The examination(s) must be made at least once in each of the following 3-month periods: January through March, April through June, July through September, and October through December. The examination shall be made during daylight hours unless there is insufficient rainfall or snow melt to produce a runoff event.

(1) Examinations shall be made of grab samples collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 1 hour) of when the runoff or snowmelt begins discharging. The examinations shall document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on the samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. Where practicable, the same individual should carry out the collection and examination of discharges for entire permit term.

(2) Visual examination reports must be maintained onsite in the pollution prevention plan. The report shall include the examination date and time, examination personnel, the nature of the discharge (i.e., runoff or snow melt), visual quality of the storm water discharge (including observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution), and probable sources of any observed storm water contamination.

(3) When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may collect a sample of effluent of one of such outfall and report that the examination data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

(4) When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the records of the visual examinations. Adverse weather conditions that may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.). EPA realizes that if a facility is inactive and

unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly visual examination.

D. Storm Water Discharges Associated With Industrial Activity From Asphalt Paving and Roofing Materials Manufacturers and Lubricant Manufacturers

1. Discharges Covered Under This Section

On November 16, 1990 (55 FR 47990), EPA promulgated the regulatory definition of "storm water discharges associated with an industrial activity." This definition includes point source discharges of storm water from eleven major categories of facilities, including facilities commonly identified by Standard Industrial Classification (SIC) 29. Today's permit only covers storm water discharges associated with industrial activities at facilities which manufacture asphalt paving mixtures and blocks (SIC code 2951), asphalt felts and coatings (SIC code 2952), and lubricating oils and greases (SIC code 2992). Hereinafter, facilities with primary SIC codes 2951 or 2952 will be referred to as "Asphalt Facilities," and facilities with primary SIC code 2992 as "Lubricant Manufacturers."

Section XI.D of today's permit does not apply to renderers of fats and oils, petroleum refining facilities or to oil recycling facilities. Petroleum refining facilities are not eligible for coverage under today's permit, because these types of facilities did not participate in the group application process. Renderers of fats and oils are covered under Section XI.U of today's permit. Oil recycling facilities are covered under Section XI.N of today's permit. These facilities are more appropriately grouped with the liquid waste recyclers covered under Section XI.N.

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

This section is applicable to storm water discharges from portable plants. Although portable plants were not included in the group application process the significant materials and industrial activities conducted at these facilities are sufficiently similar to permanent facilities to allow coverage. This section is applicable to storm water discharges from portable plants, with the condition that a new Notice of Intent (NOI) be submitted for each location and the pollution prevention plan be revised accordingly with each change in location.

a. Industry Profile. Presented below are brief descriptions of the industrial activities associated with asphalt facilities and lubricant manufacturers. Table D–1 shows some common significant materials exposed at these types of facilities.

TABLE D–1.—ACTIVITIES, POLLUTANT SOURCES, AND POLLUTANTS[i, ii]

Activity	Pollutant source	Pollutant
Asphalt Paving Manufacturing Facilities		
Material Storage and Handling	Additives, asphalt, asphalt cement, asphalt concrete, asphalt products, asphalt release agents, crushed stone, fuel, granite, granules, gravel, limestone, lubricants, mineral spirits, oil, quartzite rock, reclaimed asphalt pavement (RAP), sand, sandstone, slag.	TSS, Oil and Grease, pH, COD.
Asphalt Roofing Material Manufacturers		
Material Storage and Handling	Mineral spirits, asphalt, asphalt cutbacks, asphalt shingles, limestone, sand, slag, asphalt rolls, asphalt felt, talc oil and fuel.	TSS, Oil and Grease, pH and COD.
Lubricant Manufacturers		
Material Storage and Handling	Oils, waste solvents, petroleum distillates, lubricants, chemical additives.	Oil and Grease, pH, TSS.

[i] Storm water group applications, parts 1 and 2.
[ii] EPA. Development Document on Paving and Roofing Materials (EPA 440/1–74/049).

(1) Manufacturers of Asphalt Paving Mixtures and Blocks (SIC 2951). Manufacturers classified in SIC 2951 store purchased asphalt in above ground tanks. They stockpile a variety of raw materials such as sand, gravel, crushed limestone, and recycled asphalt products (RAP). These facilities produce asphalt concrete, and may also mold and cure asphalt concrete products such as asphalt blocks. There are two types of facilities associated with these activities, batch plants and drum plants.

Batch plants receive aggregate (sand, stone, limestone, gravel, etc.) in bulk by rail or truck. The aggregate is usually stockpiled outside. It is then transported by a conveyor or front-end loader to a rotary drier. When dried and heated the aggregate is transported to a screening unit which separates the aggregate into various sizes and deposits the graded aggregate into hot storage bins. Aggregate and mineral filler are then weighed and transported to a mixing unit or pug mill where they are mixed with heated asphalt cement to produce asphalt concrete. The resulting asphalt concrete is either stored in a heated silo or loaded directly onto trucks for transport to the job site.

At drum (cold feed) plants a measured amount of aggregate is placed in the drum where it is dried and heated. Heated asphalt cement is added to the same drum and mixed with the aggregate to produce asphalt concrete. The hot asphalt concrete produced by this process then goes to a surge bin or silo for storage until it is loaded onto trucks for delivery.

Hot-mix asphalt plants are often portable. There are three types of portable plants: portable, permanent, and semipermanent. Portable plants move from site to site, and the significant materials and equipment are removed upon completion of the job or project. Portable plants remain at a site anywhere from several days to several months. Permanent portable plants remain at a site on a permanent basis.

Like portable plants, semipermanent plants move from site to site. They differ, however, in that they return to locations on a recurring basis. Significant materials such as aggregate piles remain at the site while the plant is operating elsewhere. For the purposes of this section, semipermanent plants will be referred to as permanent plants, given that the effect on runoff from significant materials will essentially be the same at both sites. 'Asphalt facilities' includes both permanent and portable plants unless specified otherwise.

Facilities which manufacture asphalt concrete block feed the asphalt/aggregate mixture into a block molding machine where the mix is rammed, pressed or vibrated into its final form. The product is then stacked and allowed to cure.

(2) Manufacturers of Roofing Materials (SIC 2952). Manufacturers classified in standard industrial code 2952 typically produce bitumen-based roofing products such as asphalt shingles, built-up roofing (BUR), modified bitumen sheet material, asphalt saturated felts and bitumen-based root coatings, mastics and cements.

The typical manufacturing of bitumen based roofing products, such as shingles, BUR, modified bitumen sheet materials and asphalt saturated felt is a continuous stationary process performed on a roofing machine that begins with a roll of base material such as fiberglass mat, polyester or organic felt, coated or saturated with an asphalt or blend, surfaced with mineral granules, and concludes with a finished product. The sequence of indoor operations builds the product up in stages, adding different raw materials along the way and monitoring their application.

Bitumen-based coatings, mastics and cements are produced inside in a stationary process mixing raw materials received in bulk and containers and blended into finished batches of product. "Batch processing" is the common production method relying on the same piece of equipment in manufacturing a variety of products. The products are packaged in containers or stored for bulk shipment.

(3) Manufacturers of Lubricating Oils and Greases (SIC 2992). Facilities primarily engaged in blending, compounding, and re-refining lubricating oils and greases from purchased mineral, animal, and vegetable materials are identified as SIC code 2992. SIC code 2992 includes manufacturers of metalworking fluids, cutting oils, gear oils, hydraulic brake fluid, transmission fluid, and other automotive and industrial oil and greases.

Raw materials for SIC code 2992 facilities are typically petroleum or synthetic-based stocks and various additives. The majority of lubricating manufacturers store base stocks and chemical additives in tank farms or 55-gallon drums. SIC code 2992 facilities do not manufacture these raw materials, but rather blend and compound them to produce the product. Raw materials are proportioned according to the type of lubricant being produced.

"Batch processing" is the common production method relying on the same piece of equipment in manufacturing a variety of products. For example, in one "batch" a facility may combine the petroleum base stock with additive X in a 10,000 gallon blending tank to produce product "A." Using the same blending tank, the next "batch" is a mixture of the base stock and additive Y to produce product "B." Batch processing allows facilities to manufacture a variety of products. Some facilities, however, tend to specialize in producing a particular type of lubricant (e.g., solid, synthetic, or water-based), often to meet the demands of a specific industry.

Finished products are packaged in containers or stored for bulk shipment. Almost all facilities have shipping and receiving areas and are involved with marketing and interstate distribution of their products. Most facilities have immediate access roads or rail lines at their facility sites.

2. Pollutants in Storm Water Discharges Associated With Asphalt Facilities and Lubricant Manufacturers.

Impacts caused by storm water discharges from asphalt facilities and lubricant manufacturers will vary. Several factors influence to what extent significant materials from these types of facilities and processing operations may affect water quality. Such factors include: geographic location: hydrogeology; the type of industrial activity occurring outside (e.g., material storage, loading and unloading); the type of material stored outside (e.g., asphalt, aggregate, limestone, oil, etc.); the size of the operation; and type, duration, and intensity of precipitation events. These and other factors will interact to influence the quantity and quality of storm water runoff. For example, air emissions (i.e., settled dust) may be a significant source of pollutants at some facilities, while materials storage is a primary source at others. In addition, sources of pollutants other than storm water, such as illicit connections,[38] spills, and other improperly dumped materials, may increase the pollutant loadings discharged into waters of the United States.

Based on group application information and data, EPA has identified the storm water pollutants and sources resulting from asphalt facilities and lubricant manufacturers in Tables D–2 and D–3.

Based on the wide variety of industrial activities and significant materials at the facilities included in this sector, EPA believes it is appropriate to divide the asphalt paving and roofing materials manufacturers and lubricating oils and greases manufacturers industry into 2 subsectors to properly analyze sampling data and determine monitoring requirements. As a result, this sector has been divided into the following subsectors: asphalt paving and roofing materials and lubricating oils and greases manufacturers. The tables below include data for the eight pollutants that all facilities were required to monitor under Form 2F.

[38] Illicit connections are contributions of unpermitted non-storm water discharges to storm sewers from any of a number of sources including sanitary sewers, industrial facilities, commercial establishments, or residential dwellings. The probability of illicit connections at mineral mining and processing facilities is low yet it still may be applicable at some operations.

TABLE D–2.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY ASPHALT PAVING AND ROOFING MATERIALS MANUFACTURING FACILITIES SUBMITTING PART II SAMPLING DATA[i] (mg/L)

Pollutant Sample type	No. of facilities		No. of samples		Mean		Minimum		Maximum		Median		95th Percentile		99th Percentile	
	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	25	22	45	41	52.5	13.9	0.0	0.0	1220.0	161.0	8.0	5.0	101.2	42.8	256.1	89.3
COD	26	22	46	40	232.4	207.8	0.0	0.0	2740.0	1880.0	83.5	70.5	800.5	903.4	1897.7	2343.1
Nitrate + Nitrite Nitrogen	26	22	46	41	1.02	0.84	0.00	0.0	19.0	12.0	0.44	0.41	3.43	2.15	8.17	4.08
Total Kjeldahl Nitrogen	25	22	45	39	2.24	1.74	0.00	0.0	19.00	18.0	1.10	0.88	6.75	4.79	13.22	9.19
Oil & Grease	27	N/A	47	N/A	5.5	N/A	0.0	N/A	78.0	N/A	1.3	N/A	21.8	N/A	49.9	N/A
pH	27	N/A	47	N/A	N/A	N/A	2.4	N/A	9.6	N/A	7.2	N/A	10.1	N/A	11.8	N/A
Total Phosphorus	25	22	45	41	0.49	0.51	0.00	0.0	3.90	4.30	0.14	0.19	2.06	1.56	5.22	3.38
Total Suspended Solids	25	22	45	41	689	509.6	0	0.0	8050	3320	286	145	3570	3421	12103	13860

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.
[ii] Composite samples.

TABLE D–3.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY (LUBRICANT OILS AND GREASES MANUFACTURERS) SUBMITTING PART II SAMPLING DATA[i] (mg/L)

Pollutant Sample type	No. of facilities		No. of samples		Mean		Minimum		Maximum		Median		95th Percentile		99th Percentile	
	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	13	8	15	10	10.7	6.70	0.0	0.0	47.0	22.0	4.0	4.0	36.5	22.52	75.2	40.87
COD	15	10	17	12	108.7	57.66	10.0	10.0	905.0	142.6	42.0	55.1	303.0	175.5	622.2	314.1
Nitrate + Nitrite Nitrogen	13	8	15	10	0.64	0.77	0.00	0.0	2.63	2.43	0.21	0.30	5.01	2.88	17.2	5.83
Total Kjeldahl Nitrogen	15	9	17	11	1.76	1.24	0.00	0.19	7.98	3.0	1.10	1.10	5.17	3.86	9.43	6.86
Oil & Grease	16	N/A	18	N/A	7.8	N/A	0.0	N/A	55.0	N/A	2.0	N/A	32.7	N/A	82.2	N/A
pH	14	N/A	16	N/A	N/A	N/A	5.7	N/A	7.9	N/A	7.1	N/A	8.0	N/A	8.6	N/A
Total Phosphorus	15	10	17	12	0.41	0.28	0.00	0.01	3.66	1.28	0.11	0.14	1.30	1.23	3.03	3.18
Total Suspended Solids	15	10	17	12	271	206	0	2	3870	2130	20	28	696	592	2912	2283

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.
[ii] Composite samples.

3. Options for Controlling Pollutants

In evaluating options for controlling pollutants in storm water discharges, EPA must achieve compliance with the technology-based standards of the Clean Water Act [Best Available Technology (BAT) and Best Conventional Technology (BCT)]. This section establishes requirements for the development and implementation of a site-specific storm water pollution prevention plan consisting of a set of BMPs that are sufficiently flexible to address different sources of pollutants at different sites.

Two types of BMPs which may be implemented to prevent, reduce or eliminate pollutants in storm water discharges are those which minimize exposure (e.g., covering, curbing, or diking) and treatment type BMPs which are used to reduce or remove pollutants in storm water discharges (e.g., oil/water separators, sediment basins, or detention ponds). EPA believes exposure minimization is an effective practice for reducing pollutants in storm water discharges from asphalt facilities and lubricant manufacturers. Exposure minimization practices lessen the potential for storm water to come in contact with pollutants. These methods are often uncomplicated and inexpensive. They can be easy to implement and require little or no maintenance. EPA also believes that in some instances more resource intensive treatment type BMPs are appropriate to reduce pollutant levels such as suspended solids and oil/grease in storm water discharges associated with asphalt facilities or lubricant manufacturers. Though these BMPs are somewhat more resource intensive, they can be effective in reducing pollutant loads and may be necessary depending on the type of discharge, types and concentrations of contaminants, and volume of flow.

Table D–4 lists some BMPs which may be effective in limiting the amount of pollutants in storm water discharges from asphalt facilities and lubricant manufacturers. Based on part 1 information, several of the BMPs suggested are already in place at many of the facilities. Part 1 submittals indicate that diking, curbing, or other types of diversion occur at approximately 57 percent of the facilities. Some form of covering is used as a BMP at 25 percent of the facilities, and detention ponds are in place at 19 percent of the facilities. In addition, 38 percent of the facilities submitting part 1 information reported they had a Spill Prevention Control and Countermeasure Plan in place.

TABLE D–4.—MEASURES TO CONTROL POLLUTANTS IN STORM WATER DISCHARGES FROM ASPHALT FACILITIES AND LUBRICANT MANUFACTURERS

Activity	Suggested BMPs
Material Storage, Handling, and Processing	Cover material storage and handling areas with an awning, tarp or roof. Practice good stockpiling practices such as: storing materials on concrete or asphalt pads; surrounding stockpiles with diversion dikes or curbs; and revegetating areas used for stockpiling in order to slow runoff. Use curbing, diking or channelization around material storage, handling and processing areas to divert runon around areas where it can come into contact with material stored or spilled on the ground. Utilize secondary containment measures such as dikes or berms around asphalt storage tanks and fuel oil tanks.

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TABLE D-4.—MEASURES TO CONTROL POLLUTANTS IN STORM WATER DISCHARGES FROM ASPHALT FACILITIES AND LUBRICANT MANUFACTURERS—Continued

Activity	Suggested BMPs
	Use dust collection systems (i.e., baghouses) to collect airborne particles generated as a result of material handling operations or aggregate drying. Properly dispose of waste materials from dust collection systems and other operations. Remove spilled material and dust from paved portions of the facility by shoveling and sweeping on a regular basis. Utilize catch basins to collect potentially contaminated storm water. Implement spill plans to prevent contact of runoff with spills of significant materials. Clean material handling equipment and vehicles to remove accumulated dust and residue. Use a detention pond or sedimentation basin to reduce suspended solids. Use an oil/water separator to reduce the discharge of oil/grease.

4. Storm Water Pollution Prevention Plan Requirements

EPA believes that pollution prevention is the most effective approach for controlling contaminated storm water discharges from asphalt facilities and lubricant manufacturers. Pollution prevention plans allow the operator of a facility to select BMPs based on site-specific considerations such as: facility size, climate, geographic location, hydrogeology, the environmental setting of each facility, and volume and type of discharge generated. This flexibility is necessary because each facility will be unique in that the source, type and volume of contaminated surface water discharges will differ from site to site.

All facilities subject to this section must prepare and implement a storm water pollution prevention plan. The establishment of a pollution prevention plan requirement reflects EPA's decision to allow operators of asphalt facilities and lubricant manufacturers to utilize BMPs as the BAT/BCT level of control for the storm water discharges covered by this section. The requirements included in pollution prevention plans provide a flexible framework for the development and implementation of site specific controls to minimize pollutants in storm water discharges. This is consistent with the approach in EPA's storm water baseline general permits finalized on September 9, 1992 (57 FR 41236).

There are two major objectives to a pollution prevention plan: (1) To identify sources of pollution potentially affecting the quality of storm water discharges associated with industrial activity from a facility; and (2) to describe and ensure implementation of practices to minimize and control pollutants in storm water discharges associated with industrial activity from a facility. Specific requirements for a pollution prevention plan for asphalt facilities and lubricant manufacturers are described below. These requirements must be implemented in addition to the baseline pollution prevention plan provisions discussed previously.

a. Description of Potential Pollution Sources. There are no additional requirements beyond those described in Part VI.C.2. of this fact sheet.

b. Measures and Controls. There are no additional requirements beyond those described in Part VI.C.3. of this fact sheet.

c. Comprehensive Site Compliance Evaluation. The storm water pollution prevention plan must describe the scope and content of comprehensive site evaluations that qualified personnel will conduct to: (1) Confirm the accuracy of the description of potential pollution sources contained in the plan; (2) determine the effectiveness of the plan, and (3) assess compliance with the terms and conditions of today's permit.

Comprehensive site compliance evaluations shall be conducted at least once a year for asphalt facilities and lubricant manufacturers. The individual or individuals who will conduct the evaluations must be identified in the plan and should be members of the pollution prevention team. Inspection reports must be retained for at least 3 years after the date of the evaluation.

Comprehensive site compliance evaluations shall be conducted at least once a year at portable plant locations. Such evaluations shall be conducted at least once at portable plant locations that are not in operation a full year.

Based on the results of each evaluation, the description of potential pollution sources, and measures and controls, the plan must be revised as appropriate within 2 weeks after each evaluation. Changes in the measures and controls must be implemented on the site in a timely manner, but no later than 12 weeks after completion of the evaluation.

For portable plants, the plan must be revised as appropriate as soon as possible, but no later than 2 weeks after each evaluation. Two weeks is adequate time for portable plants to modify their plans due to the simpler and smaller nature of these operations in comparison to permanent facilities.

5. Numeric Effluent Limitations

In addition to the numeric effluent limitations established under Part V.B, part XI.D.4 of today's permit includes numeric effluent limitations for storm water discharges resulting from the production of asphalt paving and roofing emulsions. Discharges from areas where production of asphalt paving and roofing emulsions occurs may not exceed a TSS concentration of 23.0 mg/L of runoff for any one day, nor shall the average of daily values for 30 consecutive days exceed a TSS concentration of 15.0 mg/L of runoff. Oil and grease concentrations in storm water discharges from these areas may not exceed 15.0 mg/L of runoff for any 1 day, nor should the average daily values for 30 consecutive days exceed an oil and grease concentration of 10.0 mg/L of runoff. The pH of these discharges must be within the range of 6.0 to 9.0. Facilities with such discharges must be in compliance with these effluent limitations upon commencement of coverage and for the entire term of the permit. These effluent limitations are in accordance with 40 CFR 443.12 and 40 CFR 443.13, Effluent Guidelines and Standards, Paving and Roofing Materials Point Source Category, Asphalt Emulsion Subcategory. These limitations represent the degree of effluent reduction attainable by the application of best practicable control technology and best available technology.

6. Monitoring and Reporting Requirements

a. Analytical Monitoring Requirements. Under the revised methodology for determining pollutants of concern for the various industrial sectors, only asphalt paving and roofing materials manufacturers are required to perform analytical monitoring of storm water discharges. As discussed previously, the median composite sample concentration for TSS of 145 mg/L is higher than the benchmark value for TSS of 100 mg/L for the asphalt paving and roofing materials subsector, thus triggering monitoring for TSS. The monitoring requirements are presented in Table D–5 for asphalt paving and roofing materials manufacturers.

At a minimum, storm water discharges from asphalt paving and roofing materials manufacturers must be monitored quarterly during the second year of permit coverage. Samples must be collected at least once in each of the following periods: January through March; April through June; July through September; and October through December. At the end of the second year of permit coverage, a facility must calculate the average concentration for each parameter listed in Table D–5. If the permittee collects more than four samples in this period, then they must calculate an average concentration for each pollutant of concern for all samples analyzed.

TABLE D–5.—ASPHALT PAVING AND ROOFING MATERIALS MANUFACTURERS MONITORING REQUIREMENTS

Pollutants of concern	Cut-off concentration
Total Suspended Solids	100 mg/L.

If the average concentration for a parameter is less than or equal to the cut-off concentration, then the permittee is not required to conduct quantitative analysis for that parameter during the fourth year of the permit. If, however, the average concentration for a parameter is greater than the cut-off concentration, then the permittee is required to conduct quarterly monitoring for that parameter during the fourth year of permit coverage. Monitoring is not required during the first, third, and fifth year of the permit. The exclusion from monitoring in the fourth year of the permit is conditional on the facility maintaining industrial operations and BMPs that will ensure a quality of storm water discharges consistent with the average concentrations recorded during the second year of the permit. The schedule for monitoring is presented in Table D–6.

TABLE D–6.—SCHEDULE OF MONITORING

2nd Year of Permit Coverage	• Conduct quarterly monitoring. • Calculate the average concentration for all parameters analyzed during this period. • If average concentration is greater than the value listed in Table B–7, then quarterly sampling is required during the fourth year of the permit. • If average concentration is less than or equal to the value listed in Table B–7, then no further sampling is required for that parameter.
4th Year of Permit Coverage	• Conduct quarterly monitoring for any parameter where the average concentration in year 2 of the permit is greater than the value listed in Table B–7. • If industrial activities or the pollution prevention plan have been altered such that storm water discharges may be adversely affected, quarterly monitoring is required for all parameters of concern.

In cases where the average concentration of a parameter exceeds the cut-off concentration, EPA expects permittees to place special emphasis on methods for reducing the presence of those parameters in storm water discharges. Quarterly monitoring in the fourth year of the permit will be used to reassess the effectiveness of the adjusted pollution prevention plan.

EPA realizes that if a facility is inactive and unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly chemical sampling.

(1) Sample Type. All discharge data shall be reported for grab samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The required 72-hour storm event interval is waived where the preceding measurable storm event did not result in a measurable discharge from the facility. The required 72-hour storm event interval may also be waived where the permittee documents that less than a 72-hour interval is representative for local storm events during the season when sampling is being conducted. The grab sample shall be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable.

If storm water discharges associated with industrial activity commingle with process or nonprocess water, then where practicable permittees must attempt to sample the storm water discharge before it mixes with the non-storm water discharge.

(2) Representative Discharge. When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may test the effluent of one of such outfalls and report that the quantitative data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluent. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

(3) Alternative Certification. Throughout today's permit, EPA has included monitoring requirements for facilities which the Agency believes have the potential for contributing significant levels of pollutants to storm water discharges. The alternative certification described below is necessary to ensure that monitoring requirements are only imposed on those facilities that do, in fact, have storm water discharges containing pollutants at concentrations of concern. EPA has

determined that if materials and activities are not exposed to storm water at the site, then the potential for pollutants to contaminate storm water discharges does not warrant monitoring.

Therefore, a discharger is not subject to the monitoring requirements of this Part provided the discharger makes a certification for a given outfall or on a pollutant-by-pollutant basis in lieu of monitoring described under paragraph *b.* below, under penalty of law, signed in accordance with Part VII.G. (Signatory Requirements), that material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, industrial machinery or operations, significant materials from past industrial activity, and that are located in areas of the facility that are within the drainage area of the outfall are not presently exposed to storm water and will not be exposed to storm water for the certification period. Such certification must be retained in the storm water pollution prevention plan and submitted to EPA in lieu of monitoring reports required under paragraph *b.* (below). If the permittee cannot certify for an entire period, they must submit the date exposure was eliminated and any monitoring required up until that date. This certification option is not applicable to compliance monitoring requirements associated with effluent guidelines. EPA does not expect facilities to be able to exercise this certification for indicator parameters, such as TSS and BOD.

b. Reporting Requirements. Permittees are required to submit all monitoring results obtained during the second and fourth year of permit coverage within 3 months of the conclusion of each year. For each outfall, one Discharge Monitoring Report Form must be submitted per storm event sampled. For facilities conducting monitoring beyond the minimum requirements an additional Discharge Monitoring Report Form must be filed for each analysis. The permittee must include a measurement or estimate of the total precipitation, volume of runoff, and peak flow rate of runoff for each storm event sampled.

EPA also believes that between quarterly visual examinations and site compliance evaluations potential sources of contaminants can be recognized, addressed, and then controlled with BMPs. In determining the monitoring requirements, EPA considered the nature of the industrial activities and significant materials exposed at these sites, and performed a review of data provided in Part 2 group applications.

c. Quarterly Visual Examination. Quarterly visual examinations of a storm water discharge from each outfall are required at asphalt facilities and lubricant manufacturers. The examination must be of a grab sample collected from each storm water outfall. The examination of storm water grab samples shall include any observations of color, odor, turbidity, floating solids, foam, oil sheen, or other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on these samples.

The examination must be made at least once in each designated period during daylight hours unless there is insufficient rainfall or snow-melt to runoff. Where practicable, the same individual should carry out the collection and examination of discharges throughout the life of the permit to ensure the greatest degree of consistency possible. Examinations shall be conducted in each of the following periods for the purposes of inspecting storm water quality associated with storm water runoff and snow melt: January through March; April through June; July through September; October through December. Grab samples shall be collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 60 minutes) of when the runoff begins discharging. Reports of the visual examination include: the examination date and time, examination personnel, visual quality of the storm water discharge, and probable sources of any observed storm water contamination. The visual examination reports must be maintained onsite with the pollution prevention plan.

EPA believes that this quick and simple assessment will help the permittee to determine the effectiveness of his/her plan on a regular basis at very little cost. Although the visual examination cannot assess the chemical properties of the storm water discharged from the site, the examination will provide meaningful results upon which the facility may act quickly. The frequency of this visual inspection will also allow for timely adjustments to be made to the plan. If BMPs are performing ineffectively, corrective action must be implemented. A set of tracking or follow-up procedures must be used to ensure that appropriate actions are taken in response to the examinations. The visual examination is intended to be performed by members of the pollution prevention team. This hands-on examination will enhance the staff's understanding of the storm water problems on that site and the effects of the management practices that are included in the plan.

When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination. Adverse weather conditions which may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

EPA realizes that if a facility is inactive and unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly visual examination.

d. Compliance Monitoring Requirements. Today's permit requires permittees with storm water discharges associated with the production of asphalt paving or roofing emulsions to monitor for the presence of total suspended solids, oil and grease, and for pH at least annually. These monitoring requirements are necessary to evaluate compliance with the numeric effluent limitation imposed on these discharges. Monitoring shall be performed upon a minimum of one grab sample. All samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The grab sample shall be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable. Monitoring results shall be submitted on Discharge Monitoring Report Form(s) postmarked no later than the last day of the month following collection of the sample. For each outfall, one Discharge Monitoring Report form must be submitted per storm event sampled. Facilities which discharge through a large or medium municipal separate storm sewer system (systems serving a population of 100,000 or more) must also submit signed copies of discharge monitoring reports to the operator of the municipal separate storm sewer system. Alternative Certification provisions described in Section XI.D.5 do not apply to facilities subject to compliance monitoring requirements in this section. Compliance monitoring is required at least annually for discharges subject to effluent limitations. Therefore, EPA cannot permit a facility to waive compliance monitoring.

Asphalt emulsion manufacturing facilities are not required to collect and analyze separate samples for the presence of TSS to satisfy the Compliance Monitoring requirements of Section XI.D.5.d. during a year in which the facilities have collected and analyzed samples for TSS in accordance with the Analytical Monitoring requirements of Section XI.D.5.a. The results of all TSS Analytical Monitoring analyses may also be reported as Compliance Monitoring results in accordance with Section XI.D.5.d.(3) where the monitoring methodologies are consistent.

E. Storm Water Discharges Associated With Industrial Activity From Glass, Clay, Cement, Concrete, and Gypsum Product Manufacturing Facilities

1. Discharges Covered Under This Section

On November 16, 1990 (55 FR 47990), EPA promulgated the regulatory definition of "storm water discharges associated with industrial activity." This definition included point source discharges of storm water from eleven categories of facilities. Category (ii) identifies facilities classified as Standard Industrial Classification (SIC) code 32 as having storm water discharges associated with an industrial activity.

The following section describes the industrial activities and permit conditions for storm water discharges associated with industrial activity classified under Major SIC Group 32. The discussion focuses on the industries covered by today's permit. There are industries in Major SIC Group 32 beyond those discussed below; however, representatives of these industries did not choose to participate in the group application process on which this section is based. Therefore, they are not eligible for coverage under this permit.

This section only covers storm water discharges associated with industrial activities from facilities engaged in gypsum, cement, clay, glass, and concrete products manufacturing.[39]

Facilities subject to the requirements of this section include the following types of manufacturing operations: flat glass, (SIC code 3211); glass containers, (SIC code 3221); pressed and blown glass, not elsewhere classified, (SIC code 3229); hydraulic cement, (SIC code 3241); brick and structural clay tile, (SIC code 3251); ceramic wall and floor tile, (SIC code 3253); clay refractories, (SIC code 3255); structural clay products not elsewhere classified (SIC code 3259); vitreous table and kitchen articles (SIC code 3262); fine earthenware table and kitchen articles (SIC code 3263); porcelain electrical supplies, (SIC code 3264); pottery products, (SIC code 3269); concrete block and brick, (SIC code 3271); concrete products, except block and brick (SIC code 3272); ready-mix concrete, (SIC code 3273); gypsum products, (SIC code 3275); minerals and earths, ground or otherwise treated, (SIC code 3295); and nonclay refractories, (SIC code 3297).

Wash waters from vehicle and equipment cleaning areas are process wastewaters. This section does not cover any storm water that combines with process wastewater, unless the process wastewater is in compliance with another NPDES permit. This section does not cover any discharge subject to an existing or expired NPDES general permit. The section may cover runoff which derives from the storage of materials used in or derived from the cement manufacturing process[40] unless storm water discharges are already subject to an existing or expired NPDES permit.

Discharges from several industrial activities in Major SIC Group 32 are not covered by this section. These activities are: lime manufacturing (SIC 3274); cut stone and stone products (SIC 3281); abrasive products (SIC 3291); asbestos products (SIC 3292); and mineral wool and mineral wool insulation products (SIC 3297).

These types of facilities are not covered by this (or any other) section of today's permit, because these types of industrial activities were not represented in the group application process nor are they believed to be sufficiently similar to industrial activities that were included in the group application process. Because these facilities were not included in the group application process there is no additional information with which to develop industry-specific permit language.

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

a. Industry Profile. Part XI.E. of today's permit has been developed for storm water discharges from glass, clay, cement, concrete, and gypsum products manufacturers. As stated above, these facilities are regulated under category (ii) of the definition of storm water discharges associated with industrial activity. Part XI.E. of today's permit addresses the industry-specific permit requirements for storm water discharges from these industries.

There are a variety of industrial processes that occur at manufacturing facilities covered under this section. The following descriptions summarize basic operations occurring at each type of industry.

(1) Glass Product Manufacturing. Facilities primarily engaged in the manufacturing of glass and glassware, or manufacturing glass products from purchased glass are classified under standard industrial groups 321–323. Facilities covered by these SIC codes share several similar steps in the manufacturing process. Such processes include the storage of raw materials, weighing the materials, charging, melting and forming. Although the forming processes vary greatly, the steps with a potential exposure to storm water are somewhat homogeneous.

The first step in the glass manufacturing process is batch preparation. This involves the selection and storage of the raw materials that will be used in the process. Such materials may include silica sand, limestones, feldspars, borates, soda ash, boric acid, potash and barium carbonate. Once the desired characteristics of the final product are

[39] Please note that storm water discharges associated with industrial activity from facilities identified as SIC code 323 (glass products made of purchased glass) only occur where material handling equipment or activities, raw materials intermediate products, final products, waste materials, by-products or industrial machinery are exposed to storm water. SIC code 323 facilities are only required to submit storm water permit applications when activities or materials are exposed to storm water.

[40] These discharges are subject to effluent limitation guidelines under 40 CFR 412.11.

assessed, the composition of the batch is determined and the raw materials are mixed together. The batch is then conveyed to the furnaces.

Furnaces are used to melt the batch to produce glass. Most of the furnaces in the glass manufacturing industry are fueled by natural gas or oil. The batch is placed in the furnace and allowed to melt. Once the glass has been melted and conditioned it is channeled to a forming machine.

Forming operations consist of up to four major steps, the first of which involves a further conditioning process to prepare the glass for primary forming. Primary forming, which may include drawing, blowing, pressing, or casting, is the second step in the forming operation. This operation is usually followed by an annealing step. Annealing is the process of subjecting the glass to heat and slow cooling in order to toughen the product. The final process in the forming operation may include one or more secondary operations. Operations such as grinding and polishing, laminating, sealing and coating of glass are common secondary operations. Materials used for secondary operations vary, examples are the resins used to laminate glass to produce safety glass products, such as car windows.

(2) Cement Manufacturing. Facilities primarily engaged in manufacturing hydraulic cement (e.g., portland, natural, masonry, and pozzolana cements) are identified as SIC code 3241. The manufacturing process is generally the same for all facilities classified as SIC 3241. The three basic steps in cement manufacturing are: (1) Proportioning, grinding, and blending raw materials; (2) heating raw materials to produce a hard, stony substance known as "clinker"; and (3) combining the clinker with other materials and grinding the mixture into a fine powdery form.

The first step in cement manufacturing is proportioning, grinding and blending raw materials. The primary raw material is lime. Lime is typically obtained from limestone, cement rock, oyster shell marl, and chalk. Other ingredients in cement manufacturing may include silica, alumina, and iron. The blending and grinding of these raw materials is achieved through either "wet" processing or "dry" processing. Wet processing operations use water when grinding and blending raw materials, and dry processing operations grind and blend raw materials in a dried state. Until they are fed into kilns for clinker production, materials ground from wet processing are stored in slurry tanks, while dry processing materials are stored in silos.

Kilns typically are coal, gas, or oil fired. In the kiln raw materials are commonly heated to a temperature of 1600 degrees Celsius (2900 degrees Fahrenheit). At these extreme temperatures, clinker is formed as raw materials begin to fuse and harden. Air is then used to cool clinker emerging from the kiln.

The final stage of the process involves adding small amounts of gypsum or stone (used to control setting times) to the clinker and grinding the mixture into a fine powdery form. The powdery product is then cooled before storage, bagging, and shipping.

There are facilities classified as SIC 3241 which only perform the final grinding step in the cement manufacturing process. These facilities do not have kilns to heat raw materials, and so obtain clinker from manufacturing plants.

(3) Clay Product Manufacturing. Facilities primarily engaged in manufacturing clay products, including brick, tile (clay or ceramic), or pottery products are classified as standard industrial groups 325 and 326. Although clay product manufacturing facilities produce a wide variety of final products, there are several similar processing steps shared by most facilities in this industry: (1) Storage and preparation of raw materials; (2) forming; (3) drying; (4) firing; and (5) cooling.

Manufacturers classified as standard industrial groups 325 and 326 typically use clay (common, silt, kaolin and/or phyllite) and shale (mud, red, blue and/or common) as their primary raw materials. However, some industries supplement these materials with slag (cinders), cement and lime. Raw materials are generally stored outside.

Raw materials are crushed and ground prior to manufacturing. Stones are removed, and particles of raw materials are screened to ensure they are the correct size. Water is then added to raw materials in mixing chambers and "mud" is formed. The mud is molded into the desired product during the forming stage. Depending on the final product, one of several different methods will be used when forming mud into the desired shape. The most common methods use pressure or hydraulic machines to shape products.

Following the forming process, products are left to dry. Drying is necessary to reduce the moisture content prior to firing. A common method for reducing moisture content is air drying clay products in a controlled environment (e.g., a drying chamber). When the drying process is complete, the clay is ready for firing in kilns.

There are two basic types of kilns: the periodic kiln and the tunnel kiln. With a periodic kiln, products are fired for a specified period of time and then promptly removed. With a tunnel kiln, products pass through the kiln on conveyor belts, and by the time the clay reaches the end of the kiln, the firing process is complete. The primary source of energy for most firing kilns is natural gas. Natural gas is typically supplemented with coal, sawdust, or oil. Fired products may then be glazed with salt or other materials for special applications.

(4) Concrete Products. Facilities primarily engaged in manufacturing concrete products, including ready-mixed concrete, are identified as SIC group 327. Although concrete product facilities in SIC group 327 produce a variety of final products, they all have common raw materials and activities.

Concrete products manufacturers combine cement, aggregate, and water to form concrete. Aggregate generally consists of: sand, gravel, crushed stone, cinder, shale, slag, clay, slate, pumice, vermiculite, scoria, perlite, diatomite, barite, limonite, magnetite, or ilmenite. Admixtures including fly ash, calcium chloride, triethanolamine, calcium salt, lignosulfunic acid, vinosol, saponin, keratin, sulfonated hydrocarbon, fatty acid glyceride, vinyl acetate, and styrene copolymer of vinyl acetate may be added to obtain desired characteristics, such as slower or more rapid curing times.

Typically, aggregate is received in bulk quantities by rail, truck, or barge. It is stored outside, and kept moist, until it is conveyed to distribution bins. The first stage in the manufacturing process is proportioning cement, aggregate, admixtures and water, and then transporting the product to a rotary drum, or pan mixer.

To form concrete block and brick, the mixture is then fed into an automatic block molding machine that rams, presses, or vibrates the mixture into its final form. The final product is then stacked on iron framework cars where it cures for 4 hours. Decorative blocks may be produced by adding colors to the mix, or splitting the surface into desired shapes.

Precast concrete products, may contain steel structural members for increased strength. These products include transformer pads, meter boxes, pilings, utility vaults, steps, cattle guards, and balconies. After being mixed in a central mixer, concrete is poured into forms or molded in the same manner as concrete block and

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brick. Forms are often coated with a release oil to aid stripping. The concrete "sets" or cures in the forms for a number of hours (depending upon the type of admixtures used). When the concrete has cured, the forms are removed. Forms are washed for reuse, and the concrete products are stored until they can be shipped.

In addition to the permanent concrete product facilities, there are a number of portable ready mix concrete operations which operate on a temporary basis. The portable plants are typically dedicated to providing ready mix concrete to one construction project. Portable plants have the same significant materials and industrial activities as permanent facilities. Therefore, portable concrete plants are eligible for coverage under Part XI.E. of today's permit.

(5) Gypsum Products Manufacturing. Facilities primarily engaged in manufacturing plaster, wallboard, and other products composed wholly or partially of gypsum (except plaster of paris and papier-mâché) are classified as SIC code 3275.

The gypsum product manufacturing process begins with calcining the gypsum: finely ground raw gypsum (referred to as "land plaster") is fed into imp mills or calcining kettles where extreme heat removes 75 percent of the gypsum's molecular moisture. The result is a dry powder called stucco, which is cooled and conveyed to storage bins.

To produce wallboard, stucco is fed into pin mixers where it is blended with water and other additives to produce a slurry. The slurry is then applied to continuous sheets of paper to form wallboard. In addition to producing wallboard, some facilities may combine stucco with additives (excluding water) to produce plaster. Plaster is then bagged or bulked and shipped off site for purchase.

EPA considers calcining the first step in gypsum product manufacturing. Many facilities with a primary SIC code of 3275 may have mining/quarry and crushing activities at their sites. Please note, however, that because these activities are not considered part of the manufacturing operations, storm water discharges from mining/quarry and crushing are not covered under Part XI.E. of the today's permit. Discharges associated with gypsum mining activities are addressed under Part XI.J. of today's permit and VIII.J. of the fact sheet.

2. Pollutants in Storm Water Discharges Associated With Glass, Clay, Cement, Concrete, and Gypsum Product Manufacturing

Impacts caused by storm water discharges from gypsum, concrete, clay, glass, and concrete manufacturing operations will vary. Several factors influence to what extent industrial activities and significant materials from these types of facilities and processing operations can affect water quality. Such factors include: geographic location; hydrogeology; the type of industrial activity occurring outside (e.g., material storage, loading and unloading, or vehicle maintenance); the type of material stored outside (e.g., aggregate, limestone, clay, concrete, etc.); the size of the operation; and type, duration, and intensity of precipitation events. These and other factors will interact to influence the quantity and quality of storm water runoff. For example, air emissions (i.e., settled dust) may be a significant source of pollutants at some facilities, while material storage is a primary source at others. In addition, sources of pollutants other than storm water, such as illicit connections,[41] spills, and other improperly dumped materials, may increase the pollutant loadings discharged into waters of the United States.

Table E-1, Potential Sources of Pollutants in Storm Water Discharges Associated with Glass, Clay, Cement, Concrete, and Gypsum Manufacturing, summarizes the industrial activities indicated in the part 1 group applications for facilities covered under this section of today's permit. Table E-1 also lists the likely sources of contamination of storm water that are associated with this activity. The third column of the table lists the pollutants or the indicator parameters for the pollutants which may be present in the storm water discharges associated with the industrial activity. The table is limited to the industrial activities which are commonly exposed to storm water. Industrial activities which predominantly occur indoors, such as glass forming, are not listed in Table E-1.

TABLE E-1.—POTENTIAL SOURCES OF POLLUTANTS IN STORM WATER DISCHARGES ASSOCIATED WITH GLASS, CLAY, CEMENT, CONCRETE, AND GYPSUM MANUFACTURING

Activity	Pollutant source	Pollutants/indicators
Material Storage at Glass Manufacturing Facilities.	Exposed or spilled: sand, soda ash, limestone, cullet, and petroleum products.	TSS, COD, oil and grease, pH, lead.
Materials Storage at Clay Products Manufacturing Facilities.	Exposed: ceramic parts, pryophyllite ore, shale, ball clay, fire clay, kaolin, tile, silica, graphite, coke, coal, brick, sawdust, waste oil, and used solvents.	TSS, pH, COD, oil and grease, aluminum, lead, zinc.
Material Handling at Clay Products Manufacturing Facilities Including: Loading/Unloading.	Exposed: ceramic parts, liquid chemicals, ammonia, waste oil, used solvents, pryophyllite ore, shale, ball clay, fire clay, kaolin, tile, alumina, silica, graphite, coke, coal, olivine, magnesite magnesium carbonate, brick, sawdust, and wooden pallets.	TSS, pH, oil and grease, TKN, COD, BOD, aluminum, lead, zinc.
Forming/Drying Clay Products	Clay, shale, slag, cement, and lime	TSS, pH.
Material Storage at Cement Manufacturing Facilities.	Exposed: kiln dust, limestone, shale, coal, clinker, gypsum, clay, slag, and sand.	TSS, pH, COD, potassium, sulfate.
Material Handling at Cement Manufacturing Facilities.	Exposed: kiln dust, limestone, shale, coal, clinker, gypsum, clay, slag, anhydrite, and sand.	TSS, pH, COD, potassium, sulfate, oil and grease.
Crushing/Grinding at Cement Manufacturing Facilities.	Settled dust and ground limestone, cement, oyster shell, chalk, and clinker.	TSS, pH.
Material Storage at Concrete Product Manufacturing Facilities.	Exposed: aggregate (sand and gravel), concrete, shale, clay, limestone, slate, slag, and pumice.	TSS, COD, pH.

[41] Illicit connections are contributions of unpermitted non-storm water discharges to storm sewers from any of a number of sources including sanitary sewers, industrial facilities, commercial establishments, or residential dwellings.

TABLE E-1.—POTENTIAL SOURCES OF POLLUTANTS IN STORM WATER DISCHARGES ASSOCIATED WITH GLASS, CLAY, CEMENT, CONCRETE, AND GYPSUM MANUFACTURING—Continued

Activity	Pollutant source	Pollutants/indicators
Material Handling at Concrete Product Manufacturing Facilities.	Exposed: aggregate, concrete, shale, clay, slate, slag, pumice, and limestone as well as spills or leaks of cement, fly ash, admixtures and baghouse settled dust.	TSS, COD, pH, lead, iron, zinc.
Mixing Concrete	Spilled: aggregate, cement, and admixture	TSS, pH, COD, lead, iron zinc.
Casting/Forming Concrete Products	Concrete, aggregate, form release agents, reinforcing steel, latex sealants, and bitumastic coatings.	TSS, pH, oil and grease, COD, BOD.
Vehicle and Equipment Washing at Concrete Product Manufacturing Facilities.	Residual: aggregate, concrete, admixture, oil and grease	TSS, pH, COD, oil and grease.
Crushing/Grinding of Gypsum Rock	Exposed or spilled: gypsum rock and dust	TSS, pH.
Material Storage at Gypsum Manufacturing Facilities.	Exposed: gypsum rock, synthetic gypsum, recycled gypsum and wallboard, stucco, perlite ore/expanded perlite, and coal.	TSS, COD, pH.
Material Handling at Gypsum Manufacturing Facilities (including bagging and packaging).	Exposed or spilled: gypsum rock, synthetic gypsum, recycled gypsum and wallboard, stucco, perlite ore/expanded perlite, and coal.	TSS, pH, COD.
Equipment/Vehicle Maintenance	Gasoline, diesel, fuel, and fuel oil	Oil and grease, BOD, COD.
	Parts cleaning	COD, BOD, oil and grease, pH.
	Waste disposal of solvents, oily rags, oil and gas filters, batteries, coolants, and degreasers.	Oil and grease, lead, iron, zinc, aluminum, COD, pH.
	Fluid replacement including lubricating fluids, hydraulic fluid, oil, transmission fluid, radiator fluids, solvents, and grease.	Oil and grease, arsenic, lead, cadmium, chromium, COD, and benzene.

The activities common to the facilities covered under Part XI.E. of today's permit are material storage and material handling operations. All facilities covered under this section handle and store nonmetallic minerals. These minerals are typically loaded and unloaded in areas of the site that are exposed to storm water. The minerals are often stored outdoors until they are utilized in the industrial processes. Handling and storing these minerals outdoors may result in the discharge of a portion of the materials in storm water runoff. The presence of the nonmetallic minerals in the storm water is measured by the total suspended solids (TSS) test. Many of the minerals processed by the facilities are calcareous, such as limestone or chalk. The presence of these materials can elevate the pH of the storm water discharged from the site.

Vehicle fueling, repair, maintenance and cleaning occurs at many facilities covered under this section. Facilities will fuel, repair and maintain vehicles used to transport significant materials to, from or around the facility. Facilities may also perform maintenance on process or material handling equipment such as mixers or conveyors. The fueling, maintenance and repair activities may result in leaks or spills of oil from the vehicles and equipment. The spilled material may be carried off of the site in the storm water discharge.

Ready mix concrete facilities will frequently wash out the mixers of the trucks after concrete has been delivered to a job site. The wash out water contains unhardened concrete. Facilities will often wash down the exterior of their vehicles. The wash off water may contain cement, sand, gravel, clay, or other materials. The wash water from the vehicles should be either treated and discharged from the site through a sanitary sewer or NPDES permitted discharge or collected in a recycle pond where the heavy solids settle out and the water is recycled back to be used in the plant. Pollutants from the wash water may settle out on the site before it is treated or recycled. These pollutants may come into contact with storm water and be discharged from the site.

Based on the wide variety of industrial activities and significant materials at the facilities included in this sector, EPA believes it is appropriate to divide the glass, clay, cement concrete and gypsum product industry into subsectors to properly analyze sampling data and determine monitoring requirements. As a result, this sector has been divided into the following subsectors: manufacturers of flat glass, glass and glassware, pressed or blown glass products made of purchased glass; hydraulic cement manufacturers; manufacturers of clay products, pottery and related products (including nonclay refractories); and concrete, gypsum and plaster product manufacturers (including ground minerals and earth). Tables E-2, E-3, E-4 and E-5 below include data for the eight pollutants that all facilities were required to monitor for under Form 2F. The tables also list those parameters that EPA has determined merit further monitoring.

TABLE E-2.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY FLAT GLASS, GLASS AND GLASSWARE, PRESSED OR BLOWN GLASS PRODUCTS MADE OF PURCHASED GLASS MANUFACTURING FACILITIES SUBMITTING PART II SAMPLING DATA[i] (MG/L)

Pollutant Sample type	No. of facilities		No. of samples		Mean		Minimum		Maximum		Median		95th percentile		99th percentile	
	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	9	9	17	17	9.4	7.76	0.0	0.0	45.0	16.0	5.0	7.0	27.8	17.56	49.5	25.01
COD	9	9	17	17	84.6	95.81	14.0	7.0	317.0	512.0	56.0	51.0	245.3	307.6	440.7	605.3
Nitrate + Nitrite Nitrogen	9	9	17	17	0.99	0.87	0.00	0.0	7.21	4.79	0.56	0.55	2.76	3.01	5.23	6.20
Total Kjeldahl Nitrogen	9	9	17	17	2.01	1.73	0.67	0.0	4.92	4.47	1.50	1.80	4.42	4.44	6.58	6.82
Oil & Grease	9	N/A	16	N/A	2.7	N/A	0.0	N/A	29.0	N/A	0.0	N/A	15.4	N/A	49.5	N/A
pH	9	N/A	18	N/A	N/A	N/A	4.6	N/A	9.8	N/A	7.9	N/A	10.5	N/A	11.8	N/A
Total Phosphorus	9	9	17	17	0.39	0.31	0.10	0.0	1.50	0.83	0.33	0.23	0.91	0.71	1.43	1.06

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TABLE E–2.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY FLAT GLASS, GLASS AND GLASSWARE, PRESSED OR BLOWN GLASS PRODUCTS MADE OF PURCHASED GLASS MANUFACTURING FACILITIES SUBMITTING PART II SAMPLING DATA[i] (MG/L)—Continued

Pollutant Sample type	No. of facilities		No. of samples		Mean		Minimum		Maximum		Median		95th percentile		99th percentile	
	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
Total Suspended Solids	9	9	17	17	60	110.6	6	0.0	230	800	40	19.0	215	450	453	1314

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.
[ii] Composite samples.

TABLE E–3.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY HYDRAULIC CEMENT MANUFACTURING FACILITIES SUBMITTING PART II SAMPLING DATA[i] (MG/L)

Pollutant Sample type	No. of facilities		No. of samples		Mean		Minimum		Maximum		Median		95th percentile		99th percentile	
	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	4	4	7	7	7.8	5.3	0.0	0.0	40.2	27.0	0.0	0.0	42.5	27.99	95.2	60.6
COD	4	4	7	7	277.3	55.2	0.0	15.0	1411.0	136.0	38.8	40.0	1350.7	173.0	4198.2	323.1
Nitrate + Nitrite Nitrogen	4	4	7	7	0.78	3.40	0.23	0.10	1.77	17.5	0.66	0.67	1.82	15.44	2.75	49.7
Total Kjeldahl Nitrogen	4	4	7	7	1.85	1.16	0.00	0.0	7.15	2.81	0.56	1.03	12.77	5.20	41.07	11.15
Oil & Grease	4	N/A	7	N/A	1.5	N/A	0.0	N/A	5.0	N/A	0.0	N/A	9.6	N/A	22.8	N/A
pH	4	N/A	6	N/A	N/A	N/A	7.2	N/A	11.2	N/A	8.1	N/A	12.3	N/A	14.2	N/A
Total Phosphorus	4	4	7	7	1.00	0.18	0.00	0.01	3.88	0.53	0.16	0.05	18.43	1.14	143.86	3.72
Total Suspended Solids	4	4	7	7	2528	300.6	10	6.0	17065	1368	82	57	7499	1709	40323	6791

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.
[ii] Composite samples.

TABLE E–4.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY STRUCTURAL CLAY PRODUCTS, POTTERY, AND RELATED PRODUCTS MANUFACTURING FACILITIES SUBMITTING PART II SAMPLING DATA[i] (MG/L)

Pollutant Sample type	No. of facilities		No. of samples		Mean		Minimum		Maximum		Median		95th percentile		99th percentile	
	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	18	18	23	22	10.4	10.7	0.0	0.0	47.0	42.0	9.3	9.1	30.2	32.3	50.2	54.32
COD	18	18	23	22	91.1	77.9	0.0	0.0	620.0	420.0	39.0	37.5	324.3	273.7	703.1	592.4
Nitrate + Nitrite Nitrogen	16	16	21	20	0.76	0.76	0.00	0.00	1.80	2.30	0.40	0.56	2.53	2.20	4.65	3.75
Total Kjeldahl Nitrogen	18	18	23	22	1.93	1.40	0.00	0.00	13.00	6.70	1.10	0.82	5.02	4.94	10.59	9.06
Oil & Grease	18	N/A	23	N/A	1.46	N/A	0.00	N/A	9.0	N/A	0.0	N/A	7.9	N/A	17.6	N/A
pH	18	N/A	23	N/A	N/A	N/A	5.0	N/A	9.0	N/A	7.0	N/A	9.2	N/A	10.1	N/A
Total Phosphorus	16	16	21	20	0.31	0.28	0.00	0.0	1.70	1.42	0.12	0.14	1.22	1.14	2.75	2.43
Total Suspended Solids	18	18	23	22	177	203	4	0.0	1300	1440	73	50	747	1066	2066	3745
Aluminum	8	8	8	8	3.96	6.48	0.3	0	14	42	2.7	1.1	16.51	24.18	37.73	74.09

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.
[ii] Composite samples.

TABLE E–5.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY CONCRETE, GYPSUM AND PLASTER PRODUCTS MANUFACTURING FACILITIES SUBMITTING PART II SAMPLING DATA[i] (MG/L)

Pollutant Sample type	No. of facilities		No. of samples		Mean		Minimum		Maximum		Median		95th percentile		99th percentile	
	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	156	153	211	207	14.0	5.84	0.0	0.0	1300.0	74.0	4.0	3.4	33.5	19.4	71.0	35.9
COD	156	154	213	208	81.6	62.4	0.0	0.0	700.0	510.0	51.0	43.5	251.8	190.8	472.7	350.6
Nitrate + Nitrite Nitrogen	147	145	203	198	1.27	0.85	0.00	0.0	48.00	22.20	0.57	0.52	4.16	2.91	9.45	6.05
Total Kjeldahl Nitrogen	147	144	204	198	2.45	1.39	0.00	0.0	101.00	17.30	1.20	1.00	6.21	3.91	12.08	6.87
Oil & Grease	157	N/A	214	N/A	4.6	N/A	0.0	N/A	130.0	N/A	1.4	N/A	15.5	N/A	34.5	N/A
pH	146	N/A	199	N/A	N/A	N/A	2.0	N/A	12.3	N/A	8.9	N/A	12.1	N/A	13.8	N/A
Total Phosphorus	156	153	213	207	1.00	0.74	0.00	0.00	18.00	10.70	0.30	0.25	3.54	2.60	9.61	6.51
Total Suspended Solids	154	154	211	208	1322	374.5	0	0.0	61000	3340	250	170	3872	1724	12482	4636
Iron	8	8	8	8	10.4	7.1	0.2	1	29	14	5.4	6.5	72.2	23.1	224.3	41.9

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.
[ii] Composite samples.

3. Options for Controlling Pollutants

There are a number of options for eliminating or minimizing the presence of pollutants in storm water discharges from glass, clay, cement or concrete product manufacturing facilities. In evaluating the options for controlling pollutants in the storm water discharges associated with the industrial activities covered under this section, EPA must comply with the requirements of Section 402(p)(3) of the Clean Water Act which require the compliance with the Best Available Technology (BAT) and Best Conventional Technology (BCT).

EPA believes that it is infeasible to develop effluent limitations for storm water discharges associated with glass, clay, cement, or concrete manufacturing beyond those already established in the Effluent Limitation Guidelines. There are significant variations from site to site on the industrial activity and significant materials exposed to storm water. The data collected to date is inadequate to characterize these variations. Therefore, EPA believes that the requirement for a facility operator to develop a pollution prevention plan which considers the specific conditions at his or her site satisfies the BAT/BCT requirements. The pollution prevention plan will call for the implementation of best management practices that minimize contact between the storm water and pollutant sources or which remove pollutants from the storm water before it is discharged from the site. Table E–6 lists the pollution prevention measures or best management practices which are most applicable to facilities classified in major SIC Group 32. The table is organized by the specific industrial activities which may introduce pollutants to storm water. The right column lists corresponding BMPs which may be considered.

TABLE E–6.—MEASURES TO CONTROL POLLUTANTS IN STORM WATER DISCHARGES FROM GLASS, CLAY, CEMENT, CONCRETE, AND GYPSUM FACILITIES[1]

Activity	Associated BMPs
Storing dry bulk materials including: sand, gravel, clay, cement, fly ash, kiln dust, and gypsum.	Store materials in an enclosed silo or building.
	Cover material storage piles with a tarp or awning.
	Divert runon around storage areas using curbs, dikes, diversion swales or positive drainage away from the storage piles.
	Install sediment basins, silt fence, vegetated filter strips, or other sediment removal measures downstream/downslope.
	Only store washed sand and gravel outdoors.
Handling bulk materials including: sand, gravel, clay, cement, fly ash, kiln dust, and gypsum.	Use dust collection systems (e.g., bag houses) to collect airborne particles generated as a result of handling operations.
	Remove spilled material and settled dust from paved portions of the facility by shoveling and sweeping on a regular basis.
	Periodically clean material handling equipment and vehicles to remove accumulated dust and residue.
	Install sediment basins, silt fence, vegetated filter strips, or other sediment removal measures downstream/downslope.
Mixing operations	Use dust collection systems (e.g., bag houses) to collect airborne particles generated as a result of mixing operations.
	Remove spilled material and settled dust from the mixing area by shoveling and sweeping on a regular basis.
	Clean exposed mixing equipment after mixing operations are complete.
	Install sediment basins, silt fence, vegetated filter strips, or other sediment removal measures downstream/downslope.
Vehicle and equipment washing	Designate vehicle and equipment wash areas that drain to recycle ponds or process wastewater treatment systems.
	Train employees on proper procedure for washing vehicles and equipment including a discussion of the appropriate location for vehicle washing.
	Conduct vehicle washing operation indoors or in a covered area.
	Clean wash water residue from portions of the site that drain to storm water discharges.
Dust Collection	Maintain dust collection system and baghouse. Properly remove and recycle or dispose of collected dust to minimize exposure of collected dust to.
Pouring and curing pre-cast concrete products	Pour and cure precast products in a covered area.
	Clean forms before storing outdoors.

[1] From "Storm Water Management for Industrial Activities: Developing Pollution Prevention Plans and Best Management Practices," (EPA 832–R–92–006) EPA, 1992, and proposed pollution prevention plans submitted by group applicants.

In addition to the activity-specific best management practices listed in Table E–6 above, there are structural practices that may be effective in reducing the pollutants found in the storm water discharges from facilities in Major SIC Group 32. This section does not specifically require that these structural measures be installed; however, the permittee must consider measures such as these at the facility. The structural measures include: vegetative filter strips, grassed swales, detention ponds, retention ponds or recycle ponds. These structural measures remove pollutants from the storm water which is carrying them off site. The measures listed above are effective in removing the heavy suspended solids which are common in the storm water discharges from clay, cement, concrete, and gypsum facilities.

Vegetated filter strips are gently sloped areas covered with either natural or planted vegetation. Vegetated filter strips remove pollutants from storm water by a filtering action. Vegetated filter strips can be located along the down slope perimeter of the industrial activity but not in areas of concentrated flow. Grassed swales are similar to vegetated filter strips. Within Major SIC Group 32, four percent of the designated sampling facilities indicated in their part 1 group applications that they had vegetated filter strips at their facilities. Grassed swales also remove pollutants from storm water flows by a filtering action. A grassed swale consists of a broad, grass lined ditch or swale with gradual slopes or check dams to reduce the velocity of flow. Unlike vegetated filter strips, grassed swales can remove pollutants from concentrated storm water runoff. Over 13 percent of the designated samplers in Major SIC Group 32 indicated that there were grass lined swales at their facility.

Retention ponds and detention ponds are storm water management measures used to control the quantity and quality of storm water discharged from a site. A detention pond is a pond which temporarily detains the storm water discharged from an area. While detained in the pond, the heavy suspended particles in the storm water settle to the bottom of the pond. The result is a discharge from the detention pond with a TSS concentration which is lower than the influent concentration to the pond. Retention ponds retain the storm water within the pond with no discharge except for when extreme rainfall events occur. The water collected in the retention pond either evaporates, infiltrates, or is used as process water on site. Twenty seven percent of the designated samplers in Major SIC Group 32 indicated that there was a pond on their site which was used as a storm water management measure.

4. Special Conditions

a. Prohibition of Non-storm Water Discharges. The prohibited non-storm water discharges under this section are the same as those described under section V1.B.2 of this fact sheet with one exception. Part XI.E.2. of today's permit clarifies that the discharges of pavement washwaters from facilities covered under Part XI.E. of the permit are authorized under this section after the accumulated fly ash, cement, aggregate, kiln dust, clay, concrete or other dry significant materials handled at the facility have been removed from the pavement by sweeping, vacuuming, combination thereof or other equivalent measures, or the washwaters are conveyed into a BMP designed to remove solids prior to discharge, such as sediments basins, retention basins, and other equivalent measures. Where practicable pavement washwater shall be directed to process wastewater treatment or recycling systems. The clarification is made for this sector because EPA believes that a primary source of pollutants in the storm water discharges from facilities covered under this sector are spilled materials or settled dust from material handling processes. A primary focus of the pollution prevention plan requirements for these industries are good housekeeping measures, in particular, sweeping the paved portions of the site surrounding the material handling areas. Washing the paved areas without first sweeping or otherwise removing the accumulated solids may result in the discharge of these pollutants in the washwater unless the washwater is contained onsite or otherwise collected without discharge.

5. Storm Water Pollution Prevention Plan Requirements

a. Contents of the Plan.

(1) Description of Potential Pollutant Sources. All facilities covered by today's permit must prepare a description of the potential pollutant sources at the facility which complies with the common requirements described in Part VI.C.2. of this fact sheet. In addition to these requirements, facilities covered by this section must provide the following additional information in their pollution prevention plan.

Facilities covered under Part XI.E. of today's permit must identify on the site map the location of any: bag house or other air pollution control device; any sedimentation or process waste water recycling pond and the areas which drain to the pond. The location of the bag house or air pollution control equipment is required because this equipment stores the particulates or dust that are removed from the air in and around the material handling equipment. There is a potential that the collected dust or particulates could come into contact with storm water. Therefore the site map must indicate the location of this potential source. The site map for the facility must clearly indicate the portion of the facility which drains to sedimentation or recycle ponds that receive process wastewater. This information is necessary to illustrate the portion of the site where runoff is already controlled. The site map must also indicate the outfall locations and the types of discharges contained in the drainage areas of the outfalls (e.g. storm water and air conditioner condensate). In order to increase the readability of the map, the inventory of the types of discharges contained in each outfall may be kept as an attachment to the site map. The site map for these facilities must also indicate the portion of the site where regular sweeping or other equivalent good housekeeping measures will be implemented to prevent the accumulation of spilled materials or settled dust.

(2) Measures and Controls. Part VI.C.3. of today's fact sheet describes a number of measures and controls which are effective in controlling the discharge of pollutants in storm water discharged from a number of types of industrial activities including those facilities in Major SIC Group 32. The following section describes BMPs which EPA believes are particularly effective in controlling the pollutants discharged from glass, clay, cement, concrete or gypsum manufacturing facilities. Facilities covered under Part XI.E. are required to consider each of these BMPs or its equivalent in their pollution prevention plan.

(a) Good Housekeeping—Today's permit requires that the pollution prevention plans for facilities covered under this section must specifically address measures to minimize the discharge of spilled cement, sand, kiln dust, fly ash, settled dust or other significant materials in storm water from paved portions of the site that are exposed to storm water. Measures used to minimize the presence of these materials may include regular sweeping, or other equivalent measures. The plan shall indicate the frequency of sweeping or other measures. The frequency shall be determined based upon consideration of the amount of industrial activity occurring in the area and frequency of precipitation. This requirement is established in an effort to minimize the discharge of solids from these types of facilities. Sweeping to prevent the discharge of solids must be considered in the pollution prevention plan because it is a cost effective measure well suited to the dry, granular, and powder-like materials used at the facilities covered under this section.

This section also requires that facilities minimize the exposure of fine solids such as cement, fly ash, baghouse dust, and kiln dust to storm water. The pollution prevention plan shall consider storing these materials in enclosed silos, hoppers, or other containers, in buildings, or in covered areas of the facility. Fine solids are a particular concern because the small particles are readily suspended by storm water and carried off of the site.

(b) Preventative Maintenance—There are no additional preventative maintenance requirements beyond these described in Part VI.C.3 of this fact sheet.

(c) Spill Prevention and Response—There are no additional spill prevention and response requirements for facilities in the glass, clay, cement, concrete or gypsum products industries beyond those described in Part VI.C.3.c. of this fact sheet.

(d) Inspections—Facilities in the glass, clay, cement, concrete, and gypsum products industries are required to conduct self inspections at a frequency which they determine to be adequate to ensure proper implementation of their pollution prevention plan, but not less frequently than once per month. Monthly inspections are necessary for the facility to be able to assess the effectiveness of

the pollution prevention plan. Less frequent inspections may allow facilities to delay inspections until after periods of high activity when the greatest potential for exposure of materials occurs. This section requires that the inspections take place while the facility is in operation because this is the only time when potential pollutant sources (such as malfunctioning dust control equipment or non-storm water discharges from equipment washing operations) may be evident. The inspectors must observe several portions of the site which EPA believes are potential sources of pollutants in storm water including: material handling areas, above ground storage tanks, hoppers or silos, dust collection/ containment systems, vehicle washing, and equipment cleaning areas.

(e) Employee Training—In addition to the requirements described in Part VI.C.3.e. of this fact sheet, the pollution prevention plan training requirements for facilities in the glass, clay, cement, concrete, and gypsum industries require that the employee training program address procedures for equipment and vehicle washing. This is because these are common activities in these industries which result in process wastewater which may be discharged into the storm water conveyance system. Training programs should focus on where and how equipment should be cleaned at the facility so that there will be no unpermitted discharge of wash water to the storm water conveyance system. EPA recommends that facilities conduct training annually at a minimum. However, more frequent training may be necessary at facilities with high turnover of employees or where employee participation is essential to the storm water pollution prevention plan.

(f) Recordkeeping and Internal Reporting Procedures—There are no additional recordkeeping and internal reporting procedure requirements for facilities in the stone, clay, glass or concrete products industries beyond than those described in Part VI.C.3.f. of this fact sheet.

(g) Non-storm Water Discharges—There are no additional non-storm water discharge certification requirements for facilities in the stone, clay, glass or concrete products industries beyond those described in Part VI.C.2.d. of this fact sheet with the exception of facilities engaged in production of concrete products. These facilities must include in the certification a description of measures which insure that process wastewater which results from washing of trucks, mixers, transport buckets, forms or other equipment are discharged in accordance with NPDES requirements or are recycled. These nonprocess wastewater discharges are common to this industry. However, these discharges are not eligible for coverage under this section and it is necessary to assess the facility for the presence of these discharges so that steps may be taken to eliminate the discharges or to cover the process discharges with a separate permit.

A number of facilities in the concrete products industry maintain wash water recycle/retention ponds which receive the process wastewater from equipment cleaning and other operations. These ponds may also receive a portion or all of the runoff from the industrial site. These facilities are required to provide an estimate of the depth of the 24-hour duration storm event that would be required to cause the recycle/retention pond to overflow and discharge to the waters of the United States. Methods to make this estimate can include, but are not limited to, the original design calculations for the recycle/retention pond or historical observation.

(h) Sediment and Erosion Control—There are no additional sediment and erosion control requirements for facilities in the stone, clay, glass, or concrete products industries beyond those described in Part VI.C.3.g. of this fact sheet.

(i) Management of Runoff—There are no additional requirements for management of runoff at facilities in the stone, clay, glass, or concrete products industries beyond than those described in Part VI.C.3.h. of this fact sheet.

(3) Comprehensive Site Compliance Evaluation. Facilities in the glass, clay, cement, concrete, and gypsum product sector must perform an annual site compliance evaluation as described in Part VI.C.4. of this fact sheet. For facilities in the concrete product manufacturing industries, the evaluation must specifically address the following portions of the site: above ground storage tanks, hoppers or silos; dust collection/containment systems; truck wash down; and equipment cleaning areas. Because these areas are the most likely sources of pollutants, these portions of the site must be thoroughly evaluated.

6. Numeric Effluent Limitations

Part XI.E.4. of today's permit establishes numeric effluent limitations for storm water discharges from storage areas for materials used or produced at cement manufacturing facilities. Discharges from these areas may not exceed a maximum TSS concentration of 50 mg/L. The pH of the discharges from these areas must be within the range of 6.0 to 9.0. Untreated discharges from the facility which are a result of a storm with a rainfall depth greater than the 10-year, 24-hour storm event are not subject to this limitation. These effluent limitations are in accordance with 40 CFR 411.32 and 40 CFR 411.37. Effluent Guidelines and Standards, Cement Manufacturing Point Source Category, Materials Storage Piles Runoff Subcategory. These limitations represent the degree of effluent reduction attainable by the application of best practicable control technology and best conventional pollutant control technology. Dischargers subject to these numeric effluent limitations must be in compliance with the limits upon commencement of and for the entire term of this permit. Discharges that are associated with industrial activities that do not contain runoff from material storage areas at cement manufacturing facilities are not subject to the effluent limitation described above.

7. Monitoring and Reporting Requirements

a. Analytical Monitoring Requirements. EPA believes that glass, clay, cement, concrete, and gypsum product manufacturing may reduce the level of pollutants in storm water runoff from their sites through the development and proper implementation of the storm water pollution prevention plan requirements discussed in today's permit. In order to provide a tool for evaluating the effectiveness of the pollution prevention plan, requires two of the four subsectors within the glass, clay, cement, concrete and gypsum product manufacturing sector to perform analytical monitoring.

The clay product subsector includes brick and structural clay tile manufacturers (SIC 3251), ceramic wall and floor tile manufacturers (SIC 3253), clay refractories (SIC 3255), manufacturers of structural clay products, not elsewhere classified (SIC 3259), manufacturers of vitreous china table and kitchen articles (SIC 3232), manufacturers of fine earthenware table and kitchen articles (SIC 3263), manufacturers of porcelain electrical supplies (SIC 3264), pottery products (SIC 3269) and non-clay refractories (3297). Data submitted by group applicants within this subsector show that a significant portion of the facilities discharge aluminum concentrations higher than bench mark values. Therefore facilities with these industrial activities must monitor for the pollutant identified in Table E–7.

The concrete and gypsum subsector includes concrete block and brick manufacturers (SIC 3271), concrete products manufacturers (SIC 3272), ready mix concrete manufacturers (SIC 3273), gypsum product manufacturers (SIC 3275) and manufacturers of mineral and earth products (SIC 3295). Data submitted by group applicants within this subsector show that a significant portion of the facilities discharge total suspended solids and iron in concentrations higher than bench mark values. Therefore facilities with these industrial activities must monitor for pollutants identified in Table E–8.

The glass product subsector includes flat glass manufacturers (SIC 3211), glass container manufacturers (SIC 3221), pressed and blown glass and glassware manufacturer (SIC 3229), and manufacturers of glass products made of purchased glass (SIC 3231). Monitoring data submitted by facilities within this subsector do not indicate that these facilities are likely to discharge storm water with pollutant concentrations greater than the bench marks. Therefore, this sector is not subject to analytical monitoring requirements under this permit.

The cement manufacturing subsector includes manufacturers of hydraulic cement (SIC 3241). This subsector is not subject to the analytical monitoring requirements under Section XI.E.5.a this permit. However, because these facilities are subject to numerical effluent limitations they are subject to compliance monitoring described in section XI.E.5.d of the permit.

At a minimum, storm water discharges from clay and gypsum, and concrete product manufacturing must be monitored quarterly (January through March, April through June, July through September and October through December) during the second year of permit coverage. At the end of the second year of permit coverage, a facility must calculate the average concentration for each parameter listed in Tables E–7 and E–8. If the permittee collects more than four samples in this period, then they must calculate an average concentration for all parameters analyzed, not simply a minimum of four selected analysis.

TABLE E–7.—CLAY PRODUCT INDUSTRY MONITORING REQUIREMENTS

Pollutants of concern	Cut-off concentration
Total Recoverable Aluminum	0.75 mg/L.

TABLE E–8.—CONCRETE AND GYPSUM PRODUCT INDUSTRY MONITORING REQUIREMENTS

Pollutants of concern	Cut-off concentration
Total Suspended Solids (TSS) ...	100 mg/L.
Total Recoverable Iron	1.0 mg/L.

If the average concentration for a parameter is less than or equal to the value listed in Tables E–7 or E–8, then the permittee is not required to conduct quantitative analysis for that parameter during the fourth year of the permit. If, however, the average concentration for a parameter is greater than the cut-off concentration listed in Tables E–7 or E–8, then the permittee is required to conduct quarterly (in the same quarterly periods listed above) monitoring for that parameter during the fourth year of permit coverage. Monitoring is not required during the first, third, and fifth year of the permit. The exclusion from monitoring in the fourth year of the permit is conditional on the facility maintaining industrial operations and BMPs that will ensure a quality of storm water discharges consistent with the average concentrations recorded during the second year of the permit.

TABLE E–9.—SCHEDULE OF MONITORING

2nd Year of Permit Coverage	• Conduct quarterly monitoring. • Calculate the average concentration for all parameters analyzed during this period. • If average concentration is greater than the value listed in Table E–7 or E–8, then quarterly sampling is required during the fourth year of the permit. • If average concentration is less than or equal to the value listed in Table E–7 or E–8, then no further sampling is required for that parameter.
4th Year of Permit Coverage	• Conduct quarterly monitoring for any parameter where the average concentration in year 2 of the permit is greater than the value listed in Table E–7 or E–8. • If industrial activities or the pollution prevention plan have been altered such that storm water discharges may be adversely affected, quarterly monitoring is required for all parameters of concern.

In cases where the average concentration of a parameter exceeds the cut-off concentration, EPA expects permittees to place special emphasis on methods for reducing the presence of those parameters in storm water discharges. Quarterly monitoring in the fourth year of the permit will reassess the effectiveness of the adjusted pollution prevention plan.

EPA realizes that if a facility is inactive and unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly chemical sampling.

b. Alternative Certification. Throughout today's permit, there are monitoring requirements for facilities which the Agency believes have the potential for contributing significant levels of pollutants to storm water discharges. The alternative described below is necessary to ensure that monitoring requirements are only imposed on those facilities that do, in fact, have storm water discharges containing pollutants at concentrations of concern. EPA has determined that if materials and activities are not exposed to storm water at the site, then the potential for pollutants to contaminate storm water discharges does not warrant monitoring.

Therefore, a discharger is not subject to the monitoring requirements of this Part provided the discharger makes a certification for a given outfall, or on a pollutant-by-pollutant basis, in lieu of sampling required under Part XI E.5 of today's permit, that material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, industrial machinery or operations, significant materials from past industrial activity that are located in areas of the facility that are within the drainage area of the outfall are not presently exposed to storm water and will not be exposed to storm water for the certification period. Such certification must be retained in the storm water pollution prevention plan and submitted to EPA in lieu of monitoring reports required under Part XI E.5.b. The permittee is required to complete any and all sampling until the exposure is eliminated. If the facility is reporting for a partial year, the permittee must specify the exposure was eliminated. If the permittee is certifying that a pollutant was present for part of the reporting period, nothing relieves the permittee from the responsibility to sample that parameter up until the exposure was eliminated and it was determined that no significant materials remained.

This certification is not to be confused with the low concentration sampling waiver. The test for the application of this certification is whether the pollutant is exposed, or can be expected to be present in the storm water discharge. If the facility does not and has not used a parameter, or if exposure is eliminated and no significant materials remain, then the facility can exercise this certification. In the case of certifying that a pollutant is not present, the permittee must submit the certification along with the monitoring reports required under paragraph (*b*) below. If the permittee cannot certify for an entire period, they must submit the date exposure was eliminated and any monitoring required up until that date. This certification option is not applicable to compliance monitoring requirements associated with effluent limitations. EPA does not expect facilities to be able to exercise this certification for indicator parameters, such as TSS and BOD.

c. Reporting Requirements. Permittees are required to submit all monitoring results obtained during the second and fourth year of permit coverage within 3 months of the conclusion of each year. For each outfall, one signed Discharge Monitoring Report Form must be submitted per storm event sampled. For facilities conducting monitoring beyond the minimum quarterly requirements an additional Discharge Monitoring Report Form must be filed for each analysis.

d. Sample Type. All discharge data shall be reported for grab samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The required 72-hour storm event interval is waived where the preceding measurable storm event did not result in a measurable discharge from the facility. The required 72-hour storm event interval may also be waived where the permittee documents that less than a 72-hour interval is representative for local storm events during the season when sampling is being conducted. The grab sample shall be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable.

If storm water discharges associated with industrial activity commingle with process or nonprocess water, then where practicable permittees must attempt to sample the storm water discharge before it mixes with the non-storm water discharge.

e. Representative Discharge. When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may test the effluent of one of such outfalls and report that the quantitative data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluent. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area (e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)) shall be provided in the plan.

f. Quarterly Visual Examination of Storm Water Quality. Quarterly visual examinations of storm water discharges from each outfall are required. Note that this requirement applies to all facilities and not just those subject to the analytical monitoring requirements under Part VI.E.7. of this fact sheet. The examination must be of a grab sample collected from each storm water outfall. The examination of storm water grab samples shall include any observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, or other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on these samples.

The examination must be made at least once every 3 months (January through March, April through June, July through September, and October through December) during permit coverage. Examinations shall be made during daylight unless there is insufficient rainfall or snow-melt to produce runoff. Whenever practicable, the same individual should carry out the collection and examination of discharges throughout the life of the permit to ensure the greatest degree of consistency possible. Grab samples shall be collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 60 minutes) of when the runoff begins discharging. Reports of the visual examination include: the examination date and time, examination personnel, visual quality of the storm water discharge, and probable sources of any observed storm water contamination. The visual examination reports must be maintained onsite with the pollution prevention plan.

EPA believes that this quick and simple assessment will allow the permittee to approximate the effectiveness of his/her plan on a regular basis at very little cost. Although the visual examination cannot assess the chemical properties of the storm water discharged from the site, the examination will provide meaningful results upon which the facility may act quickly. The frequency of this visual examination will also allow for timely adjustments to be made to the plan. If BMPs are performing ineffectively, corrective action must be implemented. A set of tracking or follow-up procedures must be used to ensure that appropriate actions are taken in response to the examination. The visual examination is intended to be performed by members of the pollution prevention team. This hands-on examination will enhance the staff's understanding of the storm water problems on that site and the effects of the management practices that are included in the plan.

When a discharger is unable to collect samples over the course of the monitoring period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination. Adverse weather conditions which may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

EPA realizes that if a facility is inactive and unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly visual examination.

g. Compliance Monitoring Requirements. Today's permit requires permittees with discharges of runoff from material storage at cement manufacturing facilities to monitor for the presence of TSS and pH. These monitoring requirements are necessary to evaluate compliance with the numeric effluent limitation established for these discharges. Monitoring shall be performed upon a minimum of one grab sample. All samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The grab sample shall be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable. Monitoring results shall be submitted on Discharge Monitoring Report Form(s) postmarked no later than the 31st day of the month following collection of the sample. Facilities which discharge through a large or medium municipal separate storm sewer system (systems serving a population of 100,000 or more) must also submit signed copies of discharge monitoring reports to the operator of the municipal separate storm sewer system. Alternative Certification provisions described in Section VI.E.5 do not apply to facilities subject to compliance monitoring requirements in this section. Compliance monitoring is required at least annually for discharges subject to effluent limitations. Therefore, EPA cannot permit a facility to waive compliance monitoring.

F. Storm Water Discharges Associated With Industrial Activity From Primary Metals Facilities

1. Discharges Covered Under This Section

On November 16, 1990 (55 FR 47990), the U.S. Environmental Protection Agency (EPA) promulgated the regulatory definition of "storm water discharges associated with industrial activity." This definition included point source discharges of storm water from 11 categories of industrial facilities. This section of today's permit includes storm water discharges associated with industrial activity from primary metals facilities. These facilities are commonly identified by Standard Industrial Classification (SIC) code 33. The SIC codes eligible for coverage under this section of today's permit include the following:

a. Steel works, blast furnaces, and rolling and finishing mills, including: steel wiredrawing and steel nails and spikes; cold-rolled steel sheet, strip, and bars; and steel pipes and tubes (SIC 331).

b. Iron and steel foundries, including: gray and ductile iron, malleable iron, steel investment, and steel foundries, not elsewhere classified (SIC 332).

c. Primary smelting and refining of nonferrous metals, including: primary smelting and refining of copper and primary production of aluminum (SIC 333).

d. Secondary smelting and refining of nonferrous metals (SIC 334).

e. Rolling, drawing, and extruding of nonferrous metals, including: rolling, drawing, and extruding of copper; aluminum extruded products; rolling, drawing, and extruding of nonferrous metals, except copper and aluminum; and drawing and insulating of nonferrous wire (SIC 335).

f. Nonferrous foundries (castings), including: aluminum die-castings, nonferrous die-castings, except aluminum, aluminum foundries, copper foundries, and nonferrous foundries, except copper and aluminum (SIC 336).

g. Miscellaneous primary metal products, not elsewhere classified, including metal heat treating (SIC 339).

Group applications were received from facilities representing each of the categories of industry eligible for coverage under this section. A large number of group applications also included facilities identified by other SIC codes. These facilities may be covered in whole, or in part, by other sections of today's permit. In other cases, SIC codes may have been assigned improperly. The special conditions reflected in this section of today's permit relate to specific operations taking place at a facility. These operations should be used as the basis for determining permit requirements appropriate for that particular facility.

Although there are many activities common to some or all of the facilities covered by this section, some of the operations discussed are unique to a particular industry group. Due to the broad range of activities conducted by facilities in this category, it would be impossible to identify all activities occurring at facilities covered by this section. This fact sheet attempts to describe the major activities representative of many of the facilities addressed by this section and provides examples of concerns associated with storm water discharges from primary metals facilities. All materials present and industrial activities taking place at a facility that have a potential impact on storm water discharges must be addressed by the facility's pollution prevention plan, whether or not the material or activity is specifically addressed by this section.

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

2. Industry Profile

Facilities in the primary metals industry conduct a wide range of activities. The SIC manual lists seven industry groups (three-digit SIC codes), and 27 industry numbers (four-digit SIC codes) within the sector. Of these, facilities representing 21 four-digit SIC codes submitted group applications.

Due to the large number of alternate processes available for many activities conducted within the primary metals industry it is very difficult to characterize "typical" facilities. Facilities within the same industry can employ quite dissimilar processes to arrive at a similar product. Differences can be found in the types of raw materials, furnaces or ovens, casting processes, the degree of mechanization, and any finishing operations which may be employed by a particular facility. Considerable differences can also be seen between facilities based on their customers needs. Some facilities may operate as a job shop, providing finished parts to other companies. Other facilities could conduct more limited operations and pass the product on to other facilities that provide finishing operations exclusively.

These differences in specific processes, as well as in the general scale and scope of individual operations can make facilities with the same or similar SIC codes quite different. Due to the difficulty in subdividing the industry into distinct facility types, the following discussion briefly describes the full range of activities potentially employed by members of this industry. Despite the substantial diversity within the industry group, there are a number of general operations which characterize the majority of industrial processes.

Facilities in the primary metals industry are typically involved in one or more of the following general operations: raw material storage and handling; furnace and oven related processes; preparation of molds, casts, or dies; metal cleaning, treating and finishing; and waste handling and disposal.

a. Raw Material Storage and Handling Activities. Due to the nature of the primary metals industry, large quantities of raw materials are required for many operations. The extent to which these materials are stored outside exposed to precipitation will depend on the specific operations taking place at a facility, the size of the operation, as well as the storage space available that is covered. Some of the most common materials used are metals, fuels, fluxes, refractories, sand, and an assortment of solvents, acids, and other chemicals.

The primary raw material for all facilities in the industry is the source of metal to be used or processed. For steel works, smelters, and blast furnaces, the raw material could be metallic ores, scrap, dross, or foundry returns. Foundries may use scrap materials, borings, turnings, metal ingots, pigs or a mixture of these and other materials. Rolling mills, heat treaters, and metal finishing operations will generally use billets, slabs, blooms, bars, pigs or other cast metal pieces as their primary raw material. These may be produced at another part of the same facility, or purchased from another source. Some of these materials may arrive with protective or incidental coatings of oil, oxides, or other impurities. Due to the large size and volume of some of these materials they may be stored outside.

Energy sources for facilities within the industry are also quite varied. While steel mills with coking operations may use coal as the fuel for firing coke ovens, coal would also be the raw material that would be converted to coke. Some iron and steel foundries or mini-mills may use coke as a fuel only, or may use electric arc furnaces for melting. Smaller foundries (ferrous or nonferrous) may use gas-fired or electric induction furnaces.

A variety of fluxes are often added to the molten metal to allow impurities to be removed as slag or dross. In the iron and steel industry, limestone is probably the most common flux used. Others include dolomite, soda ash, fluorspar, and calcium carbide. Nonferrous operations may use other fluxing agents or none at all.

During the melting process, refractories are used to line and protect the furnaces. These refractories have limited lives and must be replaced periodically. The life of the refractory will depend on the type of furnace as well as the material being melted. Some large furnaces require almost constant patching of the refractory materials and thus large quantities may be stored for future use.

Another common material used in casting operations is sand. Many foundries will use sands of different types to produce the molds and cores for the production of castings. Although some facilities are able to recycle their sand, others must dispose of some or all of the used sand and thus require large amounts of fresh sand as a raw material. There are also a large number of sand additives and binders which may be used to control the properties of the mold produced. "Wet" sand may contain clay, seacoal, bentonite, wood flour, phenol, iron oxide, and numerous other acids and chemicals, some of which may be toxic.

Other processes related to finishing operations can require a wide variety of solvents, chemicals, and acids. Many facilities involved in cleaning, treating, painting, or other finishing operations may store these products in tanks or drums which may be exposed to precipitation.

b. Furnace, Rolling, and Finishing Operations. The majority of processes within the primary metals industry are conducted inside. These activities include all types of furnace operations, rolling operations, as well as all kinds of metal finishing activities. Many of these operations, however, generate significant quantities of particulate matter which, if not properly controlled, can result in exposure to precipitation.

There are many different types of furnaces. Each has advantages and limitations and are used for different types of metals. Facilities may use coal, coke, or gas fired furnaces as well as electric arc or induction furnaces.

Coke ovens, or batteries, generally use coal fired furnaces to heat coal in the absence of oxygen to drive off volatiles. The resultant product is coke which is subsequently used in other furnace operations. Blast furnaces are usually operated on a continuous basis with coke, iron ore, and fluxes charged at the top of a vertical shaft while molten pig iron and slag are tapped at different levels below.

Sintering plants burn coke breeze (particles too small to use for charging in cupola or blast furnaces) mixed with iron ore, flue dust, or other products to fuse them into materials that can then be charged with regular coke in a furnace. Cupola furnaces are used by ferrous foundries and operate in essentially the same manner as blast furnaces, allowing a range of scrap steel and iron to be charged with coke and fluxes at the top of the furnace.

Basic oxygen process furnaces use a mixture of molten iron and scrap as the charge. High-purity oxygen is injected into the furnace where it combines with impurities in the charge materials and provides heat to melt the charge of scrap.

There are two types of electric furnaces in use. Electric arc furnaces operate in a batch fashion and are often used by steel mini-mills. Scrap metal is placed in the furnace along with three electrodes which provide the energy to melt the charge. Electric induction furnaces are generally smaller than other types described above and require that cleaner metals be used.

Gas-fired furnaces are often used by nonferrous foundries. They are generally small and require relatively clean metals for melting.

One trait that all types of furnaces share is the generation of significant emissions, including particulate emissions. Blast furnaces, sintering plants, and cupola furnaces, all fired by coke, have particularly high particulate emissions. These furnaces are capable of handling a relatively "dirty" charge, with significant impurities which can lead to a variety of emissions problems. For these reasons, these types of furnaces will have emissions controls such as baghouses, wet scrubbers, or electrostatic precipitators. Electric arc furnaces are also able to melt fairly "dirty" scrap and can also have significant levels of particulate emissions.

At the other end of the spectrum are smaller electric induction and gas fired furnaces which generally require a very clean charge. Although this reduces the volume of emissions concerns significantly, they are also less likely to have as extensive pollution control and thus fugitive emissions of particulates may be significant.

The effectiveness of emissions control equipment in controlling particulate generation will depend on the furnace operation, the raw materials used, the type of control equipment in place, and the degree to which it is operating properly. Fugitive emissions, faulty or improperly maintained equipment, and "dirty" raw materials can all contribute to particulate emissions that may not be captured by pollution control equipment, and may be exposed to precipitation.

Another category of operations are rolling, drawing, and extruding operations. Facilities involved in these operations will often use furnaces similar to those described above. The metal will often be heated, and then passed through a series of rollers which alter its' dimensions, making it longer, flatter, etc. This process generally involves large amounts of contact cooling water which can contain high levels of suspended solids and oil and grease.

c. Preparation of Molds, Pouring, Cooling, and Shakeout. Foundry operations and die-casters will generally prepare the molds, casts, or dies that will determine the ultimate shape of the product to be produced. There are a number of possible operations with significant differences between them. These include sand casting, investment casing, and die casting.

Sand casting operations involve a number of possible steps and a range of materials. Casts are shaped in two sections which form the outside of the part to be produced. Cores can also be used to form inner surfaces of the parts. A variety of sands may be used and can be combined with clay and a number of other additives to give the mold the desired properties. Once the casting has cooled, it is placed on a vibrating screen which shakes loose the majority of the sand. The casting is then ready for cleaning and finishing operations. At some facilities the used sand may be recycled or some or all of the sand may need to be disposed of and replaced.

Investment casting involves the formation of a wax replica of the part to be produced, usually in a metal die. A series of wax parts may be attached to a "tree." Once a tree is completed, it is coated with a ceramic cast in a series of dipping operations. The wax may then be removed from the cast in a furnace or the metal can be poured in directly. As in sand casting, the casting is allowed to cool before the cast is removed. A separate wax form and ceramic shell must be made for each part to be produced.

Die-castings employ a more direct route from molten metal to finished part. A metal die is produced and molten metal in injected under pressure into it. Once it has cooled, the casting is removed and is ready for finishing operations. Unlike sand casting or investment casting, the die can be used over and over to produce more parts.

Like most foundry operations, molds are generally prepared indoors. There are, however, particulate emissions associated with the pouring and cooling of molten metal.

d. Metal Cleaning, Treating, and Finishing. Almost all operations in the primary metals industry result in metal products which require some degree of finishing. The type of finishing activities undertaken depend on the material being treated, as well as the properties desired in the final part and can include both mechanical and chemical operations.

Castings generally come out of their molds with metal sprues and other imperfections which must be removed. This can be done through grinding, cutting, or blasting with sand, shot, or grit. Other possible operations include drilling, threading, or dimensioning. A combination of these operations is often necessary.

Some facilities such as rolling mills will use a descaling process to remove oxides and other residues which can form on the surfaces of metallic products. Typical operations include blasting with water or sand. This produces large quantities of scale and other particulate matter which may contain other residual products such as oil.

Heat treating is another operation which can involve furnaces for controlled heating and cooling of large quantities of metal. A variety of media may be used to cool metals at different rates. Oil, water, and liquid salt baths may all be used depending on the properties desired in the finished product. Acid pickling may be used to remove unwanted material from the surface of metal. Other cleaning and finishing operations may involve a wide range of solvents, acids, or other chemicals. All of these processes can generate toxic wastes in the form of sludges, particulates, or spent baths. In addition, residuals from these operations left on the metal surface may become exposed to storm water if materials are transported or stored outside.

e. Waste Handling and Disposal. Wastes are generated from numerous sources within the primary metals industry. Some types of waste are found at a majority of facilities while others may be specific to a particular activity. Some of the common waste products include used sand, cores, butts, refractory rubble, machining and finishing wastes, slag, dross, and collected particulates such as baghouse dust.

Sand casting operations which are not able to fully recycle their sand may generate large volumes of waste or "burnt" sand. "Wet" sands may contain any one of a number of additives, depending on the specific type of casting being produced. Other related wastes include the cores and butts used in the sand casing process.

Most casting operations will produce a product which requires some degree of machining and finishing. The wastes produced will depend mainly on the material being finished and whether a mechanical or chemical process is used. Machining waste can include fines, turnings, or cuttings as well as shot, grit, and scale from blasting operations. Chemical finishing can result in waste solvents, acids, and pickling sludges and baths which contain metal wastes.

The metal melting process results in the production of slag from ferrous, or dross from nonferrous materials. The content and volume of these wastes produced will vary depending on the charge material, and any fluxing agents or additives that may be used. In general, slag is produced in greater quantities and will be more likely to be stored outside, however there is the possibility of exposure of both types of waste to precipitation.

Particulate matter generated in furnaces and during machining is another source of waste with significant potential for storm water contamination. These waste streams may be segregated at larger facilities or combined, but the concerns are essentially the same. The dusts are collected in baghouses, electrostatic precipitators, wet scrubbers, or in cyclones and disposed of. If the pollution control equipment is inadequate, or not operating effectively, there is potential for storm water contamination from these types of waste.

3. Pollutants Found in Storm Water Discharges

Impacts caused by storm water discharges from primary metals facilities will vary. A number of factors will influence to what extent the activities at a particular facility will affect water quality. These include: geographic location, hydrogeology, the amounts and types of materials stored outside, the types of processes taking place outside, the size of the operation, as well as the characteristics of a particular storm event. These and other factors will interact to affect the quantity and quality of storm water runoff. For example, particulate emissions from furnaces or ovens may be a significant source of pollutants at some facilities, while outdoor material storage such as scrap piles may be a primary source at others. In addition, sources of pollution other than storm water, such as illicit connections,[42] spills, and other improperly dumped materials, may contribute significant levels of pollutants into waters of the United States.

A summary of industrial activities conducted by primary metals facilities in the group application process is listed in Table F–1. The table also lists the sources of pollutants related to the activity and what the specific pollutants of concern are. The table is limited to those activities which are generally conducted outside, or that have potential to contribute pollutants to storm water discharges. Many processes in the primary metals industry are conducted inside and are therefore not represented in Table F–1.

TABLE F–1.—POLLUTANTS OF CONCERN FOR MAJOR ACTIVITIES WITHIN THE PRIMARY METALS INDUSTRY

Activity	Source	Pollutants
Raw material storage and handling	Metal product stored outside such as foundry returns, scrap metal, turnings, fines, ingots, bars, pigs, wire.	Residual or protective Oil and Grease, Metals, TSS, COD, TSS.
	Outdoor storage or handling of fluxes	pH (limestone).
	Storage piles, bins, or material handling of coke or coal	TSS, pH, metals.
	Storage or handling of casting sand or refractory	TSS.
Vehicle Maintenance	Vehicle fueling and maintenance or outdoor storage tanks and drums of gas, diesel, kerosene, lubricants, solvents.	Oil and grease.
Waste materials—handling, storage, and disposal.	Slag or dross stored or disposed of outside in piles or drums	Metals, pH.
	Fly ash, particulate emissions, dust collector sludges and solids, baghouse waste.	TSS.
	Storage and disposal of waste sand or refractory rubble in piles outside.	TSS, metals, misc. "wet" sand additives.
	Machining waste—fines, turnings, oil, borings, gates, sprues, scale	TSS, metals, oil and grease.
	Obsolete equipment stored outside	Oil and grease.
	Landfilling or open pit disposal of wastes onsite	See Part VIII.L.
Furnace operations and pollution control equipment.	Losses during charging of coke ovens or sintering plants and from particulate emissions.	TSS, particulates, metals, volatiles, pH.
	Particulate emissions from blast furnaces, electric arc furnaces, induction furnaces.	TSS, metals.
	Fugitive emissions from poorly maintained or malfunctioning baghouses, scrubbers, electrostatic precipitators, cyclones.	TSS, metals.
	Wastewater treatment operations exposed to precipitation	See Part VIII.T.
Rolling, casting, and finishing operations.	Exposure of wastewater used for cooling or descaling related to rolling.	Oil and grease, pH, TSS, metals, COD.
	Storage of products outside after painting, pickling, or cleaning operations.	pH, solvents, metals.
	Casting cooling or shakeout exposed to precipitation or wind	TSS, metals.
	Losses of particulate matter from machining operations (grinding, drilling, boring, cutting) through deposition or storage of products outside.	Metals, TSS.
Plant yards	Areas of the facility with unstabilized soils subject to erosion	TSS.
Illicit discharges	Improper connection of floor, sink, or process wastewater drains	Dependent on source.

Although operations at primary metals facilities may vary considerably, the elements with potential impact on storm water discharges are fairly uniform and consistent. Facilities may include considerable areas of raw and waste material storage such as coal, coke, metal, ores, sand, scale, scrap, and slag. Processes generally involve furnaces for heating and melting metals or for producing coke, any of which may result in significant particulate emissions. Due to the nature of their operations some facilities will have large areas of exposed soil and heavy vehicle traffic which can lead to erosion.

a. Raw Material Storage and Handling Activities. Raw materials with potential effects on storm water discharges fall into a number of distinct categories.

Sands used for the production of molds or cores can contribute to TSS loadings. Piles of materials may be washed away directly, or spills and windblown losses may occur during handling and process related activities.

Metal raw materials can come in numerous forms including billet, slab, pig, bar. These materials have the potential to corrode which can result in the loss of metal to a solution, i.e., water. The following metals are referred to as the galvanic (or electromotive) series and have a tendency to corrode and become soluble in water; magnesium, aluminum, cadmium, zinc, steel or iron, cast iron, chromium, tin, lead, nickel, soft and silver solder, copper, stainless steel, silver, gold, platinum, brass and bronze. For some metals, the extent and rate of corrosion is dependent on whether it occurs in an oxygen-starved or oxygen-abundant atmosphere. If materials are coated in oil to prevent corrosion, or residual chemicals used to clean or treat the metal are present, these can also be a source of pollution easily picked up by storm water runoff.

Scrap metals come in a variety of forms including machining waste such as turnings, shavings, filings, borings or as post consumer waste in a variety of forms. These materials can contribute metals, oil and grease, suspended solids, and other pollutants to storm water

[42] Illicit connections are contributions of unpermitted non-storm water discharges into storm sewers from any number of sources including sanitary sewers, industrial facilities, commercial establishments, or residential dwellings.

runoff depending on their makeup and origin.

Runoff related to storage and handling of coal and coke can contribute suspended solids, metals, as well as oil and grease to runoff. These can be released from piles, hoppers, or bins through handling or wind-blown losses. Significant losses can also occur during handling with conveyors, trucks, or while preparing charges for the furnace or sintering operations.

Fluxes such as limestone may be stored in piles, bins, or hoppers outside or become exposed to precipitation during unloading and handling activities. Limestone can increase the pH of storm water. Fluxes can also contribute to loadings of suspended solids (TSS) or have other effects depending on their makeup.

A variety of acids and solvents may be stored in drums or tanks for use in metal treating and cleaning operations. Leaks and spills from tanks and drums or during handling can result in discharges with storm water. These materials can affect pH of storm water and may be toxic.

b. Process Activities. Many processes can contribute pollutants to storm water discharges. These can include all types of furnaces, metal finishing activities, as well as material handling equipment.

Furnaces of all types can generate particulate emissions. The quantity and character of these emissions can vary greatly depending on the type of furnace, the material being melted, the fuel used, and any pollution control equipment that may be in place. In general, large coke-fired and electric arc furnaces capable of handling fairly dirty charge products will have higher emissions, but are also more likely to have sophisticated pollution control such as wet scrubbers, baghouses, and electrostatic precipitators. Smaller gas fired or electric induction furnaces generally require a fairly clean charge and have less emissions, but might also have less sophisticated controls. Settling of these emissions on roofs and plant yards are very likely to be washed away in storm water runoff. These particulates can contain a wide range of constituents which can contribute metals and suspended solids to discharges.

Material handling equipment such as conveyors, trucks, and forklifts can all contribute drippings of oil and grease as well as hydraulic fluids. This equipment may also generate or release particulate matter related to the materials being handled. Pallets, hoppers, drums, and storage bins may all contain residual materials which may become exposed to storm water.

Metal finishing operations can be divided in two general types. Mechanical operations such as grinding, blasting, boring, chipping, cutting, and descaling can all produce metal fines, chips, and turnings which may contribute metals and suspended solids to discharges. Residuals of oil or other materials on the finished goods or waste products can also contribute pollutants. Other finishing operations include acid pickling, solvent cleaning, and all types of heat treating activities. Materials that have been treated or finished may have residual chemicals on them such as pickling baths, oil or liquid salt quench media, or solvents. Exposure of these materials could contribute to pH, metals, or oil and grease in storm water discharges.

Stationary process equipment may also produce a substantial amount of residual particulate material that tends to accumulate on and around the equipment. Many materials used for primary metals production are conducive to this type of buildup. This will typically occur around rotating machinery, moving parts, bearings, conveyors and at the output of the equipment, e.g., storage containers. Particulate material that accumulates can become a source of contamination if it comes in contact with either precipitation or storm water runoff.

c. Waste Material Storage, Handling, and Disposal. Waste materials are generated in large volume from many of the facilities in this industry. These wastes can include used sand, cores and butts, refractories, slag and dross, baghouse or cyclone dusts, scrubber dusts and sludges, machining wastes, and obsolete equipment. There is potential for pollution from many of these sources if not properly stored, handled, and disposed of.

Used sands, cores, butts, and refractory rubble are all potential sources of TSS. Due to the large volumes potentially generated and their generally benign nature, these materials are often stored outside. The exposure of these materials to molten metal also presents the possibility of contamination with metals which may also get washed away with storm water.

Wastes related to pollution control equipment are particularly susceptible to being discharged with storm water if not properly controlled. These wastes could originate from baghouses, cyclones, electrostatic precipitators or scrubbers. These may be in place to control emissions from a large variety of ovens and furnaces, as well as mechanical or chemical metal finishing operations. These dusts and sludges typically contain an assortment of metals, metal oxides, and other particulate matter. The size of particulates that are able to be captured will vary from one type of equipment to the next and will depend on proper operation and maintenance.

Machining and finishing waste which is not collected as described above may also be generated in significant quantities. This material is typically metallic fines and particulate matter but may contain cutting oil or other materials as well. If stored outside in piles, drums, hoppers, or other containers these materials can contribute metals, TSS, or oil to precipitation and storm water runoff.

d. Erosion and Sediment Loss. Erosion from plant yards is another potential source of storm water contamination from primary metals facilities. Areas of vehicle traffic related to material handling, loading, unloading, material storage areas etc. may all have exposed soils with the potential for erosion. These soils can contribute to TSS loadings in storm water discharges. Exposed surfaces also limit the potential for housekeeping measures such as sweeping, making spills of other materials (particulate or liquid) harder to clean up and more likely to be washed away with storm water. The large size of many primary metals facilities makes this a concern. For example: one group application consists of 5 facilities with a total land area of 623 acres. Of this, approximately 105 acres (16.9 percent) were impervious surfaces (buildings, paved areas), leaving 83 percent of the total area potentially susceptible to erosion. Vehicle traffic, material handling, and storage activities taking place in unstabilized areas can all lead to erosion.

e. Group Application Monitoring Data. Based on the wide variety of industrial activities and significant materials at the facilities included in this sector, EPA believes it is appropriate to divide the primary metals industry into subsectors to properly analyze sampling data and determine monitoring requirements. As a result, this sector has been divided into the following subsectors: steel works, blast furnaces, and mills (SIC 331); iron and steel foundries (SIC 332); primary smelting and refining of nonferrous metals (SIC 333); secondary smelting and refining of nonferrous metals (SIC 334); nonferrous rolling and drawing (SIC 335); nonferrous foundries (SIC 336); and miscellaneous primary metals products (SIC 339). Tables F–2, F–3, F–4, and F–5 below include data for the eight pollutants that all facilities were required to monitor for under Form 2F.

The tables also list those parameters that EPA has determined may merit further monitoring. Tables are not included for primary smelting and refining of nonferrous metals manufacturing facilities; secondary smelting and refining of nonferrous metals manufacturing facilities; and miscellaneous primary metal products facilities subsectors because less than three facilities submitted data for each of these subsectors.

TABLE F–2.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY STEEL WORKS, BLAST FURNACES, AND ROLLING AND FINISHING MILLS SUBMITTING PART II SAMPLING DATA [i] (mg/L)

Pollutant Sample type	No. of facilities		No. of samples		Mean		Minimum		Maximum		Median		95th percentile		99th percentile	
	Grab	Comp [ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	9	8	17	15	17.2	16.3	1.0	1.0	60.0	60.0	10.0	9.30	59.3	59.3	119.4	128.2
COD	9	8	17	15	100.2	74.7	19.0	9.0	340.0	235.0	62.0	55.0	287.9	215.4	514.6	380.6
Nitrate + Nitrite Nitrogen	9	8	16	14	2.01	1.41	0.08	0.09	15.30	9.5	0.51	0.40	7.03	4.62	18.5	11.6
Total Kjeldahl Nitrogen	9	8	17	15	1.81	1.32	0.00	0.64	4.30	2.7	1.60	1.10	4.17	2.29	6.15	2.96
Oil & Grease	9	N/A	17	N/A	3.1	N/A	0.0	N/A	16.4	N/A	2.0	N/A	9.9	N/A	18.4	N/A
pH	9	N/A	17	N/A	N/A	N/A	5.4	N/A	9.4	N/A	7.5	N/A	9.5	N/A	10.5	N/A
Total Phosphorus	9	8	17	15	0.51	0.28	0.01	0.02	2.26	0.80	0.42	0.20	2.89	1.08	8.55	2.29
Total Suspended Solids	9	8	17	15	173	82	0	0	866	717	66	39	1123	346	4141	1030
Aluminum	3	3	5	5	3.24	1.9	0.3	0.3	7.9	6	2.8	1.1	15.51	7.1	35.7	15.24
Zinc	7	6	14	11	1.556	1.208	0	0	16	9.3	0.29	0.37	5.471	5.73	16.48	19.445

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.
[ii] Composite samples.

TABLE F–3.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY IRON AND STEEL FOUNDRIES SUBMITTING PART II SAMPLING DATA [i] (mg/L)

Pollutant Sample type	No. of facilities		No. of samples		Mean		Minimum		Maximum		Median		95th percentile		99th percentile	
	Grab	Comp [ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	31	30	64	56	35.8	57.6	0.0	0.0	1200.0	2500.0	11.0	10.0	79.8	64.0	176.7	133.2
COD	32	31	64	57	287.9	118.3	0.0	0.0	3600.0	640.0	108.5	76.0	1046.0	339.1	2731.7	605.9
Nitrate + Nitrite Nitrogen	31	30	64	56	0.77	0.86	0.00	0.02	5.90	4.50	0.58	0.62	2.17	3.02	3.84	6.03
Total Kjeldahl Nitrogen	31	30	64	57	3.50	3.18	0.00	0.0	30.00	24.0	2.00	1.81	11.35	9.84	21.84	18.7
Oil & Grease	31	N/A	64	N/A	6.5	N/A	0.0	N/A	140.0	N/A	0.0	N/A	24.1	N/A	69.3	N/A
pH	31	N/A	65	N/A	N/A	N/A	2.6	N/A	10.3	N/A	7.6	N/A	10.1	N/A	11.4	N/A
Total Phosphorus	31	30	65	57	1.79	0.40	0.00	0.00	76.00	4.00	0.28	0.22	3.67	1.65	10.33	3.73
Total Suspended Solids	31	30	65	57	594	228	0	1.0	6300	1200	138	123	2644	1000	8264	2417
Aluminum	4	4	11	11	5.99	5.38	0	0	20	21.4	4.49	3.3	47.24	17.51	141.97	33.1
Copper	27	26	57	50	7.919	5.155	0	0	210	140	0.08	0.04	6.629	3.362	31.253	15.875
Iron	4	3	8	7	9.2	10.1	0.2	0.4	26.3	30.4	8.6	8.1	62	54.5	170.5	134.8
Pyrene	3	3	4	4	.08	0.02	0	0	0.29	0.07	0.01	0	0.58	....	2.37	....
Zinc	29	28	62	54	18.35	14.395	0.01	0.047	430	330	0.57	0.46	23.162	14.843	96.353	52.671

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.
[ii] Composite samples.

TABLE F–4.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY ROLLING, DRAWING, AND EXTRUDING OF NONFERROUS METALS MANUFACTURING FACILITIES SUBMITTING PART II SAMPLING DATA [i] (mg/L)

Pollutant Sample type	No. of facilities		No. of samples		Mean		Minimum		Maximum		Median		95th percentile		99th percentile	
	Grab	Comp [ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	6	6	20	10	38.4	32.0	5.5	2.2	150.0	110.0	22.0	18.5	126.4	126.6	252.5	282.8
COD	8	8	20	20	138.9	80.6	0.0	0.0	495.0	230.0	93.5	50.8	480.5	269.3	950.7	503.5
Nitrate + Nitrite Nitrogen	7	7	19	19	1.75	3.71	0.10	0.30	5.61	19.1	1.60	1.80	7.58	11.8	16.76	24.52
Total Kjeldahl Nitrogen	8	8	20	20	4.71	6.45	0.34	0.0	30.00	42.0	2.95	1.65	15.68	19.77	32.73	48.67
Oil & Grease	8	N/A	20	N/A	2.5	N/A	0.0	N/A	20.0	N/A	1.1	N/A	8.2	N/A	15.9	N/A
pH	8	N/A	20	N/A	N/A	N/A	4.1	N/A	8.0	N/A	6.2	N/A	8.6	N/A	9.9	N/A
Total Phosphorus	8	8	20	20	0.12	0.10	0.00	0.0	0.50	0.30	0.09	0.06	0.38	0.31	0.68	0.56
Total Suspended Solids	8	8	20	20	45	58	0	0	429	310	7	6	182	310	531	1043
Copper	8	8	20	20	0.931	0.822	0	0	6.8	3.4	0.13	0.14	5.106	6.501	20.38	29.326
Zinc	8	8	20	20	0.525	0.417	0.021	0.04	2.3	1.9	0.3	0.3	1.806	1.189	3.637	2.085

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.
[ii] Composite samples.

TABLE F–5.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY NONFERROUS FOUNDRIES (CASTINGS) SUBMITTING PART II SAMPLING DATA [i] (mg/L)

Pollutant Sample type	No. of facilities		No. of samples		Mean		Minimum		Maximum		Median		95th percentile		99th percentile	
	Grab	Comp [ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	14	14	30	27	14.7	12.8	0.0	3.0	51.0	47.0	10.5	6.0	38.6	29.6	63.1	46.3
COD	14	14	30	27	125.1	82.8	0.0	7.0	1400.0	510.0	50.5	32.0	390.9	260.1	907.0	535.7
Nitrate + Nitrite Nitrogen	13	13	28	25	0.99	0.85	0.00	0.00	3.60	2.08	0.74	0.77	2.80	2.12	4.64	3.32
Total Kjeldahl Nitrogen	13	13	28	25	2.29	2.17	0.15	0.58	22.00	9.70	1.30	1.40	6.34	5.08	12.06	8.19
Oil & Grease	14	N/A	30	N/A	4.2	N/A	0.0	N/A	47.0	N/A	0.5	N/A	16.7	N/A	35.5	N/A
pH	14	N/A	29	N/A	N/A	N/A	2.8	N/A	8.0	N/A	6.5	N/A	8.8	N/A	10.1	N/A
Total Phosphorus	14	14	30	26	0.26	0.13	0.00	0.0	1.50	0.96	0.07	0.05	1.17	0.52	3.26	1.26
Total Suspended Solids	14	14	29	26	145	111	0	0	2100	1100	20	37	536	563	1521	1761
Copper	14	14	30	27	0.494	0.672	0	0	4.2	7	0.26	0.2	1.861	2.532	4.122	6.122
Zinc	13	13	28	25	1.435	1.494	0	0	9.36	10.1	0.36	0.5	6.429	5.424	16.489	13.307

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.
[ii] Composite samples.

Although there are a wide range of pollutants which may be of concern for primary metals facilities, monitoring requirements for these facilities have been determined based on industry subgroups which exceed benchmarks for certain pollutants. As Tables F–2 through F–5 illustrate, there are a variety of pollutants which must be addressed at primary metals facilities.

4. Options for Controlling Pollutants

There are five main areas of concern related to primary metals facilities. These are raw material storage and handling; waste material storage, handling, and disposal; furnace, oven, and related pollution control activities; rolling, extruding, casting, and finishing operations; plant yards; and illicit connections.

Table F–6 summarizes the primary sources of pollution in each of these categories and potential Best Management Practices (BMPs) associated with each.

TABLE F–6.—POTENTIAL BEST MANAGEMENT PRACTICES FOR SOURCES WITHIN THE PRIMARY METALS INDUSTRY

Source	Potential best management practices
Metal product stored outside such as foundry returns, scrap metal, turnings, fines, ingots, bars, pigs, wire.	Store all wastes indoors or in sealed drums, covered dumpsters, etc.
	Minimize raw material storage through effective inventory control.
	Minimize runon from adjacent properties and stabilized areas to areas with exposed soil with diversion dikes, berms, curbing, concrete pads, etc.
Outdoor storage or handling of fluxes	Store fluxes in covered hoppers, silos, or indoors and protect from wind-blown losses.
	Stabilize areas surrounding storage and material handling areas and establish schedule for sweeping.
Storage piles, bins, or material handling of coke or coal.	Where possible store coke and coal under cover or indoors and protect from wind-blown losses.
	Prevent or divert runon from adjacent areas with swales, dikes, or curbs.
	Minimize quantities of coke or coal stored onsite through implementation of effective inventory control.
	Trap particulates originating in coke or coal storage or handling areas with filter fabric fences, gravel outlet protection, sediment traps, vegetated swales, buffer strips of vegetation, catch-basin filters, retention/detention basins or equivalent.
Storage or handling of casting sand	Store raw sand in silos, covered hoppers, or indoor whenever possible.
	Prevent or divert runon from adjacent areas with swales, dikes, or curbs.
	Minimize quantities of sand stored onsite through implementation of effective inventory control.
	Tarp or otherwise cover piles.
	Trap particulates originating in coke or coal storage or handling areas with filter fabric fences, gravel outlet protection, sediment traps, vegetated swales, buffer strips of vegetation, catch-basin filters, retention/detention basins or equivalent.
Vehicle fueling and maintenance	See Part VIII.P.
Outdoor storage tanks or drums of gas, diesel, kerosene, lubricants, solvents.	Store tanks and drums inside when possible.
	Establish regular inspection of all tanks and drums for leaks, spills, corrosion, damage, etc.
	Utilize effective inventory control to reduce the volume of chemicals stored onsite.
	Prevent runon to and runoff from tank and drum storage areas, provide adequate containment to hold spills and leaks.
	Prepare and train employees in dealing with spills and leaks properly, use dry clean-up methods when possible.
Slag or dross stored or disposed of outside in piles or drums.	Collect waste waters used for granulation of slag—these are not allowed under this section.
	Store slag and dross indoors, under cover, or in sealed containers.
	Establish regular disposal of slag or dross to minimize quantities stored and handled onsite.
	Minimize runon to slag storage areas with diversion dikes, berms, curbing, vegetated swales.
	Trap particulates originating in slag storage areas with filter fabric fences, gravel outlet protection, sediment traps, vegetated swales, buffer strips of vegetation, catch-basin filters, retention/detention basins or equivalent.
Fly ash, particulate emissions, dust collector sludges and solids, baghouse dust.	Store all dusts and sludges indoors to prevent contact with storm water or losses due to wind.
	Establish regular disposal schedule to minimize quantities of pollutants stored and handled onsite.
Storage and disposal of waste sand or refractory rubble in piles outside.	Move piles under cover or tarps whenever possible.
	Establish regular disposal schedule to minimize quantities stored onsite.
	Stabilize areas of waste product storage and perform regular sweeping of area.
Scrap processing activities (shredding etc.)	See Part VIII.N.
Machining waste stored outside or exposed to storm water—fines, turnings, oil, borings, gates, sprues, scale.	Store all wastes indoors or in sealed drums, covered dumpsters, etc.
	Stabilize areas of waste product storage and perform regular sweeping and cleaning of any residues.

TABLE F–6.—POTENTIAL BEST MANAGEMENT PRACTICES FOR SOURCES WITHIN THE PRIMARY METALS INDUSTRY—Continued

Source	Potential best management practices
	Consider using booms, oil/water separators, sand filters, etc. for outfalls draining areas where oil is potentially present. Minimize runon from adjacent properties and stabilized areas to areas with exposed soil with diversion dikes, berms, curbing, concrete pads, etc.
Obsolete equipment stored outside	Where possible, dispose of unused equipment properly, or move indoors. Cover obsolete equipment with a tarp or roof. Consider using booms, oil/water separators, sand filters, etc. for outfalls draining areas where oil is potentially present. Minimize runoff coming into contact with old equipment through berms, curbs, or placement on a concrete pad.
Material losses from handling equipment such as conveyors, trucks, pallets, hoppers, etc.	Schedule frequent inspections of equipment for spills or leakage of fluids, oil, or fuel. Inspect for collection of particulate matter on and around equipment and clean. Where possible cover these areas to prevent losses to wind and precipitation. Store pallets, hoppers, etc. which have residual materials on them under cover, with tarps, or inside.
Losses during charging of coke ovens or sintering plants.	Cover any exposed areas related to furnace charging/material handling activities. Stabilize areas around all material handling areas and establish regular sweeping. Route runoff from particulate generating operations to sediment traps, vegetated swales, buffer strips of vegetation, catch-basin filters, retention/detention basins or equivalent.
Particulate emissions from blast furnaces, electric arc furnaces, induction furnaces and fugitive emissions from poorly maintained or malfunctioning baghouses, scrubbers, electrostatic precipitators, cyclones.	Establish schedule for inspection and maintenance of all pollution control equipment—check for any particulate deposition from leaks, spills, or improper operation of equipment and remedy. Route runoff from particulate generating operations to sediment traps, vegetated swales, buffer strips of vegetation, catch-basin filters, retention/detention basins or equivalent.
Storage of products outside after painting, pickling, or cleaning operations.	Store all materials inside or under cover whenever possible. Prevent runon to product storage areas through curbs, berms, dikes, etc. Consider using booms, oil/water separators, sand filters, etc. for outfalls draining areas where oil is potentially present. Remove residual chemicals from intermediate or finished products before storage or transport outside.
Casting cooling or shakeout operations exposed to precipitation or wind.	Perform all pouring, cooling, and shakeout operations indoors in areas with roof vents to trap fugitive particulate emissions. Recycle into process as much casting sand as possible.
Landfilling or open pit disposal of wastes onsite	See Part VIII.L.
Losses of particulate matter from machining operations (grinding, drilling, boring, cutting) through deposition or storage of products outside.	Store all intermediate and finished products inside or under cover. Consider using booms, oil/water separators, sand filters, etc. for outfalls draining areas where oil is potentially present. Clean products of residual materials before storage outside. Stabilize storage areas and establish sweeping schedule.
Areas of the facility with unstabilized soils subject to erosion.	Minimize runon from adjacent properties and stabilized areas to areas with exposed soil with diversion dikes, berms, vegetated swales, etc. Stabilize all high traffic areas including all vehicle entrances, exits, loading, unloading, and vehicle storage areas. Conduct periodic sweeping of all traffic areas. Trap sediment originating in unstabilized areas. Filter fabric fences, gravel outlet protection, sediment traps, vegetated swales, buffer strips of vegetation, catch-basin filters, retention/detention basins or equivalent. Inspect and maintain all BMPs on a regular basis. Provide employee training on proper installation and maintenance of sediment and erosion controls.
Improper connection of floor, sink, or process wastewater drains.	Inspect and test all floor, sink, and process wastewater drains for proper connection to sanitary sewer and remove any improper connections to storm sewer or waters of the United States.

5. Special Conditions

The following section identifies special conditions that are applicable to permittees applying for coverage under Part XI.F. of today's permit.

a. Prohibition of Non-storm Water Discharges. This section requires primary metals facilities to certify that certain non-storm water discharges are not occurring at their facilities. A list of common non-storm water discharges that are not authorized by this section has been identified. These discharges are prohibited due to the likelihood these discharges will contain substantial pollutant concentrations. This list is included in the permit only to add more specificity to the general non-storm water prohibition included in Part III.A. of the permit. The following non-storm water discharges are not authorized by this section: waste discharges to floor drains or sinks connected to the facilities storm sewer or storm drainage system; water originating from vehicle and equipment washing; steam cleaning wastewater; process wastewater; wash-water originating from cleaning plant floor areas or material receiving areas; wastewater from wet scrubbers; boiler blowdown; contact or noncontact cooling water; discharges originating from dust control spray water;

discharges originating from the cleaning out of oil/water separators or sumps; discharges from bermed areas with a visible oily sheen or other visible signs of contamination; discharges resulting from casting cleaning or casting quench operations; discharges from slag quench or slag rinsing operations; and discharges from wet sand reclamation operations.

This final list of non-storm water discharges does not include discharges from oil/water separators and sumps, as was proposed. EPA intended to include only discharges originating from the cleaning or maintenance of these devices in this list.

The operators of non-storm water discharges must seek coverage under a separate NPDES permit if discharging to either a municipal separate storm sewer system or to waters of the United States.

6. Storm Water Pollution Prevention Plan Requirements

a. Contents of the Plan. All facilities covered by this section must identify a pollution prevention team, prepare a description of all potential pollutant sources at the facility, and identify measures and controls appropriate for the facility. These items must comply with the common requirements described in Part VI.C. of this fact sheet. In addition to these requirements, facilities covered by Part XI.F. of today's permit must provide the following additional information in their pollution prevention plan.

(1) Description of Potential Pollutant Sources. Facilities must identify on the site map the location of any and all pollution control equipment such as baghouses, wet scrubbers, electrostatic precipitators, etc. as well as any uncontrolled stack emissions which may be located onsite. The site map must also indicate the outfall locations and the types of discharges contained in the drainage areas of the outfalls (e.g. storm water and air conditioner condensate). In order to increase the readability of the map, the inventory of the types of discharges contained in each outfall may be kept as an attachment to the site map. Due to the hazardous nature of pollutants generated in this industry, and the potential for deposition of particulate matter from emissions, these emissions can be a significant contributor to pollutants at a facility and should be identified.

(2) Measures and Controls. There are typically five types of activity and materials present at facilities in the primary metals industry with potential impacts on storm water discharges. These have been discussed in today's fact sheet and include: raw materials storage and handling; process activities related to furnace operations, casting, rolling, and extruding; waste material storage, handling, and disposal; erosion from unstabilized plant areas; and illicit discharges, spills, and leaks. Each of these areas that is applicable to a facility must be identified in the pollution prevention plan and evaluated with regard to the BMPs discussed.

(a) Good Housekeeping—This section requires that facilities implement measures to limit the amount of spilled, settled, and leaked materials which are washed away by storm water. These materials include coal dust or coke breeze, metal fines from finishing operations, particulate emissions from furnaces and ovens, as well as dust and dirt from plant yards. In paved or other impervious areas sweeping is an easy and effective way to reduce these pollutants. Sweeping frequency should be determined based on the rates of accumulation of a particular material and its potential impact on storm water discharges. Where significant particulates are generated in unstabilized areas of the plant, other measures may be necessary.

The large number of particulate generating processes and the makeup of these pollutants makes this an especially important aspect of pollution prevention at many facilities. Permittees must consider the storage of all such products under roof, in silos or covered hoppers, or under tarps to minimize exposure of particulates to precipitation and wind-blown losses.

Unstabilized areas at a site which may be related to material handling and storage or vehicle and equipment traffic should be considered for paving. These areas can build up significant levels of particulates from materials and material handling as well as soil and dust particles. Paving these areas allow good housekeeping measures to be practiced and make spills easier to clean up.

(b) Source Controls—Permittees must consider preventative measures to minimize the exposure of significant materials to storm water. Due to the large volumes of materials used in the primary metals industry, they are a significant potential source of pollutants in storm water discharges. Storage of a wide range of materials outside is common among many facilities and measures should be taken to reduce the potential for contamination of storm water.

Measures include moving materials inside, under roof or cover, removing waste materials from the premises, and establishing scheduled removal of wastes to minimize storage onsite. Other measures to prevent runoff from contacting materials include swales, berms, dikes, or curbs to divert runoff away from significant materials or processes.

Source controls offer the most effective way to reduce pollutants in storm water discharges and are generally easier to implement than treatment measures.

(c) Preventive Maintenance—Facilities must incorporate into their plan the inspection and maintenance of all equipment which could lead to releases of pollutants. This includes all particulate emissions control equipment, storage tanks and piping systems, and any other material handling equipment which could fail and release pollutants.

All particulate pollution control equipment must be maintained to operate properly and effectively to control settling of particulate matter. The inspection of emissions control is particularly important as failures may not be immediately obvious and could lead to significant releases of particulate matter. Leaks or blockage in ducts, overflows of dust collection systems, or mechanical breakdown of scrubbers could all lead to heavy particulate emission which can be easily washed away by storm water discharges. Other potential losses include leaking tanks or valves which could contain a variety of acids, solvents, or other chemicals.

(d) Spill Prevention and Response Procedures—There are no additional requirements beyond those described in Part VI.C. of this fact sheet.

(e) Inspections—Primary metals facilities are required to conduct self inspections of all storage, process, and plant yard areas at least quarterly. These inspections will allow the effectiveness of the pollution prevention plan to be monitored. The potential for problems which could affect storm water are extremely varied and can have significant impacts over a short time period. These inspections are necessary to ensure that problems are identified and remedied as quickly as possible. Points of particular importance include pollution control equipment, material handling areas, and waste collection and disposal areas. Tanks, drums, silos, bins, and hoppers are other areas of potential concern.

(f) Employee Training—There are no additional requirements beyond those described in Part VI.C. of this fact sheet. EPA recommends that facilities conduct training annually at a minimum. However, more frequent training may be necessary at facilities with high turnover of employees or where employee participation is essential to

the storm water pollution prevention plan.

(g) Recordkeeping and Internal Reporting Procedures—There are no additional requirements beyond those described in Part VI.C. of this fact sheet.

(h) Non-storm Water Discharges—There are no additional requirements beyond those described in Part VI.C. of this fact sheet.

(i) Sediment and Erosion Control—There are no additional requirements beyond those described in Part VI.C. of this fact sheet.

(j) Management of Runoff—Facilities shall consider implementation of a range of management practices to control or treat storm water runoff. These include vegetative buffer strips or swales, filter fences and other types of filters, oil/water separators, and all types of settling basins and ponds. These practices allow the capture of pollutants from storm water before it leaves the site.

Due to the large size of many primary metals facilities, source controls may not be practical. In some cases, it may not be feasible to cover or otherwise protect large areas of material storage or exposed plant yards. Deposition of particulates from furnace or other process emissions may be relatively diffuse over a large area of the facility, and very difficult to control. In these cases management practices such as settling basins, retention or detention ponds, or recycle ponds can provide effective treatment of runoff. For smaller areas, filter fabric, booms, or other types of filters may be appropriate. In areas where oil and grease is a concern, oil/water separators may be appropriate and should be considered.

b. Comprehensive Site Compliance Evaluation. The storm water pollution prevention plan must describe the scope and content of comprehensive site evaluations that qualified personnel will conduct to 1) confirm the accuracy of the description of potential pollution sources contained in the plan, 2) determine the effectiveness of the plan, and 3) assess compliance with the terms and conditions of the permit. Comprehensive site compliance evaluations should be conducted on an annual basis. The individual or individuals that will conduct the evaluations must be identified in the plan and should be members of the pollution prevention team. Evaluation reports must be retained for at least 3 years after the date of the compliance evaluation that the permit expires.

Based on the results of each evaluation, the description of potential pollution sources, and measures and controls, the plan must be revised as appropriate within 2 weeks after each evaluation. Changes in the measures and controls must be implemented on the site in a timely manner, and never more than 12 weeks after completion of the evaluation.

7. Monitoring and Reporting Requirements

a. Analytical Monitoring Requirements. EPA believes that primary metals facilities may reduce the level of pollutants in storm water runoff from their sites through the development and proper implementation of the storm water pollution prevention plan requirements discussed in today's permit. In order to provide a tool for evaluating the effectiveness of the pollution prevention plan and to characterize the discharge for potential environmental impacts, the permit requires some primary metals facilities to collect and analyze samples of their storm water discharges for the pollutants listed in Table F–7. Data submitted to EPA has been analyzed at the 3-digit SIC code level. Industry subgroups that had pollutant levels above benchmark levels are required to monitor for those pollutants. Because these pollutants have been reported at benchmark levels from primary metals facilities, EPA is requiring monitoring after the pollution prevention plan has been implemented to assess the effectiveness of the pollution prevention plan and to help ensure that a reduction of pollutants is realized.

Under the Storm Water Regulations at 40 CFR 122.26(b)(14), EPA defined "storm water discharge associated with industrial activity". The focus of today's permit is to address the presence of pollutants that are associated with the industrial activities identified in this definition and that might be found in storm water discharges. Under the methodology for determining analytical monitoring requirements, described in section VI.E.1 of this fact sheet, nitrate plus nitrite nitrogen is above the bench mark concentrations for the non-ferrous rolling and drawing and the non-ferrous foundries subsectors and pyrene is above the bench mark concentrations for the iron and steel foundries subsector. After a review of the nature of industrial activities and the significant materials exposed to storm water described by facilities in these subsectors, EPA has determined that the higher concentrations of nitrate plus nitrite nitrogen and pyrene are not likely to be caused by the industrial activity, but may be primarily due to non-industrial activities on-site. Today's permit does not require non-ferrous rolling and drawing, the non-ferrous foundries or iron and steel foundries facilities to conduct analytical monitoring for these parameters.

At a minimum, storm water discharges from selected primary metals facilities must be monitored quarterly during the second year of permit coverage. At the end of the second year of permit coverage, a facility must calculate the average concentration for each parameter that they were required to monitor as listed in Tables F–7 through F–10, after taking into account possible waivers based on the alternative certification. If the permittee collects more than four samples in this period, then they must calculate an average concentration for each pollutant of concern for all samples analyzed.

TABLE F–7.—STEEL WORKS, BLAST FURNACES, AND ROLLING AND FINISHING MILLS (SIC 331) MONITORING REQUIREMENTS

Pollutants of concern	Cut-off concentration
Total Recoverable Aluminum	0.75 mg/L
Total Recoverable Zinc	0.117 mg/L

TABLE F–8.—IRON AND STEEL FOUNDRIES (SIC 332) MONITORING REQUIREMENTS

Pollutants of concern	Cut-off concentration
Total Recoverable Aluminum	0.75 mg/L
Total Suspended Solids (TSS)	100 mg/L
Total Recoverable Copper	0.0636 mg/L
Total Recoverable Iron	1 mg/L
Total Recoverable Zinc	0.117 mg/L

TABLE F–9.—ROLLING, DRAWING, AND EXTRUDING OF NON-FERROUS METALS (SIC 335) MONITORING REQUIREMENTS

Pollutants of concern	Cut-off concentration
Total Recoverable Copper	0.0636 mg/L
Total Recoverable Zinc	0.117 mg/L

TABLE F–10.—NON-FERROUS FOUNDRIES (SIC 336) MONITORING REQUIREMENTS

Pollutants of concern	Cut-off concentration
Total Recoverable Copper	0.0636 mg/L
Total Recoverable Zinc	0.117 mg/L

If the average concentration for a parameter is less than or equal to the value listed in Tables F–7 through F–10, then the permittee is not required to conduct quantitative analysis for that parameter during the fourth year of the permit. If, however, the average concentration for a parameter is greater than the cut-off concentration listed in Tables F–7 through F–10, then the permittee is required to conduct quarterly monitoring for that parameter during the fourth year of permit coverage. Monitoring is not required during the first, third, and fifth year of the permit. The exclusion from monitoring in the fourth year of the permit is conditional on the facility maintaining industrial operations and BMPs that will ensure a quality of storm water discharges consistent with the average concentrations recorded during the second year of the permit. The schedule for monitoring is presented in Table F–11.

TABLE F–11.—SCHEDULE OF MONITORING

2nd Year of Permit Coverage	• Conduct quarterly monitoring. • Calculate the average concentration for all parameters analyzed during this period. • If average concentration is greater than the value listed in Tables F–7 through F–10, then quarterly sampling is required during the fourth year of the permit. • If average concentration is less than or equal to the value listed in Tables F–7 through F–10, then no further sampling is required for that parameter.
4th Year of Permit Coverage	• Conduct quarterly monitoring for any parameter where the average concentration in year 2 of the permit is greater than the value listed in Tables F–7 through F–10. • If industrial activities or the pollution prevention plan have been altered such that storm water discharges may be adversely affected, quarterly monitoring is required for all parameters of concern.

In cases where the average concentration of a parameter exceeds the cut-off concentration, EPA expects permittees to place special emphasis on methods for reducing the presence of those parameters in storm water discharges. Quarterly monitoring in the fourth year of the permit will reassess the effectiveness of the adjusted pollution prevention plan.

The monitoring cut off concentrations listed in Tables F–7 through F–10 are not numerical effluent limitations. These values represent a level of pollutant discharge which facilities may achieve through the implementation of pollution prevention plans. At least half of the facilities which submitted Part 2 data, reported concentrations greater than or equal to the values listed in Tables F–7 through F–10. Facilities that achieve average discharge concentrations which are less than or equal to the values in Tables F–7 through F–10 are not relieved from the pollution prevention plan requirements or any other requirements of the permit.

EPA realizes that if a facility is inactive and unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly chemical sampling.

(1) Sample Type. All discharge data shall be reported for grab samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The required 72-hours storm event interval is waived where the preceding measurable storm event did not result in a measurable discharge from the facility. The 72-hour storm event interval may also be waived where the permittee documents that less than a 72-hour interval is representative for local storm events during the season when sampling is being conducted. The grab sample shall be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable. If storm water discharges associated with industrial activity commingle with process or nonprocess water, then where practicable permittees must attempt to sample the storm water discharge before it mixes with the non-storm water discharge.

(2) Representative Discharge. When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may test the effluent of one of such outfalls and report that the quantitative data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluent. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area (e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)) shall be provided in the plan.

(3) Alternative Certification. Throughout today's permit, EPA has required monitoring requirements for facilities which the Agency believes have the potential for contributing significant levels of pollutants to storm water discharges. The alternative described below is necessary to ensure that monitoring requirements are only imposed on those facilities that do, in fact, have storm water discharges containing pollutants at concentrations of concern. EPA has determined that if materials and activities are not exposed to storm water at the site, then the potential for pollutants to contaminate storm water discharges does not warrant monitoring.

Therefore, a discharger is not subject to the monitoring requirements of this Part provided the discharger makes a certification for a given outfall, or on a pollutant-by-pollutant basis in lieu of monitoring described in Tables F–10 through F–13, under penalty of law, signed in accordance with Part VII.G. of the pursuit (Signatory Requirements), that material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, industrial machinery or operations, significant materials from past industrial activity that are located in areas of the facility that are within the drainage area of the outfall are not presently exposed to storm water and will not be exposed to storm water for the certification period. Such certification must be retained in the storm water pollution prevention plan and submitted to EPA along with the monitoring reports required under paragraph *b.* below. If the permittee cannot certify for an entire period, they must submit the date exposure was eliminated and any monitoring required up until that date. This certification option is not applicable to compliance monitoring requirements associated with effluent limitations. EPA does not expect facilities to be able to exercise this certification for indicator parameters, such as TSS and BOD.

b. Reporting Requirements. Permittees are required to submit all monitoring results obtained during the second and fourth year of permit coverage within 3 months of the conclusion of each year. For each outfall, one Discharge Monitoring Report must be submitted per storm event sampled. For facilities conducting monitoring beyond the minimum quarterly requirements an additional Discharge Monitoring Report Form must be filed for each analysis.

c. Quarterly Visual Examination of Storm Water Quality. Quarterly visual inspections of a storm water discharge from each outfall are required at primary metals facilities. The examination must be of a grab sample collected from each storm water outfall. The examination of storm water grab samples shall include any observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, or other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on these samples.

The examination must be made at least once per quarter during the term of the permit during daylight unless there is insufficient rainfall or snow-melt to runoff. Whenever practicable, the same individual should carry out the collection and examination of discharges throughout the life of the permit to ensure the greatest degree of consistency possible. Grab samples shall be collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 1 hour) of when the runoff begins discharging. Reports of the visual examination include: the examination date and time, examination personnel, visual quality of the storm water discharge, and probable sources of any observed storm water contamination. The visual examination reports must be maintained onsite with the pollution prevention plan.

When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination. Adverse weather conditions which may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (e.g., drought, extended frozen conditions, etc.).

EPA realizes that if a facility is inactive and unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly visual examination.

EPA believes that this quick and simple assessment will allow the permittee to approximate the effectiveness of his/her plan on a regular basis at very little cost. Although the visual examination cannot assess the chemical properties of the storm water discharged from the site, the examination will provide meaningful results upon which the facility may act quickly. The frequency of this visual examination will also allow for timely adjustments to be made to the plan. If BMPs are performing ineffectively, corrective action must be implemented. A set of tracking or follow-up procedures must be used to ensure that appropriate actions are taken in response to the examinations. The visual examination is intended to be performed by members of the pollution prevention team. This hands-on examination will enhance the staff's understanding of the storm water problems on that site and the effects of the management practices that are included in the plan.

G. Storm Water Discharges Associated With Industrial Activity From Metal Mining (Ore Mining and Dressing)[43] *Facilities*

1. Industrial Profile

On November 16, 1990 (55 FR 47990), the U.S. Environmental Protection Agency (EPA) promulgated the regulatory definition of "storm water discharges associated with industrial activity." This definition included point source discharges of storm water from eleven major categories of facilities, including: "(i) facilities subject to storm water effluent limitations guidelines, new source performance standards, or toxic pollutant effluent standards under 40 CFR subchapter N * * * ." and "* * * (iii) facilities classified as Standard Industrial Classifications 10 through 14 (metal mining industry) including active or inactive mining operations (except for areas of coal mining operations no longer meeting the definition of a reclamation area under 40 CFR 434.11(l) because the performance bond issued to the facility by the appropriate SMCRA authority has been released, or except for areas of noncoal mining operations which have been released from applicable State or Federal reclamation requirements after December 17, 1990) and oil and gas exploration, production, processing, or treatment operations, or that has come into contact with, any overburden, raw material, intermediate products, finished products, by-products or waste products located on the site of such operations."

This section of today's general permit only applies to the portions of categories (i) and (iii) identified by 40 CFR Part 440 and the metal mining industry (Standard Industrial Classification (SIC) code 10). SIC code 10 includes establishments primarily engaged in mining, developing mines, or exploring for metallic minerals (ores). This group also includes all ore dressing and beneficiating operations, whether performed at mills operated in conjunction with the mines served or at mills, such as custom mills, operated separately. Common activities at these mills include: crushing, grinding, and separation by gravity concentration, magnetic separation, electrostatic separation, flotation, or leaching[44]. The following is a listing of the types of mining/milling facilities that are covered under SIC code 10: Iron Ores (SIC Code 1011); Copper Ores (SIC Code 1021); Lead and Zinc Ores (SIC Code 1031); Gold Ores (SIC Code 1041); Silver Ores (SIC Code 1044); Ferroalloy Ores, Except Vanadium (SIC Code 1061); Uranium-Radium-Vanadium Ores (SIC Code 1094); and Miscellaneous Metal Ores, Not Elsewhere Classified (SIC Code 1099).

This section does not cover any discharge subject to effluent limitation guidelines, including storm water that combines with process wastewater and mine drainage. Storm water that does not come into contact with any overburden, raw material, intermediate product, finished product, by-product, or waste product located on the site of

[43] For the purposes of this part of the fact sheet, the term "metal mining" includes all ore mining and/or dressing and beneficiating operations, whether performed at mills operated in conjunction with the mines served or at mills, such as custom mills, operated separately.

[44] For more information on metal mines/mills see EPA, Effluent Guidelines Division. November 1982. "Development Document for Effluent Limitations Guidelines and Standards for the Ore Mining and Dressing Point Source Category." EPA 440/1-82/061.

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the operation is not subject to permitting under this section according to Section 402(l)(2) of the Clean Water Act. Storm water discharges associated with industrial activity from inactive mining operations occurring on Federal lands where an operator cannot be identified cannot be covered by this permit.

Storm water discharges from mining claims where no mining activities have been undertaken (including no historic activities) except minimal activities undertaken for the purpose of maintaining a mining claim do not need to be covered by a permit. (This applies to Federal and private lands.)

This section is applicable to all phases of mining operations, whether active or inactive, as long as there is exposure to significant materials. This includes land disturbance activities such as the expansion of current extraction sites, active and inactive mining stages, and reclamation activities.

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

There are typically three phases to a mining operation: the exploration and construction phase; the active phase; and the reclamation phase. The exploration and construction phase entails exploration and a certain amount of land disturbance to determine the financial viability of a site. Construction includes building of site access roads, and removal of overburden and waste rock to expose minable ore. These land-disturbing activities are significant potential sources of storm water contaminants. The active phase includes each step from extraction through production of a saleable product. The active phase may include periods of inactivity due to the seasonal nature of these metal mining activities. The final phase of reclamation is intended to return the land to its pre-mining state.

Because of the land-disturbing nature of the ore mining and dressing industry, contaminants of concern generated by industrial activities in this industry include total suspended solids (TSS), total dissolved solids (TDS), turbidity, pH, and heavy metals. Table G-1 lists potential pollutant source activities, and related pollutants associated with ore mining and dressing facilities.

TABLE G-1.—ACTIVITIES, POLLUTANT SOURCES, AND POLLUTANTS

Activity	Pollutant source	Pollutant
Site Preparation	Road Construction	Dust, TSS, TDS, turbidity.
	Removal of Overburden	Dust, TSS, TDS, turbidity.
	Removal of waste rock to expose the metal	Dust, TSS, TDS, turbidity.
Mineral Extraction	Blasting activities	Dust, TSS, nitrate/nitrite.
Beneficiation Activities	Milling	Dust, TSS, TDS, pH, turbidity, fines, heavy metals.
	Flotation	Dust, TSS, TDS, pH, turbidity, fines, chemical reagents, acids, heavy metals.
	Gravity Concentration	TSS, TDS, pH, turbidity, heavy metals.
	Amalgamation	Dust, TSS, TDS, pH, turbidity, heavy metals, mercury.
	Waste Rock Storage	Dust, TSS, TDS, turbidity, pH, heavy metals.
	Raw Material Loading	Dust, TSS, TDS, turbidity, heavy metals.
	Processing materials unloading	Diesel fuel, oil, gasoline, chemical reagents.
	Raw or Waste Material Transportation	Dust, TSS, TDS, turbidity, heavy metals.
Leaching	Heap leach piles	Dust, TSS, TDS, turbidity, pH, heavy metals, cyanide.
Other Activities.	Sedimentation pond upsets	TSS, TDS, turbidity, pH, heavy metals.
	Sedimentation pond sludge removal and disposal	Dust, TSS, TDS, turbidity, pH, heavy metals.
	Air emission control device cleaning	Dust, TSS, TDS, turbidity.
Equipment/Vehicle Maintenance	Fueling activities	Diesel fuel, gasoline, oil.
	Parts cleaning	Solvents, oil, heavy metals, acid/alkaline wastes.
	Waste disposal of oily rags, oil and gas filters, batteries, coolants, degreasers.	Oil, heavy metals, solvents, acids
	Fluid replacement including hydraulic fluid, oil, transmission fluid, radiator fluids, and grease.	Oil, arsenic, lead, cadmium, chromium, benzene, TCA, TCE, PAHs, solvents.
Reclamation Activities	Site preparation for stabilization	Dust, TSS, TDS, turbidity, heavy metals.

Sources: Storm Water Group Applications, Parts 1 and 2 and EPA. "Development Document for Effluent Limitations Guidelines and Standards for the Ore Mining and Dressing Point Source Category." (EPA 440/1-82/061) November 1982.

Industrial activities, significant materials, and material management practices associated with ore mining and dressing methods are typically similar, varying only in the type of rock being mined. Examples of mineral commodities obtained from ore mining and dressing facilities include: iron; copper; lead; zinc; gold; silver; ferroalloy ores such as molybdenum, manganese, chromium, cobalt, nickel, and tungsten; uranium; radium; vanadium; aluminum; antimony; bauxite; platinum; tin; and titanium. Industrial activities include, ". . . but [are] not limited to, storm water discharges from industrial plant yards; immediate access roads and rail lines used or traveled by carriers of raw materials, manufactured products, waste material, or by-products used or created by the facility; material handling sites; refuse sites; sites used for the application or disposal of process wastewaters (as defined at 40 CFR Part 401); sites used for the storage and maintenance of material handling equipment; sites used for residual treatment, storage, or disposal; shipping and receiving areas; manufacturing buildings; storage areas (including tank farms) for raw materials and intermediate and finished materials; and areas where industrial activity has taken place in the past and significant materials remain and are exposed to storm water" (40 CFR 122.26(b)(14)). The most common industrial activities at metallic mine sites include extraction of the metal, material crushing, and product separation. While all of these industrial activities can occur at metal mines, storm water discharges from some of the areas listed cannot be covered by this permit (see Part VIII.G.4. Discharges Covered Under This Section).

Significant materials include, "... but [are] not limited to: raw materials, fuels, materials such as solvents, detergents, and plastic pellets; finished materials such as metallic products; ... hazardous substances designated under Section 101(14) of CERCLA; any chemical facilities required to report pursuant to Section 313 of title III of SARA; fertilizers; pesticides; and waste products such as ashes, slag, and sludge that have the potential to be released with storm water discharge" (40 CFR 122.26(b)(12)). Significant materials commonly found at mining facilities include: overburden; waste rock; sub-ore piles; tailings; petroleum-based products; solvents and detergents; manufactured products; and other waste materials.

Materials management practices are defined as those practices employed to diminish contact by significant materials with precipitation and storm water runon, or practices utilized to reduce the offsite discharge of contaminants. To this end, sediment ponds, discharge diversion techniques, as well as methods of dispersion, are used to minimize impacts of significant materials on storm water. For mine sites requiring additional sources of water for processing operations, rainfall events as well as storm water runon will be managed for use in dust suppression, processing, and washing activities. Many mine sites are already equipped with sedimentation ponds and other established process wastewater treatment methods in order to meet effluent limitation guidelines. Additional storm water management practices used at mineral mining facilities include: discharge diversions; drainage/storm water conveyances; runoff dispersion; sediment control and collection practices; vegetation/soil stabilization; capping contaminated sources; and treatment.

Metals are recovered by three basic extraction techniques: surface mining; underground mining; and placer mining. Each type of extraction method may be followed by varying methods of beneficiation and processing. Presented below are brief descriptions of the industrial activities, significant materials, and materials management practices associated with these four extraction processes and associated beneficiation activities. Due to similarities in mining operations for many of the minerals within this sector, industrial activities, significant materials, and materials management practices are fairly uniform across this sector. Unique practices are noted.

a. Surface Mining. Many mining facilities access metal deposits using surface extraction techniques such as strip mining, open-pit, open-cut, and open-cast. Surface mining is more economical than underground especially when the ore body is large and near the surface.

(1) Industrial Activities. Extraction activities include removal of overburden and waste rock to access metal deposits. These land-disturbing activities generate piles of topsoil and other overburden as well as waste rock, which are typically stored beside, or within, the pit or quarry. In addition, land disturbance, drilling, blasting, stripping, and materials handling activities create large amounts of dust that are either dispersed by local wind patterns or collected in air pollution control mechanisms. At closure, overburden and waste rock may or may not be used to reclaim the pit or quarry depending on Federal, State, and local requirements. In addition, access roads and rail spurs, and associated loading and unloading areas, are found onsite.

Following extraction, the mined materials may be transferred to a nearby beneficiation/processing facility. At an ore beneficiation facility, the valuable metals are separated from the less valuable rock to yield a product which is higher in metal content. To accomplish this, the ore must be crushed and ground small enough so that each particle contains mostly the mineral to be recovered or mostly the less valuable, or gangue, material. Valuable minerals are separated from the gangue by gravity concentration, magnetic separation, electrostatic separation, flotation, and leaching.

(2) Significant Materials. Significant materials generated by most extraction activities at surface mines include overburden piles, waste rock piles, ore and subore piles, and materials spilled from loading and unloading activities. Other exposed materials that can be generated at these types of operations (as well as other metal mines), include: tailings from flotation and other separation stages; soils impacted by fugitive dust emissions; settling ponds that receive process wastewaters; dredged sediment disposal areas; as well as raw material and product storage. Dust and particulate matter collected in air pollution control mechanisms may also be disposed of in onsite waste piles.

(3) Materials Management Practices. Materials management practices at surface mines are typically designed to control dust emissions and soil erosion from extraction activities, and offsite transport of significant materials. Settling ponds and impoundments are commonly used to reduce total suspended solids (TSS), total dissolved solids (TDS), and other contaminants in process generated wastewaters. These controls may also be used to manage storm water runoff and runon with potentially few alterations to onsite drainage systems. Few sampling facilities indicated the presence of traditional BMPs. Only 29 percent of the sampling facilities have ponds or impoundments as a storm water control.

Tailings impoundments are used to manage tailings generated at facilities engaged in flotation or heavy media separation operations. These impoundments are used to manage beneficiation/processing wastewaters generated at the facility and may also be used to manage storm water runoff.

b. Underground Mining. Underground mining techniques are used to access metals located too far underground to access economically from the surface. Though typically a more expensive form of extraction, advantages to underground mining operations include year-round operation, less noise (applicable to facilities located near residential areas), and less surface land disturbance. The two main underground mining methods are stoping and caving. Both of these methods can be used in several variations depending on the characteristics of the ore body. Common stoping methods include cut-and-fill, square cut (timbered), shrinkage, and open. Caving methods include undercut, block, and sub-level. Underground mining is usually independent of surface mining, but sometimes underground mining precedes or follows surface mining.

(1) Industrial Activities/Significant Materials. Industrial activities that may be associated with storm water discharges include: loading/unloading activities; haul roads; products and materials storage; waste piles; and processing activities. Exposed materials

associated with surface beneficiation and processing facilities at underground mines are similar to those associated with surface mining facilities.

(2) Materials Management Practices. Materials management practices for significant materials at the surface of underground mining facilities are similar to those materials management practices used at surface mining operations. However, waste rock or mill tailings are in some cases being returned to the mine as fill for the mined-out areas or may be directed to a disposal basin.

c. Placer Mining. Placer mining is used to mine alluvial sands and gravels containing valuable metallic minerals. Placer deposits are usually mined exclusively for gold material but smaller amounts of platinum, tin, and tungsten may also be recovered. There are three main placer mining techniques including dredge, hydraulic, and open cut methods.

(1) Industrial Activities. The industrial activities at dredging placer mines excavate underwater gold deposits by bucketline, dragline, or by suction. The excavation devices dig, wash, and screen gold values which are then recovered using gravity concentration methods. Hydraulic placer mines characteristically use high pressure water jets to excavate value-laden gravel banks. The most commonly used placer mining extraction method is the open cut. It involves stripping away topsoil and overburden to expose the auriferous gravels. The gold bearing gravels are excavated in sections and pushed to a placer wash plant for processing. Gravitational concentration is the common beneficiating technique at placer mines.

(2) Significant Materials. Significant materials generated at placer operations include overburden, mine development rock, ore, sub-ore piles, mine waste dumps, tailings ponds and piles. Potential natural constituents include mercury, arsenic, bismuth, antimony, thallium, pyrite, and pyrrhotite. After settling, the liquid portion of the slurry is returned to the mill as process water and the remaining slurried waste is pumped to tailings. In placer operations, however, tailings are disposed of in streams or on land.

(3) Materials Management Practices. Settling ponds are used to manage process wastewaters and are in some cases being used to manage contaminated storm water runoff. Few materials management practices were indicated in the part 1 group applications.

d. Inactive Mine Sites. Inactive ore mining and dressing operations are those where industrial activities are no longer occurring. When active, mineral extraction could have occurred from surface mines, solution mines, placer operations, or underground mines. These sites are included in this section because significant materials may remain onsite. These materials, if exposed, are potential sources of storm water contamination. Until an inactive metals mine and/or beneficiation operation has been reclaimed under applicable State or Federal laws after December 17, 1990, the site is considered associated with an "industrial activity" and is subject to the conditions of this section. Due to the seasonal nature of this industry, mine sites can become temporarily inactive for extended periods of time. Temporarily inactive sites are not viewed the same as permanently inactive sites.

2. Pollutants Found in Storm Water Discharges From Metal Mining

The volume of storm water discharges and the type and concentrations of pollutants found in storm water discharges from active and inactive metal mining facilities will vary according to several factors. Such factors include: geographic location; hydrogeology; the physical and chemical characteristics of the ores extracted; the physical and chemical characteristics of the waste rock and overburden removed; how the ore was extracted (e.g., open pit, underground, solution or dredging); the type of industrial activities occurring onsite (e.g., extraction, crushing, washing, milling, reclamation, etc.); the size of the operation; type, duration, and intensity of precipitation events; temperature ranges and variations; and the types of pollutant control measures used at the site. Each of these, and other factors will interact to influence the quantity and quality of storm water runoff. For example, air emissions (i.e., dust) may be a significant source of pollutants at some facilities, while roads constructed of waste rock may be a primary source at others. In addition, sources of pollutants other than storm water, such as illicit connections, spills, and other improperly dumped materials, may increase the pollutant loadings discharged into waters of the United States.

Based on the wide variety of industrial activities and significant materials at the facilities included in this sector, EPA believes it is appropriate to divide the metal mining (ore mining and dressing) industry into subsectors to properly analyze sampling data and determine monitoring requirements. As a result, this sector has been divided into the following subsectors: iron ore; copper ores; lead and zinc ores, gold and silver ores; ferroalloy ores, except vanadium; metal mining services; and miscellaneous metal ores (including uranium-radium-vanadium ores). Table G–2 below includes data for the eight pollutants that all facilities were required to monitor for under Form 2F. The table also lists those parameters that EPA has determined merit further monitoring.

A table has not been included for the following subsectors because less than 3 facilities submitted data in that subsector; iron ores; lead and zinc ores; gold and silver ores; ferroalloy ores, except vanadium; metal mining services; and miscellaneous metal ores (including uranium-radium-vanadium ores).

TABLE G–2.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY COPPER ORE MINING FACILITIES SUBMITTING PART II SAMPLING DATA[i] (mg/L)

Pollutant Sample type	No. of facilities				No. of samples		Minimum		Maximum		Median		95th percentile		99th percentile	
	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	4	1	7	1	11.0	18.0	0.0	18.0	27.0	18.0	11.0	18.0	43.6	....	81.9	....
COD	4	2	7	4	234.7	360.0	0.0	160.0	630.0	740.0	160.0	270.0	1448.6	888.2	3835.9	1386.6
Nitrate + Nitrite Nitrogen	4	1	5	2	1.84	1.50	0.00	1.40	5.30	1.60	1.40	1.50	6.35	1.75	11.5	1.86
Total Kjeldahl Nitrogen	3	1	4	2	3.98	3.70	1.20	1.50	7.00	5.90	3.85	3.70	13.60	14.63	25.55	28.30
Oil & Grease	3	N/A	5	N/A	1.0	N/A	0.0	N/A	5.0	N/A	0.0	N/A	....	N/A	....	N/A
pH	5	N/A	13	N/A	N/A	N/A	4.5	N/A	8.2	N/A	7.8	N/A	9.7	N/A	10.7	N/A
Total Phosphorus	5	3	10	5	2.17	7.54	0.00	0.00	14.00	7.00	0.11	0.17	13.53	7.93	68.67	28.25
Total Suspended Solids	4	2	6	4	18113	580	0	330	100000	850	2135	570	350477	1159	4050366	1596

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.

[ii] Composite samples.

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3. Options for Controlling Pollutants From Metal Mines

There are two options for reducing pollutants in storm water discharges; end-of-pipe treatment and implementing Best Management Practices to prevent and/or eliminate pollution. Discharges from mining operations are in some ways dissimilar to other types of industrial facilities. Mining facilities are often in remote locations and may operate only seasonally or intermittently, yet need year-round controls because significant materials remain exposed to precipitation when reclamation is not completed. These characteristics make resource intensive end-of-pipe management controls less desirable. A comprehensive storm water management program for a given plant may include controls from each of these categories. Development of comprehensive control strategies should be based on a consideration of site and facility plant characteristics.

a. End-of-Pipe Treatment. At many ore mining and dressing facilities, it may be appropriate to collect and treat the runoff from targeted areas of the facility. This approach was taken with 11 industrial subcategories within the ore mining and dressing industry, subject to national effluent limitation guidelines mill process wastewater and mine drainage. There are several areas where effluent limitation guidelines influence the permitting strategy for storm water discharges: whenever storm water and mill process wastewater and mine drainage combine, the storm water discharge is also subject to effluent limitation guidelines; to meet the numeric effluent limitation guidelines, most, if not all, facilities must collect and temporarily store onsite runoff from targeted areas of the plant; the effluent limitation guidelines do not apply to discharges whenever rainfall events, either chronic or catastrophic, cause an overflow of storage devices designed, constructed, and maintained to contain a 10-year, 24-hour storm; and most technology-based treatment standards, used for treating discharges subject to effluent limitation guidelines, are based on relatively simple technologies such as settling of solids, neutralization, and drum filtration.

For storm water discharges that are not covered by the effluent limitations guidelines, BMPs may be an appropriate means for limiting pollutant contributions. However, in cases of poor quality storm water discharges (e.g., low pH, high metals, etc.), treatment may be necessary to protect receiving waters.

b. Best Management Practices. Effective storm water management controls for limiting the offsite discharge of storm water pollutants from ore mining and dressing facilities are source reduction BMPs. Source reduction BMPs are methods by which discharges of contaminants are controlled with little or no required maintenance. Examples of these types of controls include source reduction diversion dikes, vegetative covers, and berms. Source reduction practices are typically (but not always) low in cost and relatively easy to implement. In some instances, more resource intensive treatment BMPs, including sedimentation ponds, may be necessary depending upon the type of discharge, types and concentrations of contaminants, and volume of flow.

The selection of the most effective BMPs will be based on site-specific considerations such as: facility size, climate, geographic location, hydrogeology and the environmental setting of each facility, and volume and type of discharge generated. Each facility will be unique in that the source, type, and volume of contaminated storm water discharges will differ. In addition, the fate and transport of pollutants in these discharges will vary. The management practices discussed herein are well suited mechanisms to prevent or control the contamination of storm water discharges associated with mining activity.

The following four categories describe best management practice options for reducing pollutants in storm water discharges from ore mining and dressing facilities: discharge diversions; sediment and erosion control; capping of contaminated sources; treatment.

Because ore mining and dressing is largely a land disturbance activity, BMPs that minimize erosion and sedimentation will be most effective if installed at the inception of operations and maintained throughout active operations and reclamation of the site. From the construction of access and haul roads, to closure and reclamation activities, implementation of BMPs is often essential to minimizing long-term environmental impacts to an area.

Part 1 group application data indicates that few storm water BMPs have been implemented at sampling facilities. The group application process did not require a description of BMP locations, and did not require applicants to describe the number of identical BMPs implemented at each site. As a result, the effectiveness of BMPs, for storm water management, at these facilities cannot be evaluated.

Many BMPs were not listed by facilities because they have been implemented to treat waters subject to effluent limitation guidelines, and are not exclusively used for storm water management. For instance, 29 percent of the sampling subgroup reported using ponds for sediment control and collection. Since some facilities classified as SIC Code 10 are subject to effluent limitation guidelines, sedimentation ponds may be implemented at greater proportions than indicated in part 1 of the group applications.

Because BMPs described in the part 1 data are limited, EPA is providing an overview of supplementary BMPs for use at ore mining and dressing facilities. However, due to the site-specific nature of facilities within this sector, BMPs cited do not preclude the use of other viable BMP options. Table G–3 summarizes BMP options as they apply to land disturbance activities at ore mining and dressing facilities. Sources of BMP information include: "Sediment and Erosion Control: An Inventory of Current Practices—Draft," EPA, April 20, 1990; "Storm Water Management for Industrial Activities: Developing Pollution Prevention Plans and Best Management Practices," EPA, September, 1992, (EPA 832–R–92–006); "Best Management Practices for Mining in Idaho," Idaho Department of Lands, November 1992; and "Erosion & Sediment Control Handbook," Goldman et al., McGraw-Hill Book Company, 1986.

TABLE G-3.—SUMMARY OF MINE AREAS AND APPLICABLE BEST MANAGEMENT PRACTICES

Land-disturbed area	Discharge diversions	Conveyance systems	Runoff dispersion	Sediment control & collection	Vegetation	Containment	Treatment
Haul Roads and Access Roads.	Dikes, Curbs, Berms.	Channels, Gutters, Culverts, Rolling Dips, Road Sloping, Roadway Water Deflectors.	Check Dams, Rock Outlet Protection, Level Spreaders, Stream Alteration, Drop Structures.	Gabions, Riprap, Native Rock Retaining Walls, Straw Bale Barriers, Sediment Traps/Catch Basins, Vegetated Buffer Strips.	Seeding, Willow Cutting Establishment.		
Pits/Quarries or Underground Mines.	Dikes, Curbs, Berms.	Channels, Gutters.	Serrated Slopes, Benched Slopes, Contouring, Stream Alteration.	Sediment Settling Ponds, Straw Bale Barrier, Siltation Berms.	Seeding	Plugging and Grouting.	Chemical/Physical Treatment.
Overburden, Waste Rock and Raw Material Piles.	Dikes, Curbs, Berms.	Channels, Gutters.	Serrated Slopes, Benched Slopes, Contouring, Stream Alteration.	Plastic Matting, Plastic Netting, Erosion Control Blankets, Mulch-straw, Compaction, Sediment/Settling Ponds, Silt Fences, Siltation Berms.	Topsoiling, Seedbed Preparation, Seeding.	Capping	Chemical/Physical Treatment. Artificial Wetlands.
Reclamation	Dikes, Curbs, Berms.	Channels, Gutters.	Check Dams, Rock Outlet Protection, Level Spreaders, Serrated Slopes, Benched Slopes, Contouring, Drain Fields, Stream Alteration, Drop Structures.	Gabions, Riprap, and Native Rock Retaining Walls, Biotechnical Stabilization, Straw Bale Barriers, Sediment Traps/Catch Basins, Vegetative Buffer Strips, Silt Fences, Siltation Berms, Brush Sediment Barriers.	Topsoiling, Seedbed Preparation, Seeding, Willow Cutting Establishment.	Capping, Plugging and Grouting.	Chemical/Physical Treatment, Wetlands.

Haul Roads and Access Roads—Placement of haul roads or access roads should occur as far as possible from natural drainage areas, lakes, ponds, wetlands or floodplains where soil will naturally be less stable for heavy vehicle traffic. If a haul road must be constructed near water, as little vegetation as possible should be removed from between the road and the waterway, as vegetation is a useful buffer against erosion and is an efficient sediment collection mechanism. The width and grade of haul or access roads should be minimal and should be designed to match natural contours of the area. Construction of haul roads should be supplemented by BMPs that divert runoff from road surfaces, minimize erosion, and direct flow to appropriate channels for discharge to treatment areas.

Pits or Quarries—Excavation of a pit or quarry must be accompanied by BMPs to minimize impacts to area surface waters. As discussed in construction of haul roads, as little vegetation as possible should be removed from these areas during excavation activities to minimize exposed soils. In addition, stream channels and other sources of water that may discharge into a pit or quarry should be diverted around that area to prevent contamination.

BMPs can be used to control total suspended solids levels in runoff from unvegetated areas. These can include sediment/settling ponds, check dams, silt fences, and straw bale barriers.

Overburden, Waste Rock, and Raw Material Piles—Overburden, topsoil, and waste rock, as well as raw material and intermediate and final product stockpiles should be located away from surface waters and other sources of water, and from geologically unstable areas. If this is not practicable, surface water should be diverted around the piles. As many piles as possible should be revegetated, (even if only on a temporary basis.) At closure, remaining units should be reclaimed.

Reclamation Activities—When a mineral deposit is depleted and operations cease, a mine site must be reclaimed according to appropriate State or Federal standards. Closure activities typically include restabilization of any disturbed areas such as access or haul roads, pits or quarries, sedimentation ponds or work-out pits, and any remaining waste piles. Overburden and topsoil stockpiles may be used to fill in a pit or quarry (where practical.) Recontouring and revegetation should be performed to stabilize soils, and prevent erosion.

Major reclamation activities such as recontouring roads and filling in a pit or quarry can only be performed after operations have ceased. However, reclamation activities such as stabilization of banks, and reseeding and revegetation should be implemented in mined out portions, or inactive areas of a site as active mining moves to new areas.

EPA recognizes that quarries are frequently converted into reservoirs, or recreational areas, after the mineral deposit is depleted. However, this does not preclude the reclamation of disturbed areas above the quarry rim.

(1) Discharge Diversions. Discharge diversions provide the first line of defense in preventing the contamination of discharges, and subsequent contamination of receiving waters of the United States. Discharge diversions are temporary or permanent structures installed to divert flow, store flow, or limit storm water runon and runoff.

These diversion practices have several objectives. First, diversion structures can be designed to prevent otherwise uncontaminated (or less contaminated) water from crossing disturbed areas or areas containing significant amounts of contaminated materials, where contact may occur between runon and significant materials. These source reduction measures may be particularly effective for metal mining facilities to prevent runon of uncontaminated discharges from contacting exposed materials and/or reduce the flow across disturbed areas, thereby lessening the potential for erosion. Second, diversion structures can be used to collect or divert waters for later treatment, if necessary. The usefulness of these control measures are limited by such factors as the size of the area to be controlled and the type and nature of materials exposed and precipitation events.

Diversion dikes, curbs, and berms are temporary or permanent diversion structures that prevent runoff from passing beyond a certain point, and divert runoff away from its intended path. Dikes, curbs or berms may be used to surround and isolate areas of concern at metal mining sites, diverting flow around piles of overburden, waste rock, and storage areas, to minimize discharge contact with contaminated materials and to limit discharges of contaminated water from confined areas. The BMPs described below may be useful for storm water diversion at metal mining sites.

Channels or Gutters—Channels or gutters collect storm water runoff and direct its flow. Channels or gutters may act to divert runoff away from a potential source of contamination, but may also be used to channel runoff to a collection and/or treatment area including settling ponds, basins or work-out pits.

Open Top Box Culverts and Waterbars—These structures are temporary or permanent structures that divert water from a roadway surface. Open top box culverts may be used on steeply graded, unpaved roads in place of pipe culverts to divert surface runoff and flow from inside ditches onto the downhill slope of a road. These structures are typically made of wood and should periodically be monitored and repaired if necessary.

Rolling Dips and Road Sloping—Rolling dips and road sloping are permanent water diversion techniques installed using natural contours of the land during road construction. These BMPs prevent water accumulation on road surfaces and divert surface runoff toward road ditches, which then convey the storm water to ponds or other management areas.

Roadway Surface Water Deflector—A roadway surface water deflector is another technique to prevent accumulation of water on road surfaces. The structure uses a conveyor belt sandwiched between two pieces of treated wood and placed within the road to deflect water. This is a useful technique for steeply graded, unpaved roads.

Culverts—Culverts are permanent surface water diversion mechanisms used to convey water off or underneath a road. Made of corrugated metal, they must extend across the entire width of the road and beyond the fill slope. Additional erosion control mechanisms may need to be installed at the discharge end of the culvert.

Drainage systems are most effective when used in conjunction with runoff dispersion devices designed to slow the flow of water discharged from a site. These devices also aid storm water infiltration into the soil and flow attenuation. Some examples of velocity dissipation devices include check dams, rock outlet protection, level spreaders, and serrated and benched slopes.

Check Dams—Check dams are small temporary dams constructed across swales or drainage ditches to reduce the velocity of runoff flows, thereby reducing erosion and failure of the swale or ditch. This slowing reduces erosion and gullying in the channel and allows sediments to settle.

Rock Outlet Protection—Rock protection placed at the outlet end of culverts, channels, or ditches reduces the depth, velocity, and destructive energy of water such that the flow will not erode the downstream reach.

Level Spreaders—Level spreaders are outlets for dikes and diversions consisting of an excavated depression constructed at zero grade across a slope. Level spreaders diffuse storm water point sources and release it onto areas stabilized by existing vegetation.

Serrated Slopes and Benched Slopes—These runoff dispersion methods break up flow of runoff from a slope, decreasing its ability to erode. Serrated and benched slopes provide flat areas that allow water to infiltrate, and space for vegetation to grow and reinforce soils.

Contouring—Surface contouring is the establishment of a rough soil surface amenable to revegetation, through creating horizontal grooves, depressions, or steps that run with the contour of the land. Surface roughening aids in the establishment of vegetative cover by reducing runoff velocity and giving seed an opportunity to take hold and grow.

Drain Fields—Drain fields are used to prevent the accumulation of water and/or ground water at a site, by diverting infiltrating sources through gravity flow or pumping.

Stream Alteration—Altering or channelizing the path of a stream to bypass all or some disturbed areas on a site allows additional mining activities and avoids contamination of stream water by disturbed lands. This practice is complicated, however, by the need to restore the channel when mining operations end.

Drop Structures—Drop structures are large angular rocks placed in a V-shaped pattern to slow the velocity of storm water runoff. These structures are typically reinforced by logs or large rocks imbedded in the streambanks.

(2) Erosion and Sediment Controls. Erosion and sediment controls limit movement and retain sediments from being transported offsite. Several structural collection devices have been developed to remove sediment from runoff before it leaves the site. Several methods of removing sediment from site runoff involve diversion mechanisms previously discussed, supplemented by a trapping or storage device. Structural practices typically involve filtering diffuse storm water flows through temporary structures such as straw bale dikes, silt fences, brush barriers or vegetated areas.

Structural practices are typically low in cost. However, structural practices require periodic removal of sediment to remain functional. As such, they may not be appropriate for permanent use at inactive mines. However, these practices may be effectively used as temporary measures during active operation and/or prior to the final implementation of permanent measures.

(a) Structural Practices.

(i) Sediment/Settling Ponds—Sediment ponds function as sediment traps by containing runoff for long periods of time, allowing suspended solids to settle. These structures can achieve a high removal rate of sediment for both process wastewater and storm water discharges.

Discharge ponds may also be designed to act as surge ponds which are designed to contain storm surges and then completely drain in about 24 to 40 hours, and remain dry during times of no rainfall. They can provide pollutant removal efficiencies that are similar to those of detention ponds.[45]

(ii) Gabions, Riprap, and Native Rock Retaining Walls—These BMPs are all forms of slope stabilization. Gabions consist of rocks (riprap) contained by rectangular wire boxes or baskets for use as permanent erosion control structures. Riprap consists of loose rocks placed along embankments to prevent erosion.

(iii) Biotechnical Stabilization—Biotechnical stabilization uses live brush imbedded in the soils of a steep slope to prevent erosion. This method relies on the premise that the imbedded vegetation will eventually root and help stabilize the slope.

(iv) Straw Bale Barrier—Straw bales may be used as temporary berms, barriers, or diversions, capturing sediments, filtering runoff. When installed and maintained properly, these barriers remove approximately 67 percent of the sediment load.[46]

(v) Sediment Traps or Catch Basins—These temporary or permanent structures are useful for catching and storing sediment laden storm water runoff and are particularly useful during construction activities to contain runoff. The effectiveness of these BMPs is better in smaller drainage basin areas. Sediment traps are less than 50 percent effective in removing sediment from storm water runoff.[47]

(vi) Vegetated Buffer Strips—The installation of vegetated buffer strips will reduce runoff and prevent erosion at a removal efficiency rate of 75 to 99 percent depending upon the ground cover.[48]

(vii) Silt Fence/Filter Fence—A low fence made of filter fabric, wire and steel posts, should be used on small ephemeral drainage areas where storm water collects or leaves a mine site. Silt fences remove 97 percent of the sediment load and are easier to maintain and remove without creating lasting impacts to the environment.[49]

(viii) Siltation Berms—Siltation berms are typically placed on the downslope side of a disturbed area to act as an impermeable barrier for the capture and retention of sediments in surface water runoff. Plastic sheeting is typically used to cover the berm. The berm and the plastic sheeting may require periodic maintenance and repair.

(ix) Brush Sediment Barriers—Brush barriers are temporary sediment barriers composed of tree limbs, weeds, vines, root mat, soil, rock and other cleared materials placed at the toe of a slope. A brush barrier is effective only for small drainage areas, usually less than 1/4 acre, where the slope is minimal.

(b) Stabilization—Stabilization practices involve establishing a sustainable ground cover by permanent seeding, mulching, sodding, and other such practices. A vegetative cover reduces the potential for erosion of a site by: absorbing the kinetic energy of raindrops which would otherwise impact soil; intercepting water so it can infiltrate into the ground instead of running off and carrying contaminated discharges; and by slowing the velocity of runoff to promote onsite deposition of sediment. Stabilization controls are often the most important measures taken to prevent offsite sediment movement, and can provide a six-fold reduction in the discharge of suspended sediment levels.[50] Permanent seeding has been found to be 99 percent effective in controlling erosion for disturbed land areas.[51] Many states require that topsoil be segregated from other overburden for use during reclamation. While stored, topsoil stockpiles should be vegetated. This temporary form of vegetation can often be used for other piles of stored materials and for intermittent/seasonal operations.

Typically, the costs of stabilization controls are low relative to other discharge mitigation practices. Given the limited capacity to accept large volumes of runoff, and potential erosion problems associated with large concentrated flows, stabilization controls should typically be used in combination with other management practices. These measures have been documented as particularly appropriate for mining sites.

(i) Topsoiling, Seedbed Preparation—The addition of a layer of topsoil or plant growth material provides an improved soil medium for plant growth. Seedbed preparation may include the addition of topsoil ingredients to be mixed in with soils used for seedbed preparation.

(ii) Broadcast Seeding and Drill Seeding—Seeding and vegetative planting are methods used to revegetate an area. Broadcast seeding spreads seeds uniformly, by hand or machine, to steep sloped or rocky areas, flat surfaces, and areas with limited access.

(iii) Willow Cutting Establishment—Willow cutting establishment describes a method of soil stabilization useful for stream banks and other areas located adjacent to water. Similar to biotechnical stabilization, willow cuttings are used to promote growth in an area needing stabilization. Willow cuttings are typically used to reinforce a streambank or other moist area.

(iv) Plastic Matting, Plastic Netting, and Erosion Control Blankets—These BMPs are used to protect bare soils to control dust and erosion. Mats and blankets help to promote vegetative growth by maintaining moisture and heat within the soil.

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[45] "Urban Targeting and BMP Selection," EPA, Region V, November 1990.

[46] "Sediment and Erosion Control: An Inventory of Current Practices—Draft," EPA, April 20, 1990, page IV–14.

[47] "Sediment and Erosion Control: An Inventory of Current Practices—Draft," EPA, April 20, 1990, page IV–26.

[48] "Sediment and Erosion Control: An Inventory of Current Practices—Draft," EPA, April 20, 1990, page IV–7.

[49] "Sediment and Erosion Control: An Inventory of Current Practices—Draft," EPA, April 20, 1990, page IV–15.

[50] "Performance of Current Sediment Control Measures at Maryland Construction Sites," January 1990, Metropolitan Washington Council of Governments, page X.

[51] "Sediment and Erosion Control: An Inventory of Current Practices—Draft," EPA, April 20, 1990, page IV–4.

(v) Mulch-straw or Wood Chips—Mulches and wood chips are useful temporary covers for bare or seeded soils, with an erosion control effectiveness rating of 75 to 98 percent.[52] Like matting, mulch-straw or wood chips help soils retain moisture and warmth to promote vegetative growth.

(vi) Compaction—Soil compaction using a roller or other heavy equipment increases soil "strength" by increasing its density. More dense soil is less prone to erosion and long-term soil settlement.

(3) Capping. In some cases, the elimination of a pollution source through capping contaminant sources may be the most cost effective control measure for discharges from inactive ore mining and dressing facilities. Depending on the type of management practices chosen the cost to eliminate the pollutant source may be very high. Once completed, however, maintenance costs will range from low to nonexistent.

Capping or sealing of waste materials is designed to prevent infiltration, as well as to limit contact between discharges and potential sources of contamination. Ultimately, capping should reduce or eliminate the contaminants in discharges. In addition, by reducing infiltration, the potential for seepage and leachate generation may also be lessened.

EPA has identified a wide variety of best management practices (BMPs) that may be used to mitigate discharges of contaminants at active and inactive metal mines. Many of the practices focus on sediment and erosion control and are similar to BMPs used in the construction industry. These controls to prevent erosion and control sedimentation are the most effective if they are installed at the inception of operations and maintained throughout active operations and reclamation of the site. For more details on the use and implementation of these practices the reader is encouraged to obtain a copy of one or more of the many good sediment and erosion control books available on the market.[53] In some cases (e.g., low pH and/or high metals concentrations), BMPs, and sediment and erosion controls may not be adequate to produce an acceptable quality of storm water discharge. Under those circumstances additional physical or chemical treatment systems may be necessary to protect the receiving waters.

(4) Treatment. Treatment practices are those methods of control which normally are thought of as being applied at the "end of the pipe" to reduce the concentration of pollutants in water before it is discharged. This is in contrast to many BMPs, where the emphasis is on keeping the water from becoming contaminated. Treatment practices may be required where flows are currently being affected by exposed materials and other BMPs are insufficient to meet discharge goals. These practices are usually the most resource intensive, as they often require significant construction costs, and monitoring and maintenance on a frequent and regular basis. Treatment options may range from high maintenance controls to low maintenance controls. High maintenance treatment techniques require manpower to operate and maintain the BMP. Low maintenance cost techniques have initial capital costs but operate with low long-term maintenance after being implemented. At a few sites, treatment measures other than high maintenance measures may be appropriate to address specific pollutants.

(a) Chemical/Physical Treatment—An example of a high maintenance technology that is found at many active metal mining facilities is chemical/physical treatment. The most common type of chemical/physical treatment involves the addition of lime or other such caustics to neutralize the discharges and/or precipitate metals. Metals may be removed from wastewater by raising the pH of the wastewater to precipitate them out as hydroxides.

(b) Oil/Water Separators—Another example of a high maintenance treatment technology is an oil/water separator. An American Petroleum Institute (API) oil/water separator or similar type of treatment device which acts to skim oil and settle sludge can be used to remove oil from water.

(c) Artificial Wetlands—This type of BMP system can be an effective system for improving water quality either alone or in conjunction with other treatment practices. Wetland processes are able to filter sediments, and absorb and retain chemical and heavy metal pollutants through biological degradation, transformation, and plant uptake.

Natural wetlands should not be considered as part of the treatment system because they are considered to be waters of the United States. The necessary controls, or BMPs, must be provided prior to discharging the storm water runoff to natural wetlands or other receiving waters.

In summary, a wide variety of BMPs are available for use at active and inactive metallic mining and milling facilities. These measures range from simple low cost, low maintenance source reduction practices such as diversion structures to high cost, maintenance intensive practices such as wetlands treatment. Clearly, the selection of a practice or group of practices will be site-specific depending on conditions and potential impacts as well as the resources available at each site. A specific best available technology (or technologies) cannot be determined because of the differences between sites and the quantities and characteristics of their discharges.

(4) Discharges Covered Under This Section

Coverage under this section of today's permit is limited to all storm water discharges from inactive metal mining facilities and storm water discharges from the following areas of active metal mining facilities: topsoil piles; offsite haul/access roads if off active area; onsite haul roads if not constructed of waste rock or spent ore, and mine water is not used for dust control; runoff from tailings dams/dikes when not constructed of waste rock/tailings and no process fluids are present; concentration building, if no contact with material piles; mill site, if no contact with material piles; chemical storage area; docking facility, if no excessive contact with waste product; explosive storage; reclaimed areas released from reclamation bonds prior to December 17, 1990; and partially/inadequately reclaimed areas or areas not released from reclamation bonds.

Storm water discharges, or mine drainage discharges, which are subject to existing effluent limitations guidelines addressing storm water (or a combination of storm water and non-storm water) cannot be covered by this section. The effluent limitations guidelines that apply to active metal mining operations are contained in 40 CFR Part 440, Ore Mining and Dressing Point Source Category. These effluent guidelines include specific numeric limitations for mine drainage and discharges from mills, or "no discharge" requirements. Table G–4 identifies the discharge and source of the discharge from active metal mining facilities, that are subject to process wastewater limitations, mine drainage limitations, and storm water reporting requirements. Storm water discharges that are eligible

[52] "Sediment and Erosion Control: An Inventory of Current Practices—Draft," EPA, April 20, 1990.

[53] "Best Management Practices for Mining in Idaho," Idaho Department of State Lands, November 1992; "Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices," EPA, September 1992 (EPA 832–R–92–005); and "Erosion & Sediment Control Handbook," Goldman et al., McGraw-Hill Book Company, 1986.

for coverage under today's permit are identified under the coverage section of the permit. At all metal mining facilities, coverage under this section does not include adit drainage or contaminated springs or seeps. Table G-4 clarifies the applicability of the Effluent Limitations Guidelines found in 40 CFR Part 440. This table does not expand or redefine these Effluent Limitations Guidelines.

TABLE G-4.—APPLICABILITY OF 40 CFR PART 440 EFFLUENT LIMITATIONS GUIDELINES TO STORM WATER RUNOFF FROM ACTIVE ORE (METAL) MINING AND DRESSING SITES

Discharge/source of discharge	Applicable ELG, if any (see key)	Note/comment
Land application area runoff	MD	PW—if Process fluids present.
Crusher area	MD	PW—if Process fluids present.
Piles (seepage and/or runoff):		
Spent ore	MD	PW—if Process fluids present.
Surge/Ore	MD	PW—if Process fluids present.
Waste rock/overburden	MD	
Topsoil	SW	
Drainage:		
Pit drainage (unpumped)	MD	
Pit drainage (removed by pumping)	MD	
Mine water from underground mines (unpumped), adit discharges.	MD	
Mine water from underground mines (pumped)	MD	
Seeps/French drains	MD	PW—if Process fluids present.
Roads constructed of waste rock or spent ore:		
Onsite haul roads	MD	
Offsite haul/access roads	SW	(if off Active Area).
Roads not constructed of waste rock or spent ore:		
Onsite haul roads	SW	MD—if dust control with MD water.
Offsite haul/access roads	SW	
Milling/concentrating:		
Tailings impoundment/pile	PW	
Runoff from tailings dams/dikes when constructed of waste rock/tailings.	MD	PW—if Process fluids present.
Runoff from tailings dams/dikes when not constructed of waste rock/tailings.	SW	PW—if Process fluids present.
Heap leach pile runoff/seepage	PW	
Pregnant pond (barren and surge ponds also)	PW	
Polishing pond	PW	
Concentration building	SW	If storm water only, and no contact with piles.
Concentrate pile (product storage)	PW	
Mill site	SW	Same as concentration bldg.
Ancillary areas:		
Office/administrative building and housing	UC	Unless mixed with SW from industrial area, then SW.
Chemical storage area	SW	
Docking facility	SW	Excessive contact with waste product could constitute MD.
Explosive storage	SW	
Fuel storage (oil tanks/coal piles)	SW	
Vehicle/equipment maintenance area/building	SW	
Parking areas	SW	UC if only employee and visitor type parking.
Power plant	SW	
Truck wash area	SW	Excessive contact with waste product could constitute MD.
Reclamation-related areas:		
Any disturbed area (unreclaimed)	MD	SW if inactive area.
Reclaimed areas released from reclamation bonds after Dec. 17 1990.	UC	
Reclaimed areas released from reclamation bonds prior to Dec. 17 1990.	SW	
Partially/inadequately reclaimed areas or areas not released from reclamation bond.	SW	

KEY: UC—Unclassified; Not Subject to Storm Water Program or 40 CFR Part 440 Effluent Limitations Guidelines (ELG); MD—Subject to 40 CFR Part 440 ELG for mine drainage; PW—Subject to 40 CFR Part 440 ELG for mill discharge or process (including zero discharge ELG); SW—Storm water runoff from these sources are subject to the Storm Water Program, but are not subject to 40 CFR 440 ELG unless mixed with discharges subject to the 440 CFR 440 ELG that are not regulated by another permit prior to mixing. Non-storm water discharges from these sources are subject to NPDES permitting and may be subject to the effluent limitation guidelines under 40 CFR 440.

Temporarily inactive (e.g., winter closure, and portions of active mines that are no longer being mined, and where reclamation has not begun) mines will be permitted as an active mine. The following definitions apply to this section and are intended to provide clarification as to what is considered active, inactive, and temporarily inactive:

The following definitions are only for this section of today's permit and are not intended to supersede the definitions of active and inactive mining facilities established by 40 CFR 122.26(b)(14)(iii):

"Active Metal Mining Facility" is a place where work or other related

activity to the extraction, removal, or recovery of metal ore is being conducted. With respect to surface mines, an "active metal mining facility" does not include any area of land on or in which grading has been completed to return the earth to a desired contour and reclamation work has begun.

"Inactive Metal Mining Facility" means a site or portion of a site where metal mining and/or milling activities occurred in the past but is not an active metal mining facility, as defined in this permit and that portion of the facility does not have an active mining permit issued by the applicable (federal or state) government agency that authorizes mining at the site.

"Temporarily Inactive Metal Mining Facility" means a site or portion of a site where metal mining and/or milling activities occurred in the past, but currently are not being actively undertaken, and the facility has an active mining permit issued by the applicable (federal or state) governmental agency that authorizes mining at the site.

Operators of storm water discharges from mining related industrial activities such as vehicle maintenance, or power plants should refer to the appropriate sections of today's permit for specific guidance or requirements. Clearing, grading, and excavation activity that disturbs 5 or more acres during the exploration or preparation for beginning active mining operations cannot be covered by this section. Coverage for this type of pre-mining activity can be covered by EPA's general permit for storm water discharges from construction activities or an applicable State-issued permit. Land disturbance activities associated with the active mining operations such as expansion of existing pits, can be covered by this section.

5. Storm Water Pollution Prevention Plan Requirements

All facilities subject to this section must prepare and implement a storm water pollution prevention plan. The establishment of a pollution prevention plan requirement reflects EPA's decision to allow operators of ore mining and dressing facilities to utilize BMPs as the BAT/BCT level of control for the storm water discharges covered by this section. The requirements included in pollution prevention plans provide a flexible framework for the development and implementation of site specific controls to minimize pollutants in storm water discharges. This approach is consistent with the approach used in the baseline general permits finalized on September 9, 1992 (57 FR 41236).

Pollution prevention can be an effective approach for controlling contaminated storm water discharges from metal mining facilities. Pollution prevention plans allow the operator of a facility to select BMPs based on site-specific considerations such as: facility size; climate; geographic location; hydrogeology; the environmental setting of each facility; and volume and type of discharge generated. This flexibility is necessary because each facility will be unique in that the source, type, and volume of contaminated surface water discharges will differ from site to site. In addition, EPA believes that the adoption of BMPs reduces environmental impacts by minimizing land disturbed areas susceptible to storm water runoff. Early implementation and maintenance of BMPs facilitates ongoing reclamation activities, reducing final reclamation costs associated with site closure. BMPs are also effective at temporarily or permanently inactive mine sites.

There are two major objectives to a pollution prevention plan: 1) to identify sources of pollution potentially affecting the quality of storm water discharges associated with industrial activity from a facility; and 2) to describe and ensure implementation of practices to minimize and control pollutants in storm water discharges associated with industrial activity from a facility.

Specific requirements for a pollution prevention plan for ore mining and dressing facilities are described below. These requirements must be implemented in addition to the baseline pollution prevention plan provisions discussed previously.

a. Active and Temporarily Inactive Metal Mining Facilities.

(1) Description of Mining Activities. The storm water pollution prevention plan shall provide a narrative description of the mining and associated activities taking place at the site which affect or may affect storm water runoff intended to be covered by this section. The narrative description shall report the total acreage within the mine site, an estimate of the acreage of land currently disturbed, and an estimate of the total acreage that will be disturbed throughout the life of the mine. A general description of the mining site relative to major transportation routes and communities shall also be provided.

(2) Description of Potential Pollution Sources. Each storm water pollution prevention plan must describe activities, materials, and physical features of the facility that may contribute to storm water runoff or, during periods of dry weather, result in dry weather flows and mine pumpout. This assessment of storm water pollution will support subsequent efforts to identify and set priorities for necessary changes in materials, materials management practices, or site features, as well as aid in the selection of appropriate structural and nonstructural control techniques. In addition to the baseline general requirements storm water pollution prevention plans must describe the following elements:

(a) Drainage—The plan must contain a map of the site that shows the pattern of storm water drainage, structural features that control pollutants in storm water runoff [54] and process wastewater discharges (including mine drainage), surface water bodies (including wetlands), places where significant materials [55] are exposed to rainfall and runoff, and locations of major spills and leaks that occurred in the 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit. The map also must show areas where the following activities take place: fueling, vehicle and equipment maintenance and/or cleaning, loading and unloading, material storage (including tanks or other vessels used for liquid or waste storage), material processing, waste disposal, haul roads, access roads, and rail spurs. The site map must also indicate the outfall locations and the types of discharges contained in the drainage areas of the outfalls (e.g. storm water and air conditioner condensate). In order to increase the readability of the map, the inventory of the types of discharges contained in each outfall may be kept as an attachment to the site map.

(b) Inventory of Exposed Materials—Facility operators are required to carefully conduct an inspection of the site and related records to identify significant materials that are or may be exposed to storm water. The inventory

[54] Nonstructural features such as grass swales and vegetative buffer strips also should be shown.

[55] Significant materials include, "* * * but [are] not limited to: raw materials, fuels, materials such as solvents, detergents, and plastic pellets; finished materials such as metallic products; * * * hazardous substances designated under section 101(14) of CERCLA; any chemical facilities required to report pursuant to section 313 of title III of SARA; fertilizers; pesticides; and waste products such as ashes, slag, and sludge that have the potential to be released with storm water discharge" (40 CFR 122.26(b)(12)). Significant materials commonly found at mining facilities include: overburden; raw materials; waste rock piles; tailings; petroleum based products; solvents and detergents; heap leach pads; tailings piles/ponds, both proposed and existing; and manufactured products, waste materials or by-products used or created by the facility.

must address materials that within 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit have been handled, stored, processed, treated, or disposed of in a manner to allow exposure to storm water. Findings of the inventory must be documented in detail in the pollution prevention plan. At a minimum, the plan must describe the method and location of onsite storage or disposal; practices used to minimize contact of materials with rainfall and runoff; existing structural and nonstructural controls that reduce pollutants in storm water runoff; existing structural controls that limit process wastewater discharges; and any treatment the runoff receives before it is discharged to surface waters or a separate storm sewer system. The description must be updated whenever there is a significant change in the types or amounts of materials, or material management practices, that may affect the exposure of materials to storm water.

In addition, any existing ore or waste rock/overburden characterization data, including results of testing for acid rock generation potential must be included in the pollution prevention plan. The intent is to get an idea of the pollutants (e.g., heavy metals) that may be present in the ore and waste rock/overburden.

(3) Measures and Controls. Following completion of the source identification and assessment phase, the permittee must evaluate, select, and describe the pollution prevention measures, best management practices (BMPs), and other controls that will be implemented at the facility. The permittee must assess the applicability of the following BMPs for their site: discharge diversions, drainage/storm water conveyance systems, runoff dispersions, sediment control and collection mechanisms, vegetation/soil stabilization, capping of contaminated sources, and treatment of storm water discharges. In addition, BMPs include processes, procedures, schedules of activities, prohibitions on practices, and other management practices that prevent or reduce the discharge of pollutants in storm water runoff.

The pollution prevention plan must discuss the reasons each selected control or practice is appropriate for the facility and how each will address the potential sources of storm water pollution. The plan also must include a schedule specifying the time or times during which each control or practice will be implemented. In addition, the plan should discuss ways in which the controls and practices relate to one another and, when taken as a whole, produce an integrated and consistent approach for preventing or controlling potential storm water contamination problems.

Under the inspection requirements of the pollution prevention plan, operators of active facilities are required to conduct monthly visual inspections of BMPs and designated equipment and mine areas. Owner/operators of temporarily inactive mining sites are required to conduct quarterly inspections. If weather conditions make the mine site inaccessible, the quarterly inspection will not be required. Active mining sites have frequent inspection periods because members of the pollution prevention team will be onsite, and the fact that they are active means there is a greater potential for pollution. The inspections shall include: (1) an assessment of the integrity of storm water discharge diversions, conveyance systems, sediment control and collection systems, and containment structures; (2) visual inspections of vegetative BMPs, serrated slopes, and benched slopes to determine if soil erosion has occurred; and (3) visual inspections of material handling and storage areas and other potential sources of pollution for evidence of actual or potential pollutant discharges of contaminated storm water.

Under the employee training requirements of the pollution prevention plan, facility operators are required to conduct employee training programs at least annually. The intent of this frequency is to provide a reminder to the employees of the requirements of the storm water pollution prevention plan.

(4) Non-storm Water Discharges. Each pollution prevention plan must include a certification, signed by an authorized individual, that discharges from the site have been tested or evaluated for the presence of non-storm water discharges, including discharges that are subject to 40 CFR Part 440. The certification must describe possible significant sources of non-storm water, the results of any test and/or evaluation conducted to detect such discharges, the test method or evaluation criteria used, the dates on which tests or evaluations were performed, and the onsite drainage points directly observed during the test or evaluation. Pollution prevention plans must identify and ensure the implementation of appropriate pollution prevention measures for the non-storm water discharge.

Under the non-storm water discharge section of the pollution prevention plan, EPA will allow non-storm water discharges that mix with storm water under this section provided that the plan includes a certification that any non-storm water discharge which mixes with storm water is subject to a separate NPDES permit that applies applicable effluent limitations prior to the mixing of non-storm water and storm water. In such cases, the certification shall identify the non-storm water discharge(s), the applicable NPDES permit(s), the effluent limitations placed on the non-storm water discharge by the NPDES permit(s), and the point(s) at which the limitations are applied. In addition, Part III.A.2 of today's permit discusses non-storm water discharges that may be eligible for coverage under the permit.

b. Inactive Metal Mining Facilities

(1) Pollution Prevention Team. The storm water pollution prevention plan must identify specific individual(s) who are responsible for the development, implementation, maintenance, and revision of the pollution prevention plan. The plan shall clearly identify the responsibilities of each team member. The activities and responsibilities of the team shall address all aspects of the storm water pollution prevention plan at the inactive facility. Members of the pollution prevention team do not have to be permanently located at the inactive facility, such as the requirement for any active facility.

(2) Description of Mining Activities. The storm water pollution prevention plan shall provide a narrative description of the mining and associated activities that took place at the site. The narrative description shall report the approximate dates of operation, total acreage within the mine site and/or processing site, an estimate of the total acreage disturbed, and the activities (reclamation, etc.) that are currently taking place at the facility. A general description of the mining site relative to major transportation routes and communities shall also be provided.

(3) Description of Potential Pollution Sources. Each storm water pollution prevention plan must describe activities, materials, and physical features of the facility that may contribute to storm water runoff or, during periods of dry weather, result in dry weather flows. This assessment of storm water pollution will support subsequent efforts to identify and set priorities for necessary changes in materials, materials management practices, or site features, as well as aid in the selection of appropriate structural and nonstructural control techniques. In addition to the baseline general requirements storm water pollution prevention plans must describe the following elements:

(3) Drainage—The plan must contain a map of the site that shows the pattern of storm water drainage, structural features that control pollutants in storm water runoff[56] and process wastewater discharges (including mine drainage), surface water bodies (including wetlands), places where significant materials[57] are exposed to rainfall and runoff. The map also must show the location of the following: any remaining equipment storage, fueling, and maintenance areas; areas used for outdoor manufacturing, storage, or disposal of materials; the boundaries of former mining and milling sites; the location of each storm water outfall and an outline of the portions of the drainage area that are within the facility boundaries; tailings piles and ponds; mine drainage or any other process water discharge point; and an estimate of the direction of flow. In addition, the site map must also indicate the types of discharges contained in the drainage areas of the outfalls (e.g., storm water and air conditioner condensate). In order to increase the readability of the map, the inventory of the types of discharges contained in each outfall may be kept as an attachment to the site map.

(b) Inventory of Exposed Materials—The storm water pollution prevention plan shall include, for each outfall, an inventory and narrative description of any significant materials that may still be at the site. The description and locations of the significant materials should be consistent with those shown on the site map. Findings of the inventory must be documented in detail in the pollution prevention plan. At a minimum, the plan must describe the method and location of onsite storage or disposal; practices used to minimize contact of materials with rainfall and runoff; existing structural and nonstructural controls that reduce pollutants in storm water runoff; existing structural controls that limit process wastewater discharges; and any treatment the runoff receives before it is discharged to surface waters or a separate storm sewer system.

(c) Risk Identification and Summary of Potential Pollutant Sources—The description of potential pollution sources culminates in a narrative assessment of the risk potential that sources of pollution pose to storm water quality. This assessment should clearly point to activities, materials, and physical features of the facility that have a reasonable potential to contribute significant amounts of pollutants to storm water. The assessment must list any significant pollution sources at the site and identify the pollutant parameter or parameters (i.e., total suspended solids, arsenic, etc.) associated with each source.

(4) Measures and Controls. Following completion of the source identification and assessment phase, the permittee must evaluate, select, and describe the pollution prevention measures, best management practices (BMPs), and other controls that will be implemented at the facility. The permittee must assess the applicability of the following BMPs for their site: discharge diversions, drainage/storm water conveyance systems, runoff dispersions, sediment control and collection mechanisms, vegetation/soil stabilization, capping of contaminated sources, and treatment of storm water discharges. In addition, BMPs include processes, procedures, schedules of activities, prohibitions on practices, and other management practices that prevent or reduce the discharge of pollutants in storm water runoff. EPA recognizes that inactive mine sites and abandoned mine sites will most likely require different storm water controls because the sources and types of contamination may vary. EPA notes that inactive facilities are not required to conduct inspections such as those described in Part XI.G.3.a.(4)(d) of the permit for active and temporarily inactive facilities. Inactive sites must, however, conduct comprehensive site compliance evaluations as discussed in paragraph (5) below.

The pollution prevention plan must discuss the reasons each selected control or practice is appropriate for the facility and how each will address the potential sources of storm water pollution. The plan also must include a schedule specifying the time or times during which each control or practice will be implemented. In addition, the plan should discuss ways in which the controls and practices relate to one another and, when taken as a whole, produce an integrated and consistent approach for preventing or controlling potential storm water contamination problems.

(5) Comprehensive Site Compliance Evaluation. Where annual site compliance evaluations are shown in the plan to be impractical for inactive mining sites due to the remote location and inaccessibility of the site, site evaluations required under this part shall be conducted at appropriate intervals specified in the plan, but, in no case less than once in 3 years.

6. Monitoring and Reporting Requirements

a. Analytical Monitoring Requirements. EPA believes that active copper ore mining facilities may reduce the level of pollutants in storm water runoff from their sites through the development and proper implementation of the storm water pollution prevention plan requirements discussed in today's permit. In order to provide a tool for evaluating the effectiveness of the pollution prevention plan and to characterize the discharge for potential environmental impacts, the permit requires active copper ore mining and dressing facilities to collect and analyze samples of their storm water discharges for the pollutants listed in Table G–5. The pollutants listed in Table G–5 were found to be above levels of concern for a significant portion of active copper ore mining and dressing facilities that submitted quantitative data in the group application process. Because these pollutants have been reported at levels of concern from active copper ore mining and dressing facilities, EPA is requiring monitoring after the pollution prevention plan has been implemented to assess the effectiveness of the pollution prevention plan and to help ensure that a reduction of pollutants is realized.

At a minimum, storm water discharges from active metal mining facilities must be monitored quarterly during the second year of permit coverage. Samples must be collected at least once in each of the following periods: January through March; April through June; July through September; and October through December. At the end of the second year of permit coverage, a facility must calculate the average concentration for each parameter listed in Table G–5. If the permittee collects more than four samples in this period, then they must calculate an average concentration for each pollutant of concern for all samples analyzed.

[56] Nonstructural features such as grass swales and vegetative buffer strips also should be shown.

[57] Significant materials include, "* * * but [are] not limited to: raw materials, fuels, materials such as solvents, detergents, and plastic pellets: finished materials such as metallic products; * * * hazardous substances designated under section 101(14) of CERCLA; any chemical facilities required to report pursuant to section 313 of title III of SARA; fertilizers; pesticides; and waste products such as ashes, slag, and sludge that have the potential to be released with storm water discharge" (40 CFR 122.26(b)(12)). Significant materials commonly found at mining facilities include: overburden; raw materials; waste rock piles; tailings; petroleum based products; solvents and detergents; heap leach pads; tailings piles/ponds, both proposed and existing; and manufactured products, waste materials or by-products used or created by the facility.

TABLE G–5.—INDUSTRY MONITORING REQUIREMENTS

Pollutants of concern	Cut-off concentration
Chemical Oxygen Demand (COD)	120 mg/L
Total Suspended Solids (TSS)	100 mg/L
Nitrate plus Nitrite Nitrogen	0.68 mg/L

If the average concentration for a parameter is less than or equal to the value listed in Table G–5, then the permittee is not required to conduct quantitative analysis for that parameter during the fourth year of the permit. If, however, the average concentration for a parameter is greater than the cut-off concentration listed in Table G–5, then the permittee is required to conduct quarterly monitoring for that parameter during the fourth year of permit coverage. Monitoring is not required during the first, third, and fifth year of the permit. The exclusion from monitoring in the fourth year of the permit is conditional on the facility maintaining industrial operations and BMPs that will ensure a quality of storm water discharges consistent with the average concentrations recorded during the second year of the permit.

TABLE G–6.—SCHEDULE OF MONITORING

2nd Year of Permit Coverage	• Conduct quarterly monitoring. • Calculate the average concentration for all parameters analyzed during this period. • If average concentration is greater than the value listed in Table G–5, then quarterly sampling is required during the fourth year of the permit. • If average concentration is less than or equal to the value listed in Table G–5, then no further sampling is required for that parameter.
4th Year of Permit Coverage.	• Conduct quarterly monitoring for any parameter where the average concentration in year 2 of the permit is greater than the value listed in Table G–5. • If industrial activities or the pollution prevention plan have been altered such that storm water discharges may be adversely affected, quarterly monitoring is required for all parameters of concern.

In cases where the average concentration of a parameter exceeds the cut-off concentration, EPA expects permittees to place special emphasis on methods for reducing the presence of those parameters in storm water discharges. Quarterly monitoring in the fourth year of the permit will reassess the effectiveness of the adjusted pollution prevention plan.

The monitoring cut off concentrations listed in Table G–5 are not numerical effluent limitations. These values represent a level of pollutant discharge which facilities may achieve through the implementation of pollution prevention plans. At least half of the facilities which submitted Part 2 data, reported concentrations greater than or equal to the values listed in Table G–5. Facilities that achieve average discharge concentrations which are less than or equal to the values in Table G–5 are not relieved from the pollution prevention plan requirements or any other requirements of the permit.

EPA realizes that if a facility is inactive and unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly chemical sampling.

b. Alternative Certification. Throughout today's permit, EPA has included monitoring requirements for facilities which the Agency believes have the potential for contributing significant levels of pollutants to storm water discharges. The alternative described below is necessary to ensure that monitoring requirements are only imposed on those facilities that do, in fact, have storm water discharges containing pollutants at concentrations of concern. EPA has determined that if materials and activities are not exposed to storm water at the site, then the potential for pollutants to contaminate storm water discharges does not warrant monitoring.

Therefore, a discharger is not subject to the monitoring requirements of this Part provided the discharger makes a certification for a given outfall, or on a pollutant-by-pollutant basis in lieu of the monitoring reports required under paragraph *c* below, under penalty of law, signed in accordance with Part VII.G. of the permit (Signatory Requirements), that material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, industrial machinery or operations, significant materials from past industrial activity, that are located in areas of the facility that are within the drainage area of the outfall are not presently exposed to storm water and will not be exposed to storm water for the certification period. Such certification must be retained in the storm water pollution prevention plan and submitted to EPA in accordance with Part VI.C. of this permit. In the case of certifying that a pollutant is not present, the permittee must submit the certification along with the monitoring reports required under paragraph (*b*) below. If the permittee cannot certify for an entire period, they must submit the date exposure was eliminated and any monitoring required up until that date. This certification option is not applicable to compliance monitoring requirements associated with effluent limitations. EPA does not expect facilities to be able to exercise this certification for indicator parameters, such as TSS and BOD.

c. Reporting Requirements. Permittees are required to submit all monitoring results obtained during the second and fourth year of permit coverage within 3 months of the conclusion of each year. For each outfall, one signed Discharge Monitoring Report form must be submitted to the Director per storm event sampled. For facilities conducting monitoring beyond the minimum quarterly requirements an additional Discharge Monitoring Report Form must be filed for each analysis.

d. Sample Type. All discharge data shall be reported for grab samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The required 72-hour storm event interval is waived where the preceding measurable storm event did not result in a measurable discharge from the facility. The required 72-hour storm event interval may also be waived where the permittee documents that less than a 72-hour interval is representative for local storm events during the season when sampling is being conducted. The grab sample shall be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable.

If storm water discharges associated with industrial activity commingle with process or nonprocess water, then where practicable permittees must attempt to sample the storm water discharge before it mixes with the non-storm water discharge.

e. Representative Discharge. When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may test the effluent of one such outfall and report that the quantitative data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluent. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

F. Visual Examination of Storm Water Quality. Metal mining facilities shall perform and document a visual examination of a storm water discharge associated with industrial activity from each outfall, except discharges exempted below. The examination of storm water quality must be conducted at least once in each of the following 3-month periods: January through March, April through June, July through September, and October through December. The examination shall be made during daylight hours unless there is insufficient rainfall or snow melt to produce a runoff event.

(1) Examinations shall be made of grab samples collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 1 hour) of when the runoff or snowmelt begins discharging. The examinations shall document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on the samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. Where practicable, the same individual should carry out the collection and examination of discharges for entire permit term.

(2) Visual examination reports must be maintained onsite in the storm water pollution prevention plan. The report shall include the examination date and time, examination personnel, the nature of the discharge (i.e., runoff or snow melt), visual quality of the storm water discharge (including observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution), and probable sources of any observed storm water contamination.

(3) When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may collect a sample of effluent of one of such outfalls and report that the examination data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

(4) When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the records of the visual examinations. Adverse weather conditions that may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(5) EPA realizes that if a facility is inactive and unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly visual examination.

EPA believes that this quick and simple assessment will allow the permittee to approximate the effectiveness of his/her plan on a regular basis at very little cost. Although the visual examination cannot assess the chemical properties of the storm water discharged from the site, the examination will provide meaningful results upon which the facility may act quickly. The frequency of this visual examination will also allow for timely adjustments to be made to the plan. If BMPs are performing ineffectively, corrective action must be implemented. A set of tracking or follow-up procedures must be used to ensure that appropriate actions are taken in response to the examinations. The visual examination is intended to be performed by members of the pollution prevention team. This hands-on examination will enhance the staff's understanding of the storm water problems on that site and the effects of the management practices that are included in the plan.

7. Numeric Effluent Limitations.

There are no numeric effluent limitations beyond those described in Part VI.B. of this permit.

H. Storm Water Discharges Associated With Industrial Activity From Coal Mines and Coal Mining-Related Facilities

1. Discharges Covered Under This Section

On November 16, 1990 (55 FR 47990), EPA promulgated the regulatory definition of "storm water associated with industrial activity." This definition includes point source discharges of storm water from eleven major categories of facilities, including: "* * * (iii) facilities classified as Standard Industrial Classification (SIC) codes 10 through 14 including active or inactive mining operations (except for areas of coal mining operations no longer meeting the definition of a reclamation area under 40 CFR 434.11(l) because the performance bond issued to the facility by the appropriate SMCRA authority has been released, or except for areas of noncoal mining operations which have been released from applicable State or Federal reclamation requirements after December 17, 1990) and oil and gas exploration, production, processing, or treatment operations, or storm water contaminated by contact with any overburden, raw material, intermediate products, finished products, by-products or waste products located on the site of such operations."

This section only covers storm water discharges associated with industrial activities from inactive[58] coal mines and from access roads, haul roads, and rail lines at active coal mines. Coal mines and coal mining-related facilities subject to requirements under this section include the following types of operations: bituminous coal and lignite surface mining (SIC 1221); bituminous coal underground mining (SIC 1222); anthracite mining (SIC 1231); and coal mining services (SIC 1241).

Storm water discharges authorized by this section include storm water discharges at inactive coal mines where precipitation and storm water runon come into contact with significant materials including, but not limited to, raw materials, waste products, and by-products, overburden, and stored materials. This section also authorizes storm water discharges from haul roads, access roads, and rail lines used or traveled by carriers of raw materials, manufactured products, waste materials, or by-products created by active coal mining facilities. The following activities are covered under this section:

Haul Roads—Nonpublic roads on which coal or coal refuse is conveyed
Access Roads—Nonpublic roads providing light vehicular traffic within the facility property and to public roadways
Railroad Spurs, Sidings, and Internal Haulage Lines—Rail lines used for hauling coal within the facility property and to offsite commercial railroad lines or loading areas
Conveyor Belts, Chutes, and Aerial Tramway Haulage Areas—Areas under and around coal or refuse conveyor areas, including transfer stations
Equipment Storage and Maintenance Yards
Coal Handling Buildings and Structures
Inactive Coal Mines and Related Areas—Abandoned and other inactive mines, refuse disposal sites and other mining-related areas. This includes abandoned mine sites being reclaimed under Title IV of the Surface Mining Control and Reclamation Act. Not covered by this section are discharges from sites, or parts of sites, which are determined to cause or contribute to water quality standards violations.

This section does not cover any discharge subject to effluent limitation guidelines. Discharges from active facilities and those under reclamation are subject to NPDES permits and require treatment to meet specific effluent guideline limits as specified in 40 CFR Part 434 for pH, iron, manganese, suspended solids, and settleable solids. Storm water that does not come into contact with any overburden, raw material, intermediate product, finished product, byproduct, or waste product located on the site of the operation are not subject to permitting under this section according to Section 402(l)(2) of the Clean Water Act.

This section also does not cover storm water discharges associated with industrial activity from inactive coal mines located on Federal lands, unless an operator can be identified. These discharges are not eligible because they are more appropriately covered under an NPDES permit currently being developed.

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

Coal is a black, primarily organic substance formed from compressed layers of decaying organic matter millions of years ago.[59] Factors such as the fixed carbon content, volatile matter fraction, and heating value, determine whether coal is classified as lignite, sub-bituminous, bituminous, or anthracite. The coal mining and related facilities industry extracts and processes coal. There are two methods of coal mining: surface mining and underground mining. Surface mining is a method utilized when the coal is close to the earth's surface and it is economically viable to remove and store the overburden, which can later be used for reclamation. Underground mining occurs when coal is too deep to be surface mined or environmental restrictions prohibit surface mining.

Coal preparation activities increase the value of coal by removing impurities through size reduction, screening, gravity separation, dewatering, and drying. After this step, coal is ready to be shipped for further processing. The impurities, including shales, clays, low reject coal, and possibly some acidic materials, are then conveyed to refuse disposal facilities.

These mining methods and coal preparation activities occur during the active phase of mining and are not authorized by this section nor are they included in the storm water regulation. Most areas at active mine sites are covered by the Surface Mining Control and Reclamation Act (SMCRA). Discharges from these areas are considered process wastewaters and are covered under a separate NPDES permit. Today's permit only addresses storm water discharges from coal mines and related areas that are not already subject to effluent limitation guidelines under 40 CFR Part 434. Storm water discharges not subject to the effluent limitation guidelines may include discharges from the following areas:

a. Access Roads, Haul Roads, and Rail Lines. Access roads, haul roads, and rail lines are used for the transportation of coal, refuse (waste materials, old equipment, etc.), and overburden away from the mine workings. To build access and haul roads, common land disturbing activities such as vegetation clearing and soil grading are necessary. Refuse coal and overburden may be used as a road base material. Road building activities increase the potential for the offsite discharge of sediment in storm water runoff. In addition, coal, overburden, and refuse materials may be spilled during loading and unloading operations and during the transport of such materials along access roads, haul roads, and rail spurs.

b. Inactive Mine Sites. Although industrial processes have ended at inactive mine sites, the significant materials associated with those

[58] Inactive mining operations are mining sites that are not being actively mined, but which have an identifiable owner/operator.

[59] "Development Document for Final Effluent Limitations Guideline, New Source Performance Standards, and Pretreatment Standards for the Coal Mining Point Source Category." EPA. 1982.

industrial processes may remain at the site and contaminate storm water discharges. The areas at inactive surface or underground coal mines which are included in the storm water regulation include former locations of: conveyor belts, chutes, and aerial tramways; equipment storage and maintenance yards; coal preparation plants; and coal handling buildings and storage areas.

Inactive mine sites are regulated because significant materials remain onsite. The significant materials include, but are not limited to: coal piles, including coal refuse piles; used and old equipment, including boneyards; overburden; waste disposal sites; and waste materials. In addition, in certain areas where machinery has been intensively used or abandoned, waste lubricating fluids, solvents, and contaminated soils may be present. These materials are typically present outdoors and are exposed to storm water discharges.

2. Pollutants Found in Storm Water Discharges

Impacts caused by storm water discharges from active haul roads, access roads and rail lines and inactive coal mine and coal mining-related facilities will vary. Several factors influence to what extent significant materials from coal mines and coal mining-related facilities may affect water quality. Such factors include: geographic location; hydrogeology; the type of coal extracted; the mineralogy of the extracted resource and the surrounding rock; how the coal was extracted; the type of industrial activities occurring onsite; the size of the operation; and type, duration, and intensity of precipitation events. Each of these, and other, factors will interact to influence the quantity and quality of storm water runoff. For example, overburden may be a significant source of pollutants at some facilities, while storage areas are a primary source at others. In addition, sources of pollutants other than storm water, such as illicit connections,[60] spills, and other improperly dumped materials, may increase the pollutant loads discharged into waters of the United States.

Storm water discharges from haul roads of active sites and inactive mine sites may include many of the pollutants common to active coal mining operations. These pollutants may include acids, suspended solids, dissolved solids, iron, manganese, and traces of other metals. Table H–1 indicates the pollutant sources and pollutants for a number of industrial activities for coal mines authorized by this section.

Another problem at coal mines is acid mine drainage. In general, the problems of acid mine drainage are confined to western Maryland, northern West Virginia, Pennsylvania, western Kentucky, and along the Illinois-Indiana border. Acid mine drainage is not a problem in the West because the coals and overburden contain little pyrite, the precursor for acid mine drainage, and because of low annual precipitation.

TABLE H–1.—ACTIVITIES, POLLUTANT SOURCES, AND POLLUTANTS

Activity	Pollutant source	Pollutant
Road and Rail Construction and Maintenance—Active Sites.	Surface grading and exposure of soils	Dust, TSS, TDS, turbidity, pH.
Raw or Waste Material Transportation.	Material spills	Dust, TSS, TDS, turbidity, pH, sulfates, iron.
Location of Mining and Processing Activities at Inactive Coal Mines.	Raw Material Storage	Dust, TSS, TDS, turbidity, pH sulfates, iron.
	Waste Rock Storage	Dust, TSS, TDS, turbidity, sulfates, iron, pH.
	Disposal Areas	Dust, TSS, TDS, turbidity, pH, oil & grease.
	Surface and Underground Mines	Dust, TSS, TDS, turbidity, pH, sulfates, iron.
	Materials Handling and Loading/Unloading	Dust, TSS, TDS, turbidity, pH, sulfates, iron.
Equipment/Vehicle Maintenance.	Fueling Activities	Diesel fuel, gasoline, oil, COD.
	Parts Cleaning	Solvents, oil, heavy metals, acid/alkaline wastes.
	Waste disposal of oily rags, oil and gas filters, batteries, coolants, degreasers.	Oil, heavy metals, solvents, acids, COD.
Reclamation Activities	Site preparation for stabilization	Dust, TSS, TDS, turbidity.

Based on the similarities of the facilities included in this sector in terms of industrial activities and significant materials, EPA believes it is appropriate to discuss the potential pollutants at coal mining facilities as a whole and not subdivide this sector. Therefore, Table H–2 lists data for selected parameters from facilities in the coal mining sector. These data include the eight pollutants that all facilities were required to monitor for under Form 2F, as well as the pollutants that EPA determined merit further monitoring.

TABLE H–2.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY COAL MINES AND COAL MINING-RELATED FACILITIES SUBMITTING PART II SAMPLING DATA[i] (mg/L)

Pollutant Sample type	No. of Facilities		No. of Samples		Mean		Minimum		Maximum		Median		95th percentile		99th percentile	
	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	16	7	19	8	3.1	3.5	0.0	0.0	9.0	17.4	3.0	1.0	15.0	14.4	33.1	33.9
COD	21	11	25	12	22.9	18.8	0.0	0.0	275.0	115.0	0.0	4.0	102.0	86.9	237.5	184.6
Nitrate + Nitrite Nitrogen	17	10	20	10	0.38	0.68	0.00	0.00	3.12	3.12	0.00	0.17	1.85	3.55	3.45	8.60
Total Kjeldahl Nitrogen	18	11	21	12	1.55	1.78	0.00	0.00	5.20	7.40	0.66	0.39	10.33	10.25	32.01	31.31
Oil & Grease	27	N/A	31	N/A	1.7	N/A	0.0	N/A	13.9	N/A	1.0	N/A	6.5	N/A	13.6	N/A
pH	29	N/A	33	N/A	N/A	N/A	5.9	N/A	8.9	N/A	7.0	N/A	8.6	N/A	9.3	N/A
Total Phosphorus	18	9	20	9	0.36	0.08	0.00	0.00	5.90	0.58	0.00	0.00	1.40	0.61	5.00	1.37

[60] Illicit connections are contributions of unpermitted non-storm water discharges to storm sewers from any number of sources including sanitary sewers, industrial facilities, commercial establishments, or residential dwellings. The probability of illicit connections at coal mines and coal mining related facilities is low yet it still may be applicable at some operations.

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TABLE H-2.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY COAL MINES AND COAL MINING-RELATED FACILITIES SUBMITTING PART II SAMPLING DATA [i] (mg/L)—Continued

Pollutant Sample type	No. of Facilities		No. of Samples		Mean		Minimum		Maximum		Median		95th percentile		99th percentile	
	Grab	Comp [ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
Total Suspended Solids	18	11	22	12	2551	462	0	2	33420	3880	7	131	3167	3011	23454	13634
Aluminum, Total	7	4	9	6	87.38	8.28	0.00	0.10	517.58	38.84	5.72	2.33	898.16	54.11	6089.45	198.54
Iron, Total	11	9	13	10	193.9	53.3	0.6	1.1	930.0	294.0	9.2	11.0	1639.1	284.0	9593.9	981.7

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.

[ii] Composite samples.

Storm water discharges from inactive and abandoned coal mines, preparation, refuse disposal sites, haul roads and other inactive mining-related areas may contain substantial amounts of pollutants without the benefits of sediment and erosion control measures. Sampling data in the EPA 1982 "Development Document for Effluent Guidelines and Standards for Coal Mining" reveal typical ranges for untreated mine drainage and are indicated in Table H-3. The data are based on untreated surface and underground drainage and may not be typical of inactive sites subject only to storm water runoff. For example, a high proportion of underground mines in the survey may have resulted in the relatively low median levels of suspended solids. However, it does indicate the potential array of conventional mining pollutants which could be present in abandoned mine drainage.

3. Options for Controlling Pollutants

Mining facilities are often dissimilar to other types of industrial facilities because they may be situated in remote locations, operate only seasonally or intermittently, yet need year-round storm water management controls. EPA believes that the most effective storm water management controls for limiting the offsite discharge of storm water pollutants from active and inactive coal mines are source reduction BMPs. Source reduction BMPs are methods by which discharges of contaminants are controlled with little or no required maintenance. Examples of these types of controls include diversion dikes, vegetative covers, and berms. Source reduction practices are typically (but not always) low in cost and relatively easy to implement. In some instances, more resource intensive treatment BMPs, including sedimentation ponds and infiltration trenches, may be necessary depending upon the type of discharge, types and concentrations of contaminants, and volume of flow.

The selection of the most effective BMPs will be based on site-specific considerations such as: facility size, climate, geographic location, hydrogeology and the environmental setting of each facility, and volume and type of discharge generated. Each facility will be unique in that the source, type, and volume of contaminated storm water discharges will differ. In addition, the fate and transport of pollutants in these discharges will vary. EPA believes that the management practices discussed herein are well suited mechanisms to prevent or control the contamination of storm water discharges associated with active and inactive coal mines.

BMPs that minimize erosion and sedimentation are effective for areas along haul and access roads, and for inactive mines. Many BMPs were not listed by part 1 group application participants because the major application submitted by the National Coal Association and the American Mining Congress was comprised of only active mine sites. The only portions of an active mine site to which this section of today's permit applies are haul roads, railways, and conveyor belts, chutes, and aerial tramway haulage areas. Because the scope of storm water program, as it applies to active coal mining sites, is limited, the applicants were not required to provide EPA with BMP data for process wastewater discharges. Furthermore, active surface mines are subject to 30 CFR Part 816 and active underground mines are subject to 30 CFR Part 817, both which require the implementation of BMPs.

Since many coal facilities are required to have BMPs, the data presented in part 1 of the application may underestimate the percentage of facilities with storm water BMPs.

Because BMPs described in the part I data are limited, EPA is providing an overview of supplementary BMPs for use by facility operators to determine appropriate BMPs for haul and access roads at active coal mines and for inactive coal mines. However, due to the site-specific nature of facilities within this sector, BMPs cited do not preclude the use of other viable BMP options. Table H-3 summarizes BMP options as they apply to land disturbance activities at active and inactive coal mining facilities. Sources of BMP information include: "Sediment and Erosion Control: An Inventory of Current Practices—Draft," EPA, April 20, 1990; "Storm Water Management for Industrial Activities: Developing Pollution Prevention Plans and Best Management Practices," EPA, September, 1992, (EPA 832-R-92-006); "Best Management Practices for Mining in Idaho," Idaho Department of Lands, November 1992; and "Erosion & Sediment Control Handbook," Goldman et al., McGraw-Hill Book Company, 1986.

TABLE H-3.—SUMMARY OF MINE AREAS AND APPLICABLE BEST MANAGEMENT PRACTICES

Land-disturbed area	Discharge diversions	Conveyance systems	Runoff dispersion	Sediment control & collection	Vegetation	Containment
Haul Roads and Access Roads.	Dikes, Curbs, Berms..	Channels, Gutters, Culverts, Rolling Dips, Road Sloping, Roadway Water Deflectors.	Check Dams, Rock Outlet Protection, Level Spreaders, Stream Alteration, Drop Structures.	Gabions, Riprap, Native Rock Retaining Walls, Straw Bale Barriers, Sediment Traps/Catch Basins, Vegetated Buffer Strips.	Seeding, Willow Cutting Establishment.	

TABLE H–3.—SUMMARY OF MINE AREAS AND APPLICABLE BEST MANAGEMENT PRACTICES—Continued

Land-disturbed area	Discharge diversions	Conveyance systems	Runoff dispersion	Sediment control & collection	Vegetation	Containment
Pits/Quarries or Underground Mines.	Dikes, Curbs, Berms.	Channels, Gutters	Serrated Slopes, Benched Slopes, Contouring, Stream Alteration.	Sediment Settling Ponds, Straw Bale Barrier, Siltation Berms.	Seeding	Plugging and Grouting.
Overburden, Waste Rock and Raw Material Piles.	Dikes, Curbs, Berms.	Channels, Gutters	Serrated Slopes, Benched Slopes, Contouring, Stream Alteration.	Plastic Matting, Plastic Netting, Erosion Control Blankets, Mulch-straw, Compaction, Sediment/Settling Ponds, Silt Fences, Siltation Berms.	Topsoiling, Seedbed Preparation, Seeding.	Capping.
Reclamation	Dikes, Curbs, Berms.	Channels, Gutters	Check Dams, Rock Outlet Protection, Level Spreaders, Serrated Slopes, Benched Slopes, Contouring, Drain Fields, Stream Alteration, Drop Structures.	Gabions, Riprap, and Native Rock Retaining Walls, Biotechnical Stabilization, Straw Bale Barriers, Sediment Traps/Catch Basins, Vegetative Buffer Strips, Silt Fences, Siltation Berms, Brush Sediment Barriers.	Topsoiling, Seedbed Preparation, Seeding, Willow Cutting Establishment.	Capping, Plugging and Grouting.

Haul Roads and Access Roads—Placement of haul roads or access roads should occur as far as possible from natural drainage areas, lakes, ponds, wetlands or floodplains where soil will naturally be less stable for heavy vehicle traffic. If a haul road must be constructed near water, as little vegetation as possible should be removed from between the road and the waterway, as vegetation is a useful buffer against erosion and is an efficient sediment collection mechanism. The width and grade of haul or access roads should be minimal and should be designed to match natural contours of the area. Construction of haul roads should be supplemented by BMPs that divert runoff from road surfaces, minimize erosion, and direct flow to appropriate channels for discharge to treatment areas. Existing haul roads and nearby ditches, without BMPs, can be altered or modified to accommodate the construction of BMPs.

Surface Mines—BMPs can be used to control total suspended solids levels in runoff from unvegetated areas. These can include sediment/settling ponds, check dams, silt fences, and straw bale barriers.

Overburden, Waste Rock, and Raw Material Piles—Overburden, topsoil, and waste rock should be stabilized, recontoured if necessary, and vegetated. In addition surface waters and other sources of water should be diverted around the piles. As many piles as possible should be revegetated (even if only on a temporary basis).

Reclamation Activities—When a coal seam is depleted and operations cease, a mine site must be reclaimed according to appropriate State or Federal standards. Closure activities typically include restabilization of any disturbed areas such as access or haul roads, pits or quarries, sedimentation ponds or work-out pits, and any remaining waste piles. Overburden and topsoil stockpiles may be used to fill in a pit or quarry (where practical.) Recontouring and vegetation should be performed to stabilize soils and prevent erosion.

Major reclamation activities such as recontouring roads and filling in a pit or quarry can only be performed after operations have ceased. However, reclamation activities such as stabilization of banks, and reseeding and revegetation should be implemented in mined out portions, or inactive areas of a site as active mining moves to new areas.

The following seven categories describe best management practice options for reducing pollutants in storm water discharges from haul and access roads for active coal mines and for inactive mines: discharge diversions; drainage/storm water conveyance systems; runoff dispersion; sediment control and collection; vegetation/soil stabilization; capping of contaminated sources; and treatment.

a. Discharge Diversions. Discharge diversions provide the first line of defense in preventing the contamination of discharges, and subsequent contamination of receiving waters of the United States. Discharge diversions are temporary or permanent structures installed to divert flow, store flow, or limit storm water runon and runoff.

These diversion practices have several objectives. First, diversion structures can be designed to prevent otherwise uncontaminated (or less contaminated) water from crossing disturbed areas or areas containing significant amounts of contaminated materials, where contact may occur between runon and significant materials. These source reduction measures may be particularly effective for inactive coal mine sites because they prevent runon of uncontaminated discharges from contacting exposed materials and/or reduce the flow across disturbed areas, thereby lessening the potential for erosion. Second, diversion structures can be used to collect or divert waters for later treatment, if necessary. The usefulness of these control measures are limited by such factors as the size of the area to be controlled and the type and nature of materials exposed and precipitation events.

Diversion dikes, curbs, and berms are temporary or permanent diversion structures that prevent runoff from passing beyond a certain point, and divert runoff away from its intended path. Dikes, curbs or berms may be used to surround and isolate areas of concern, diverting flow around piles of overburden, waste rock, and storage areas, to minimize discharge contact with contaminated materials and to limit discharges of contaminated water from confined areas.

b. Drainage/Storm Water Conveyance Systems. Drainage or storm water conveyance systems can provide either a temporary or a permanent management practice which functions to channel water away from eroded or unstabilized areas, convey runoff without causing erosion, and/or carry discharges to more stabilized areas. The use of drainage systems as a permanent measure may be most appropriate in areas with extreme slopes, areas subject to high velocity runoff, and other areas where the establishment of substantial vegetation is infeasible or impractical. For instance, several BMPs described below may be useful storm water and erosion control methods applicable to haul roads and access roads.

Channels or Gutters—Channels or gutters collect storm water runoff and direct its flow. Like diversion systems, channels or gutters may act to divert runoff away from a potential source of contamination, but may also be used to channel runoff to a collection and/or treatment area including settling ponds, basins or work-out pits.

Open Top Box Culverts, and Waterbars—These structures are temporary or permanent structures that divert water from a roadway surface. Open top box culverts may be used on steeply graded, unpaved roads in place of pipe culverts to divert surface runoff and flow from inside ditches onto the downhill slope of a road. These structures are typically made of wood and should periodically be monitored and repaired if necessary.

Waterbars are berms built by a dozer, or by hand, to a one to two foot height. They serve to extend the entire width of the road, with a downslope angle between 30 and 40 percent. Waterbars are kept open at a discharge end to allow water to flow away from the road, and require little maintenance. These berms may be used as temporary or permanent structures.

Rolling Dips and Road Sloping—Rolling dips and road sloping are permanent water diversion techniques installed using natural contours of the land during road construction. These BMPs prevent water accumulation on road surfaces and divert surface runoff toward road ditches, which then convey the storm water to ponds or other management areas.

Roadway Surface Water Deflector—A roadway surface water deflector is another technique to prevent accumulation of water on road surfaces. The structure uses a conveyor belt sandwiched between two pieces of treated wood and placed within the road to deflect water. This is a useful technique for steeply graded, unpaved roads.

Culverts—Culverts are permanent surface water diversion mechanisms used to convey water off of, or underneath a road. Made of corrugated metal, they must extend across the entire width of the road, and beyond the fill slope. Additional erosion control mechanisms may need to be installed at the discharge end of the culvert.

c. Runoff Dispersion. Drainage systems are most effective when used in conjunction with runoff dispersion devices designed to slow the flow of water discharged from a site. These devices also aid storm water infiltration into the soil and flow attenuation. Some examples of velocity dissipation devices include check dams, rock outlet protection, level spreaders, and serrated and benched slopes.

Check Dams—Check dams are small temporary dams constructed across swales or drainage ditches to reduce the velocity of runoff flows, thereby reducing erosion and failure of the swale or ditch. This slowing reduces erosion and gullying in the channel and allows sediments to settle.

Check dams may be installed in small temporary or permanent channels where vegetation of the channel lining is not feasible and where there is danger of erosion. These may be areas where installation of nonerosive liners are not cost effective.

Check dams diminish the need for more stringent erosion control practices in the drainage ditch since they decrease runoff velocity. When constructing check dams, the use of overburden or waste rock should be avoided where there is the potential for contamination.

Rock Outlet Protection—Rock protection placed at the outlet end of culverts, channels, or ditches reduces the depth, velocity, and destructive energy of water such that the flow will not erode the downstream reach. The use of some materials (e.g., mine waste rock or ore) should be avoided where contamination may occur. As with check dams, rock outlet protection may also be used as a source reduction treatment mechanism by using rocks containing limestone or other alkaline materials to neutralize acidic discharges.

Level Spreaders—Level spreaders are outlets for dikes and diversions consisting of an excavated depression constructed at zero grade across a slope. Level spreaders diffuse storm water point sources and release it onto areas stabilized by existing vegetation.

Serrated Slopes and Benched Slopes—These runoff dispersion methods break up flow of runoff from a slope, decreasing its ability to erode. Serrated and benched slopes provide flat areas that allow water to infiltrate, and space for vegetation to grow and reinforce soils. Serrated slopes are equipped with small steps, from one to two feet of horizontal surface exposed on each step. Benched slopes have larger steps, with vertical cuts between two and four feet high.

Contouring—Surface contouring is the establishment of a rough soil surface amenable to revegetation, through creating horizontal grooves, depressions, or steps that run with the contour of the land. Slopes may also be left in a roughened condition to reduce discharge flow and promote infiltration. Surface roughening aids in the establishment of vegetative cover by reducing runoff velocity and giving seed an opportunity to take hold and grow. This technique is appropriate for all slopes steeper than 3:1 in order to facilitate stabilization of the slope and promote the growth of a vegetative cover. Once areas have been contoured, they should be seeded as quickly as possible.

Drain Fields—Drain fields are used to prevent the accumulation of water and/or ground water at a site, by diverting infiltrating sources through gravity flow or pumping. Typically filled with porous, permeable materials such as graded rock, or perforated pipe, and lined with geotextile fabric, these mechanisms are useful underneath significant materials, reducing the amount of water that ultimately comes into contact with significant materials.

Stream Alteration—Altering or channelizing the path of a stream to bypass all or some disturbed areas on a site, allows additional mining activities, and avoids contamination of stream water by disturbed lands. This practice is complicated, however, by the need to restore the channel when mining operations end.

Drop Structures—Drop structures are large angular rocks placed in a V-shaped pattern to slow the velocity of storm water runoff. These structures are typically reinforced by logs or large rocks imbedded in the streambanks.

d. Sediment Control and Collection. Sediment control and collection limits movement and retains sediments from being transported offsite. Several structural collection devices have been developed to remove sediment from runoff before it leaves the site. Several methods of removing sediment from site runoff involve diversion mechanisms previously discussed, supplemented by a trapping or storage device. Structural practices typically involve filtering diffuse storm water flows through temporary structures such as straw bale dikes, silt fences, brush barriers or vegetated areas.

Structural practices are typically low in cost. However, structural practices require periodic removal of sediment to remain functional. As such, they may not be appropriate for permanent use at inactive mines. However, these practices may be effectively used as temporary measures along haul roads and access roads.

Plastic Matting, Plastic Netting, and Erosion Control Blankets—These BMPs are used to protect bare soils to control dust and erosion. Mats and blankets help to promote vegetative growth by maintaining moisture and heat within the soil. Plastic matting and netting improve slope stabilization and may be used as a permanent treatment to encourage grass growth. Plastic netting is a more effective material to use while promoting growth of vegetation as it permits sunlight to penetrate through to the soils. Erosion control blankets also stabilize slopes, and control erosion. These blankets may be made of jute, or plastic netting, but are more expensive than straw.

Mulch-straw or Wood Chips—Mulches and wood chips are useful temporary covers for bare or seeded soils, with an erosion control effectiveness rating of 75 to 98 percent.[61] Like matting, mulch-straw or wood chips help soils retain moisture and warmth to promote vegetative growth. Used on slopes and/or in combination with nylon netting, these materials may prevent erosion by wind and water. Over time, however, the mulch cover will decrease in effectiveness.

Compaction—Soil compaction using a roller or other heavy equipment increases soil "strength" by increasing its density. More dense soil is less prone to erosion and long-term soil settlement. The surface of compacted soils should be roughed and seeded or vegetated to increase its durability.

Sediment/Settling Ponds—Sediment ponds function as sediment traps by containing runoff for long periods of time, allowing suspended solids to settle. These structures can achieve a high removal rate of sediment for both process wastewater and storm water discharges. Sediment/settling ponds are easily constructed and require minimal maintenance. Their flexibility to treat both process wastewater and storm water makes the use of ponds a desirable treatment for discharges from ore mining and dressing facilities. Of course, site characteristics must be such that some or all discharges can be practically channeled to a centralized area for treatment. Where this is not practical, the cost of constructing multiple sediment ponds may become prohibitive. In addition, periodic dredging may be required in order to maintain the capacity of these ponds.

Discharge ponds may also be designed to act as surge ponds which are designed to contain storm surges and then completely drain in about 24 to 40 hours, and remain dry during times of no rainfall. They can provide pollutant removal efficiencies that are similar to those of detention ponds.[62] Storm surge ponds are typically designed to provide both water quality and water quantity (flood control) benefits.

Gabions, Riprap, and Native Rock Retaining Walls—These BMPs are all forms of slope stabilization. Gabions consist of rocks (riprap) contained by rectangular wire boxes or baskets for use as permanent erosion control structures. Riprap consists of loose rocks placed along embankments to prevent erosion. Native rock retaining walls are another form of slope stabilization, with walls up to five feet in height, constructed from native rock to reinforce a steep slope.

Biotechnical Stabilization—Biotechnical stabilization uses live brush imbedded in the soils of a steep slope to prevent erosion. This method relies on the premise that the imbedded vegetation will eventually take root and help stabilize the slope.

Straw Bale Barrier—Straw bales may be used as temporary berms, barriers, or diversions, capturing sediments and filtering runoff. When installed and maintained properly, these barriers remove approximately 67 percent of the sediment load.[63] These barriers are applicable across small swales, in ditches, and at the toe of bare slopes where there is a temporary, large volume of sediment laden runoff.

Sediment Traps or Catch Basins—These temporary or permanent structures are useful for catching and storing sediment laden storm water runoff and are particularly useful during construction activities to contain runoff. The effectiveness of these BMPs is better in smaller drainage basin areas. Sediment traps are less than 50 percent effective in removing sediment from storm water runoff.[64]

Vegetated Buffer Strips—The installation of vegetated buffer strips will reduce runoff and prevent erosion at a removal efficiency rate of 75 to 99 percent depending upon the ground cover.[65] In addition, vegetated buffer strips catch and settle sediment contained in the storm water runoff prior to reaching receiving waters.

Silt Fence/Filter Fence—A low fence made of filter fabric, wire and steel posts, should be used on small ephemeral drainage areas where storm water collects or leaves a mine site. Silt fences remove 97 percent of the sediment load and are easier to maintain and remove without creating lasting impacts to the environment.[66] Silt and filter fences need to be inspected periodically, and may not be as effective as straw bales, since fabric may become clogged with fine particles preventing water flow.

Silt fences may have limited applicability for large areas: they are most effective for use in small drainage areas. These fences may also be used in conjunction with nonstructural practices to maintain the integrity of soil prior to the establishment of vegetation.

Siltation Berms—Siltation berms are typically placed on the downslope side of a disturbed area to act as an impermeable barrier for the capture and

[61] "Sediment and Erosion Control: An Inventory of Current Practices—Draft," EPA, April 20, 1990.

[62] "Urban Targeting and BMP Selection," EPA, Region V, November 1990.

[63] "Sediment and Erosion Control: An Inventory of Current Practices—Draft," EPA, April 20, 1990, page IV–74.

[64] "Sediment and Erosion Control: An Inventory of Current Practices—Draft," EPA, April 20, 1990, page IV–26.

[65] "Sediment and Erosion Control: An Inventory of Current Practices—Draft," EPA, April 20, 1990, page IV–7.

[66] "Sediment and Erosion Control: An Inventory of Current Practices—Draft," EPA, April 20, 1990, page IV–75.

retention of sediments in surface water runoff. Plastic sheeting is typically used to cover the berm. The berm and the plastic sheeting may require periodic maintenance and repair.

Brush Sediment Barriers—Brush barriers are temporary sediment barriers composed of tree limbs, weeds, vines, root mat, soil, rock and other cleared materials placed at the toe of a slope. A brush barrier is effective only for small drainage areas, usually less than ¼ acre, where the slope is minimal.

Brush barriers do not function as permanent barriers since over time the barrier itself will degrade. This BMP is most effective when located at the toe of a slope of an area in which vegetation is being grown or during temporary operations. The brush barriers remove any excessive sediment which is generated by erosion prior to the establishment of vegetation.

e. Vegetation Practices. Vegetation practices involve establishing a sustainable ground cover by permanent seeding, mulching, sodding, and other such practices. A vegetative cover reduces the potential for erosion of a site by: absorbing the kinetic energy of raindrops which would otherwise impact soil; intercepting water so it can infiltrate into the ground instead of running off and carrying contaminated discharges; and by slowing the velocity of runoff to promote onsite deposition of sediment. Vegetative controls are often the most important measures taken to prevent offsite sediment movement, and can provide a six-fold reduction in the discharge of suspended sediment levels.[67] Permanent seeding has been found to be 99 percent effective in controlling erosion for disturbed land areas.[68]

Typically, the costs of vegetative controls are low relative to other discharge mitigation practices. Given the limited capacity to accept large volumes of runoff, and potential erosion problems associated with large concentrated flows, vegetative controls should typically be used in combination with other management practices. These measures have been documented as particularly appropriate for mining sites.

Topsoiling, Seedbed Preparation—The addition of a layer of topsoil or plant growth material provides an improved soil medium for plant growth. Seedbed preparation may include the addition of topsoil ingredients to be mixed in with soils used for seedbed preparation. Ripping, dicing, and mixing soils promotes weed control and aerates the soil, encouraging seedling growth.

Broadcast Seeding and Drill Seeding—Seeding and vegetative planting are methods used to revegetate an area. Broadcast seeding spreads seeds uniformly, by hand or machine, to steep sloped or rocky areas, flat surfaces, and areas with limited access. Drill seeding is performed using a rangeland drill seeder and may not be used on rocky surfaces. Drill seeding is more suitably performed on flat, nonrocky surfaces, where the machine can insert seeds into the soil.

Willow Cutting Establishment—Willow cutting establishment describes a method of soil stabilization useful for stream banks and other areas located adjacent to water. Similar to biotechnical stabilization, willow cuttings are used to promote growth in an area needing stabilization. Willow cuttings are typically used to reinforce a streambank or other moist area. Willow cuttings require a great deal of moisture and must be planted in areas that remain moist for long periods in order to take hold and grow.

F. Capping. In some cases, the elimination of a pollution source through capping contaminant sources may be the most cost effective control measure for some discharges from inactive coal mines. Depending on the type of management practices chosen the cost to eliminate the pollutant source may be very high. Once completed, however, maintenance costs will range from low to nonexistent.

Capping or sealing of waste materials is designed to prevent infiltration, as well as to limit contact between discharges and potential sources of contamination. Ultimately, capping should reduce or eliminate the contaminants in discharges. In addition, by reducing infiltration, the potential for seepage and leachate generation may also be lessened.

The use of this practice depends on the level of control desired, the materials available, and cost considerations. Many common liners may be effective including common soil, clay, and/or synthetic liners. Generally, soil liners will provide appreciable control for the lowest cost. Synthetic or clay liners may be appropriate to cover materials known to have a significant potential to impact water quality.

EPA has identified a wide variety of best management practices (BMPs) that may be used to mitigate discharges of contaminants at coal mines. Many of the practices focus on sediment and erosion control and are similar to BMPs used in the construction industry. For more details on the use and implementation of these practices the reader is encouraged to obtain a copy of one or more of the many good sediment and erosion control books available on the market.[69] In some cases (e.g., low pH and/or high metals concentrations), BMPs, and sediment and erosion controls may not be adequate to produce an acceptable quality of storm water discharge. Under those circumstances additional physical or chemical treatment systems may be necessary to protect the receiving waters.

g. Treatment. Treatment practices are those methods of control which are normally used to reduce the concentration of pollutants in water before it is discharged. This is in contrast to many BMPs where the emphasis is on keeping the water from becoming contaminated. Treatment practices may be required where flows are currently being affected by exposed materials and where other BMPs are insufficient to meet discharge goals. These practices are usually the most resource intensive as they often entail significant construction costs and require monitoring and maintenance on a frequent and regular basis. Treatment options may range from high maintenance controls to low maintenance. High maintenance treatment techniques require periodic manpower to operate and maintain the BMP. Low maintenance cost techniques have initial capital costs but operate with little long-term maintenance after they are implemented. At a few sites, treatment measures other than high maintenance measures may be appropriate to address specific pollutants.

Chemical/Physical Treatment—An example of a high maintenance technology that is found at coal mining facilities is chemical/physical treatment. The most common type of chemical/physical treatment involves the addition of limestone to reduce the acidity of the discharge and/or precipitate metals. Metals may be removed from wastewater by raising the pH of the wastewater to precipitate them out as hydroxides. Typically, the pH of the wastewater must be raised to 9 to 12 standard units in order to achieve the

[67] "Performance of Current Sediment Control Measures at Maryland Construction Sites," January 1990, Metropolitan Washington Council of Governments, page X.

[68] "Sediment and Erosion Control: An Inventory of Current Practices—Draft," EPA, April 20, 1990, page IV–4.

[69] "Best Management Practices for Mining in Idaho," Idaho Department of State Lands, November 1992; "Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices," EPA, September 1992, (EPA 832–R–92–005); and "Erosion & Sediment Control Handbook," Goldman et al., McGraw-Hill Book Company, 1986.

desired precipitation of metals. After metals precipitation, the addition of some form of acid or carbon dioxide may be required to reduce the pH to acceptable levels. Polymer addition may be required to enhance the settling characteristics of the metal hydroxide precipitate. In general, this practice requires significant operator participation to ensure proper neutralization and/or precipitation and thus may not be cost effective for most storm water discharges.

Artificial Wetlands—This type of BMP system is gaining popularity as a method of treating process wastewater from inactive coal mines. They can be an effective system for improving water quality either alone or in conjunction with other treatment practices. The complex hydrologic, biological, physical, and chemical interactions that take place within a wetland result in a natural reduction and cleansing of influent pollutants. Wetland processes are able to filter sediments, and absorb and retain chemical and heavy metal pollutants through biological degradation, transformation, and plant uptake.

Artificial wetlands are designed to maintain a permanent pool of water. Properly installed and maintained retention structures (also known as wet ponds) and artificial wetlands will be most cost-effective when used to control runoff from larger, intensively developed sites. These artificial wetlands are created to provide treatment but also provide a wildlife habitat, and enhance recreation and landscape amenities. Artificial wetlands are being intensely researched by the Bureau of Mines as a means of mitigating acid mine drainage.

EPA strongly discourages the use of natural wetlands as part of the treatment system because they are considered to be waters of the United States. The necessary controls, or BMPs, must be provided prior to discharging the storm water runoff to natural wetlands or other receiving waters.

In summary, a wide variety of BMPs are available for inactive coal mines and for use along haul roads and access roads at active coal mines. These measures range from simple low cost, low maintenance source reduction practices such as diversion structures to high cost, maintenance intensive practices such as wetlands treatment. Clearly, the selection of a practice or group of practices will be site-specific depending on conditions and potential impacts as well as the resources available at each site. A specific best available technology (or technologies) cannot be determined because of the differences between sites and the quantities and characteristics of their discharges.

4. Storm Water Pollution Prevention Plan Requirements

Specific requirements for the pollution prevention plan for coal mines and coal mining related facilities are described below. These requirements must be implemented in addition to the common pollution plan provisions described in Section VI.C. of this fact sheet.

a. Contents of the Plan. Under the description of potential pollutant sources section, all coal mining and related facilities are required to describe all potential pollutant sources and provide the locations of these sources.

(1) A site map, such as a drainage map required for SMCRA permits, must indicate drainage areas and storm water outfalls from the potential pollutant sources as indicated in item 1 above. The map should provide, but not be limited to, the following information:

(a) Drainage direction and discharge points from all applicable mining-related areas, including culvert and sump discharges from roads and rail beds and also from equipment and vehicle maintenance areas, lubricants and other potentially harmful liquids
(b) Location of each existing erosion and sedimentation control structure and other control measures for reducing pollutants in storm water runoff
(c) Receiving streams or other surface water bodies
(d) Locations exposed to precipitation which contain acidic or metal ladened spoil, refuse, or unreclaimed disturbed areas
(e) Locations where major spills or leaks of toxic or hazardous pollutants have occurred
(f) Locations where liquid storage tanks containing potential pollutants, such as caustics, hydraulic fluids and lubricants, are exposed to precipitation
(g) Locations where fueling stations, vehicle and equipment maintenance areas are exposed to precipitation

The site map must also indicate the outfall locations and the types of discharges contained in the drainage areas of the outfalls (e.g. storm water and air conditioner condensate). In order to increase the readability of the map, the inventory of the types of discharges contained in each outfall may be kept as an attachment to the site map.

Under the measures and controls section, operators of the inactive and active coal mines are required to describe storm water management controls for coal mining-related facilities, including the following:

(2) Compliance with SMCRA Requirements. The Surface Mining Control and Reclamation Act (SMCRA) regulations require sediment and erosion control measures and practices for haul roads and most of the other active mining-related areas covered by this section. All such SMCRA requirements are also requirements of the pollution prevention plan and other applicable conditions of this section.

(3) Good Housekeeping Practices. The purpose of good housekeeping practices is to remove or lessen the potential pollution sources before they come into contact with storm water. This includes collection and removal of waste oils collected in traps; cleaning up exposed maintenance areas of spilled lubricants and fuels, and similar measures; and preventing the offsite movement of dust by sweeping or by road watering.

(4) Preventive Maintenance. A timely maintenance program should include: inspections for preventing breakdowns, corrosion of tanks and deterioration of pressure fuel or slurry pressure lines; periodic removal and disposal of accumulated solids in sediment traps; and replacement of straw bales and other control measures subject to weathering and deterioration.

(5) Inspections. For all SMCRA regulated active mining-related sites, which include most of the active facilities under this section, SMCRA authorities are required to conduct regular quarterly inspections. Coordinated inspections by the facility representative would be expected to take place either before, during or after the complete SMCRA inspections. Therefore, inspections by the facility representative would not be placing an undue burden on the facility. In addition, sediment and erosion control measures should be evaluated at least once yearly during a storm period of at least 0.1 inch rainfall where effectiveness can be evaluated first hand. Observations should also be made at this time of resulting impact of any settled solids in the receiving stream.

Inactive coal mines should be inspected at least once yearly, except where very remote, to maintain an appraisal of sediment and erosion control measures, determine outstanding problem areas, and plan for improved measures.

(6) Employee Training. There are no employee training requirements beyond those described in Section VI.C.

(7) Prohibition of Non-storm Water Discharges. Many inactive mines and portions of inactive mines are

abandoned underground mines which have seeps or other discharges which are not in response to storm events. These type discharges from inactive mines are not covered by this section. In addition, floor drains from maintenance buildings and other similar drains in mining and preparation plant areas may contain contaminants and are prohibited from inclusion in this section.

(8) Sediment, Erosion and Flow Management Controls. The plan must describe all sediment, erosion, and flow management controls used to control storm water discharges. The plan should also address the reasonableness and appropriateness of each sediment, erosion, and flow management control, and identify when they are required by State or Federal SMCRA regulations. For the most part, these measures are best management practices expected of construction and other activities which are subject to storm runoff. However, construction activities are usually much more short term than mining activities, so greater emphasis must be placed on implementing long term measures for haul roads and other mining-related facilities.

b. Comprehensive Site Compliance Evaluation. In addition to the comprehensive site compliance evaluation described in Section VI.C.4. of this fact sheet, the plan must be implemented and, where erosion control and pollution prevention measures described in the plan are found deficient, the plan must be revised to include reasonable and appropriate control measures. Reports including observations and incidences of noncompliance must be prepared and kept on file for possible review.

5. Numeric Effluent Limitation

Based on the lack of sampling data, it is infeasible for EPA to calculate effluent limitations at this time. The main pollutant concern is excess solids runoff and discharge, but there are no widely accepted solids limits which could be expected from the recommended sediment and erosion control measures. The 0.5 ml/L settleable solids limit, as required by 40 CFR Part 434 for storm discharges from surface mine settling ponds, can be considered a goal but not a requirement for control measures, which for the most part, consist of sediment ditches, straw bales and similar structures normally used for haul roads. The permit does not cover facilities that are in violation of water quality standards and where water quality-based effluent limits apply.

6. Monitoring and Reporting Requirements

a. Monitoring Requirements. EPA believes that coal mining facilities may reduce the level of pollutants in storm water runoff from their sites through the development and proper implementation of the storm water pollution prevention plan requirements discussed in today's permit. In order to provide a tool for evaluating the effectiveness of the pollution prevention plan and to characterize the discharge for potential environmental impacts, Table H–4 lists the pollutants that coal mining facilities are required to collect and analyze in their storm water discharges. The pollutants listed in Table H–4 were found to be above levels of concern for a significant portion of coal mining facilities that submitted quantitative data in the group application process. Because these pollutants have been reported at benchmark levels from coal mining facilities, EPA is requiring monitoring after the pollution prevention plan has been implemented to assess the effectiveness of the pollution prevention plan and to help ensure that a reduction of pollutants is realized.

Permittees can exercise the alternative certification on a pollutant-by-pollutant basis as described under Section (1) below. Any pollutant(s) for which the facility is unable to certify to no exposure must, at a minimum, monitor storm water discharges from coal mining facilities on a quarterly basis during the second year of permit coverage. Monitoring must be performed during the following periods: January through March; April through June; July through September; and October through December. At the end of the second year of permit coverage, a facility must calculate the average concentration for each parameter listed in Table H–4. If the permittee collects more than four samples in this period, then they must calculate an average concentration for each pollutant of concern for all samples analyzed.

TABLE H–4.—MONITORING REQUIREMENTS COAL MINING FACILITIES MG/L

Pollutants of concern	Monitoring cut-off concentration
Total Recoverable Aluminum	0.75 mg/L
Total Recoverable Iron	1.0 mg/L
Total Suspended Solids (TSS)	100 mg/L

If the average concentration for a parameter is less than or equal to the appropriate cut-off concentration, then the permittee is not required to conduct quantitative analysis for that parameter during the fourth year of the permit. If, however, the average concentration for a parameter is greater than the cut-off concentration listed in Table H–4, then the permittee is required to conduct quarterly monitoring for that parameter during the fourth year of permit coverage. Monitoring is not required during the first, third, and fifth year of the permit. The exclusion from monitoring in the fourth year of the permit is conditional on the facility maintaining industrial operations and BMPs that will ensure a quality of storm water discharges consistent with the average concentrations recorded during the second year of the permit. The schedule for monitoring is presented in Table H–5.

TABLE H–5.—SCHEDULE OF MONITORING

2nd Year of Permit Coverage	• Conduct quarterly monitoring. • Calculate the average concentration for all parameters analyzed during this period. • If average concentration is greater than the value listed in Table H–4, then quarterly sampling is required during the fourth year of the permit. • If average concentration is less than or equal to the value listed in Table H–4, then no further sampling is required for that parameter.

TABLE H-5.—SCHEDULE OF MONITORING—Continued

4th Year of Permit Coverage	• Conduct quarterly monitoring for any parameter where the average concentration in year 2 of the permit is greater than the value listed in Table H-4. • If industrial activities or the pollution prevention plan have been altered such that storm water discharges may be adversely affected, quarterly monitoring is required for all parameters of concern.

In cases where the average concentration of a parameter exceeds the cut-off concentration, EPA expects permittees to place special emphasis on methods for reducing the presence of those parameters in storm water discharges. Quarterly monitoring in the fourth year of the permit will be used to reassess the effectiveness of the adjusted pollution prevention plan.

The monitoring cut-off concentrations listed in Table H-4 are not numerical effluent limitations. These values represent a level of pollutant discharge which facilities may achieve through the implementation of pollution prevention plans. At least half of the facilities which submitted Part 2 data reported concentrations greater than or equal to the values listed in Table H-4. Facilities that achieve average discharge concentrations which are less than or equal to the appropriate cut-off concentration values are not relieved from the pollution prevention plan requirements or any other requirements of the permit.

EPA realizes that if a facility is inactive and unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly chemical sampling.

(1) Alternative Certification. Throughout today's permit, EPA has included monitoring requirements for facilities which the Agency believes have the potential for contributing significant levels of pollutants to storm water discharges. The alternative certification described below is necessary to ensure that monitoring requirements are only imposed on those facilities that do, in fact, have storm water discharges containing pollutants at concentrations of concern. EPA has determined that if materials and activities are not exposed to storm water at the site, then the potential for pollutants to contaminate storm water discharges does not warrant monitoring.

Therefore, a discharger is not subject to the monitoring requirements of this Part provided the discharger makes a certification for a given outfall or on a pollutant-by-pollutant basis in lieu of monitoring described in Table H-4, under penalty of law, signed in accordance with Part VII.G. (Signatory Requirements), that material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, industrial machinery or operations, significant materials from past industrial activity, and that are located in areas of the facility that are within the drainage area of the outfall are not presently exposed to storm water and will not be exposed to storm water for the certification period. Such certification must be retained in the storm water pollution prevention plan and submitted to EPA in accordance with Part VI.C. of this permit. In the case of certifying that a pollutant is not present, the permittee must submit the certification along with the monitoring reports required under paragraph (*2*) below. If the permittee cannot certify for an entire period, they must submit the date exposure was eliminated and any monitoring required up until that date. This certification option is not applicable to compliance monitoring requirements associated with effluent limitations. EPA does not expect facilities to be able to exercise this certification for indicator parameters, such as TSS and BOD.

(2) Reporting Requirements. Permittees are required to submit all monitoring results obtained during the second and fourth year of permit coverage within 3 months of the conclusion of each year. For each outfall, one signed Discharge Monitoring Report form must be submitted to the Director per storm event sampled. For facilities conducting monitoring beyond the minimum quarterly requirements, an additional Discharge Monitoring Report Form must be filed for each analysis.

(3) Sample Type. All discharge data shall be reported for grab samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The required 72-hour storm event interval is waived where the preceding measurable storm event did not result in a measurable discharge from the facility. The required 72-hour storm event interval may also be waived where the permittee documents that less than a 72-hour interval is representative for local storm events during the season when sampling is being conducted. The grab sample shall be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable.

If storm water discharges associated with industrial activity commingle with process or nonprocess water, then where practicable, permittees must attempt to sample the storm water discharge before it mixes with the non-storm water discharge.

(4) Representative Discharge. When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may test the effluent of one of such outfalls and report that the quantitative data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluent. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

b. Visual Examination of Storm Water Quality. Visual examinations of a storm water discharge from each outfall are required except at inactive areas not under SMCRA bond. Active areas under SMCRA bond that are located in areas with an average annual precipitation greater than 20 inches must perform the visual examinations quarterly. Active areas under SMCRA bond with an average annual precipitation less than or equal to 20 inches are required to perform visual examinations on a semiannual basis. The examination must be of a grab sample collected from each storm water outfall. The examination of storm water grab samples shall include any observations of color, odor, turbidity, floating solids, foam, oil sheen, or other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on these samples.

The examination must be made at least once in each designated period during daylight hours unless there is insufficient rainfall or snow-melt to runoff. Whenever practicable, the same individual should carry out the collection and examination of discharges throughout the life of the permit to ensure the greatest degree of consistency possible. Examinations shall be conducted in each of the following periods for the purposes of inspecting storm water quality associated with storm water runoff and snow melt: January through March; April through June; July through September; October through December. Grab samples shall be collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 1 hour) of when the runoff begins discharging. Reports of the visual examination include: the examination date and time, examination personnel, visual quality of the storm water discharge, and probable sources of any observed storm water contamination. The visual examination reports must be maintained onsite with the pollution prevention plan.

When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the records of the visual examinations. Adverse weather conditions which may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.). For facilities that have an average annual precipitation of 20 inches or less or are designated inactive by SMCRA, EPA requires semiannual visual examinations instead of quarterly.

EPA realizes that if a facility is inactive and unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly visual examination.

EPA believes that this quick and simple assessment will help the permittee to determine the effectiveness of his/her plan on a regular basis at very little cost. Although the visual examination cannot assess the chemical properties of the storm water discharged from the site, the examination will provide meaningful results upon which the facility may act quickly. The frequency of this visual examination will also allow for timely adjustments to be made to the plan. If BMPs are performing ineffectively, corrective action must be implemented. A set of tracking or follow-up procedures must be used to ensure that appropriate actions are taken in response to the examination. The visual examination is intended to be performed by members of the pollution prevention team. This hands-on examination will enhance the staff's understanding of the storm water problems on that site and the effects of the management practices that are included in the plan.

I. Storm Water Discharges Associated With Industrial Activity From Oil and Gas Extraction Facilities

1. Industry Profile

On November 16, 199C (55 FR 47990), EPA promulgated the regulatory definition of "storm water discharges associated with an industrial activity." This definition includes point source discharges of storm water from eleven major categories of facilities, including: "* * * (iii) facilities classified as Standard Industrial Classification (SIC) codes 10 through 14, including * * * oil and gas exploration, production, processing, or treatment operations, or transmission facilities that discharge storm water contaminated by contact with or that has come into contact with, any overburden, raw material, intermediate products, finished products, by-products, or waste products located on the site of such operations."

As stated above and at 40 CFR 122.26(b)(14)(iii), only those oil and gas facilities that discharge 'contaminated' storm water are required to submit permit applications under the November 16, 1990, storm water rule. For oil and gas facilities, contamination means that there has been a release of a Reportable Quantity (RQ) of oil or hazardous substances in storm water since November 16, 1987 (hereinafter referred to as 'an RQ release'). Only those facilities that have had an RQ release are required to submit a storm water permit application.

This section of today's permit only covers storm water discharges associated with industrial activities from oil and gas exploration, production, processing, or treatment operations, or transmission facilities. Hereinafter, the facilities listed above will be referred to as "oil and gas facilities." Oil and gas facilities eligible to seek coverage under this section include the following types of operations: crude petroleum and natural gas (SIC Code 1311), natural gas liquids (SIC Code 1321), drilling oil and gas wells (SIC Code 1381), oil and gas field exploration services (SIC Code 1382), oil and gas field services, not elsewhere classified (SIC Code 1389).

These industries include the extraction and production of crude oil, natural gas, oil sands and shale; the production of hydrocarbon liquids and natural gas from coal; and associated oil field service, supply and repair industries. Many of the oil field service facilities may also manufacture oil field equipment. Discharges associated with these manufacturing activities shall be covered by this section if the primary activity of the facility is grouped under Major SIC Group 13.

Pursuant to Section 311 of the Clean Water Act and Section 102 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), RQs were established for oil and hazardous substances. As defined at 40 CFR Part 110, an RQ is "the amount of oil that violates applicable water quality standards or causes a film or sheen upon or a discoloration of the surface of the water or adjoining shorelines or causes a sludge or emulsion to be deposited beneath the surface of the water or upon adjoining shorelines." The RQs for other substances are listed in 40 CFR 117.3 and 302.4 in terms of pounds released over any 24-hour period.

Discharges covered by this section include all storm water discharges from facilities which have had an RQ release where precipitation and storm water runon come into contact with significant materials including, but not limited to, drilling and production equipment and other machinery, raw materials, waste products, by-products, finished products, stored materials, and fuels. This includes storm water discharges from access roads, and rail lines used or traveled by carriers of raw materials, manufactured products, waste

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materials, or by-products created by the facility.

This section does not cover storm water discharges from inactive oil and gas extraction facilities located on Federal lands, unless an operator of the activity can be identified. These discharges are more appropriately covered under a permit currently being developed by EPA.

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

Oil and gas exploration and production includes all activities related to the search for, and extraction of, liquid and gas petroleum from beneath the earth's surface. Found almost exclusively in sedimentary rocks, oil and natural gas accumulate in geologic confinements called traps which, by virtue of an impermeable overlying layer, have stopped the migration of the fluid. The volume of petroleum contained in a trap can vary from negligible to billions of barrels.

Though at one time such traps may have been close enough to the surface to allow easy detection (i.e., surface seepage), modern exploration relies on sophisticated geophysical testing techniques to locate potentially producible formations. Gravitational and seismic surveys of subsurface geology provide indirect indications of the likelihood of finding promising geological formations. This process is complicated by the fact that, at least in the U.S., the average depth at which one may reasonably expect to find oil is increasing since many of the largest shallow formations are assumed to have been found already.

Drilling operations require construction of access roads, drill pads, mud pits, and possibly work camps or temporary trailers. Drill pads are areas used to stage the drilling operation and generally range from 2 to 5 acres. The pad accommodates the drilling rig and associated operations including pumps, reserve pits, and mud tanks.

Modern well drilling involves the use of a rotary drill to bore through soil and rock to the desired well depth. The drill bit is constantly washed with a circulating drilling fluid, or "mud," which serves to cool and lubricate the bit and remove the cuttings to the surface. The drilling mud also serves to prevent "blowouts" from overpressured water and gas bearing formations. If the drill reaches the desired depth and fails to locate a producible deposit of oil or gas, the well must be plugged and the site abandoned. Even if oil and/or gas is found the well may not be producible. If the formation fails to exhibit the right combination of expected volume, porosity, and permeability, the costs of extraction would be prohibitive.

After a well has been drilled, it is "completed" if well logging data indicate that the well is capable of producing commercial quantities of oil or gas. Completion includes a number of operations that may be necessary to allow the well to produce oil or gas. These include installing and cementing casing, installing the production tubing and downhole equipment, repairing damage that drilling may have caused to the formation, and possibly stimulating the well. During a well's active life, periodic "workovers" are necessary. Workovers can include a number of procedures intended to maintain or enhance production. These can include repairing or replacing downhole equipment, removing accumulated scale or paraffin from tubing or casing, and stimulating the formation to restore or enhance production. Wells are stimulated, whether by treating with acid or fracturing, during completion or workover or both: it is common for wells to be stimulated at completion and then periodically throughout their lives.

Acid stimulation involves introducing an acid solution to the formation. The acid dissolves the rock, thus creating or enlarging flow path openings. Acids are also used to repair damage to formations caused by drilling or other operations. In addition, they may be used for scale removal and other purposes. Fracturing by hydraulic pressure is achieved by pumping fluids at high pressure (i.e., at high rates) into the well, thereby causing material failure of the rock in the formation of interest (i.e., fractures). Fracturing is also done using explosive devices to fire projectiles into the formation of interest. The fractures induced in the formations serve as flow paths for hydrocarbons.

In instances where the reservoir is sufficiently large, "delineation" wells are drilled to determine the boundary of the reservoir and additional "development" wells are drilled to increase the rate of production from the "field." Because few new wells in the U.S. have sufficient energy (pressure) to force oil all the way to the surface, surface or submersible pumps are placed at the wells and production begins.

This first phase of production, primary production, may continue for several to many years, requiring only routine maintenance to the wells as they channel oil to the surface for delivery to refineries. However, as the oil is removed from the formation, the formation pressure decreases until the wells will no longer produce. Because 70 percent of the total recoverable oil may remain in the formation, additional energy may be supplied by the controlled injection of water from the surface into the formation. The injected water acts to push the oil toward the well bores. Such secondary recovery or "water flooding" projects may employ hundreds of injection wells throughout a field to extend the life of the wells. Much of the water used for injection is pumped along with oil from the producing well, separated from the oil, and then reinjected.

Produced fluid, as pumped from a well, is sent through one or more process units to separate the waste fractions (e.g., produced water, emulsions, scale, and produced sand) from the salable hydrocarbon.

As oil and gas are recovered from wells, they are collected or gathered in pipelines for transport to produced fluid treatment facilities. These facilities separate marketable gas and crude oil from water and sand.

Often, service companies are hired by the oil company to perform many of the activities described above. Typically these contractors drill the wells and perform other specific tasks such as installing casing, conducting formation tests, and managing wastes, etc. When a well or field ceases to produce oil or gas at an economically feasible rate, the field must be abandoned and reclaimed.

2. Pollutants in Storm Water Discharges Associated with Oil and Gas Facilities

Exploration and production techniques will vary depending on the type and characteristics of formations, pollutants present, and waste management controls. Therefore, impacts associated with storm water discharges from oil and gas facilities will vary. Several other factors influence to what extent significant materials from these types of facilities and processing operations can affect water quality.

Such factors include: hydrology/geology; the types of chemical additives and lubricating fluids used; the procedure for waste management; the nature and size of the RQ release; the amount of contamination remaining after the RQ release; the size of the operation; and type, duration, and intensity of precipitation events. These and other factors will interact to influence the quantity and quality of storm water runoff. In addition, sources of pollutants other than storm water, such as illicit connections,[70] spills, and other improperly dumped materials, may increase the pollutant loadings discharged into waters of the United States.

Based on information submitted with the group applications and other documents, EPA has identified some storm water pollutants and sources typically associated with oil and gas facilities in Table I–1. Due to distinct industrial activities and materials used at facilities, however, sources and associated pollutants will vary from site to site. The pollutants listed in Table I–1 are not meant to be a comprehensive listing of all potential storm water pollutants at oil and gas facilities.

TABLE I–1.—ACTIVITIES, POLLUTANT SOURCES, AND POLLUTANTS

Activity	Pollutant source	Pollutant
Construction of: —Access Roads —Drill Pads —Reserve Pits —Personnel Quarters —Surface Impoundments	Soil/dirt, leaking equipment and vehicles	TSS, TDS, oil and grease.
Well Drilling	Drilling fluid,[i] lubricants, mud, cuttings, produced water	TSS, TDS, oil and grease, COD, chlorides, barium, naphthalene, phenanthrene, benzene, lead, arsenic, fluoride.
Well Completion/Stimulation	Fluids (used to control pressure in well), cement, residual oil, acids, surfactants, solvents, produced water, sand.	TSS, TDS, oil and grease, COD, pH, acetone, toluene, ethanol xylenes.
Production	Produced water, oil, waste sludge, tank bottoms, acids, oily debris, emulsions.	Chlorides, TDS, oil and grease, TSS, pH, benzene, phenanthrene, barium, arsenic, lead, antimony.
Equipment Cleaning and Repairing.	Cleaning solvents, lubricants, chemical additives	TSS, TDS, oil and grease, pH.
Site Closures	Residual muds, oily debris	TSS, TDS, oil and grease.

[i] The potential contaminants to be found in drilling fluid varies from site to site, depending on the components of the fluid and any pollutants added due to use of the fluid. Storm water discharges that come into contact with used drilling fluids may include the following pollutants, among others: toluene, ethyl benzene, phenol, benzene, and phenanthrene. Used drilling fluids may also contain inorganic pollutants from additives or downhole exposure, such as arsenic, chromium, lead, aluminum, sulfur, and various sulfates.

Based on the similarities of the facilities included in this sector in terms of industrial activities and significant materials, EPA believes it is appropriate to discuss the potential pollutants at oil and gas extraction facilities as a whole and not subdivide this sector. Therefore, Table I–2 lists data for selected parameters from facilities in the oil and gas extraction sector. These data include the eight pollutants that all facilities were required to monitor under Form 2F.

TABLE I–2.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY OIL AND GAS EXTRACTION FACILITIES SUBMITTING PART II SAMPLING DATA[i] (MG/L)

Pollutant	No. of facilities		No. of samples		Mean		Minimum		Maximum		Median		95th percentile		99th Percentile	
Sample type	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	34	32	39	37	13.9	10.7	0.0	0.0	116.0	90.0	10.4	7.0	32.9	26.8	52.9	44.8
COD	35	32	40	35	138.3	112.2	14.0	0.0	1050.0	450.0	78.5	78.0	401.9	330.4	755.3	601.4
Nitrate + Nitrite Nitrogen	34	31	39	35	0.47	0.54	0.00	0.00	5.50	9.90	0.15	0.09	2.06	2.10	6.17	7.15
Total Kjeldahl Nitrogen	35	32	40	34	1.31	1.52	0.00	0.00	9.00	14.50	0.69	0.83	4.68	5.49	9.75	12.56
Oil & Grease	35	N/A	40	N/A	9.4	N/A	0.0	N/A	169.0	N/A	3.0	N/A	24.7	N/A	56.0	N/A
pH	34	N/A	40	N/A	N/A	N/A	5.9	N/A	11.3	N/A	7.2	N/A	9.2	N/A	10.0	N/A
Total Phosphorus	35	32	40	37	16.17	3.98	0.00	0.00	149.72	50.74	0.20	0.16	68.03	20.01	461.08	102.13
Total Suspended Solids	35	32	41	34	332	369	3	1	1657	4186	70	40	1820	1831	6110	7869

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.
[ii] Composite samples.

3. Options for Controlling Pollutants

In evaluating options for controlling pollutants in storm water discharges, EPA must achieve compliance with the technology-based standards of the Clean Water Act [Best Available Technology (BAT) and Best Conventional Technology (BCT)]. The Agency does not believe it is necessary to establish specific numeric effluent limitations or a specific design or performance standard in this section for storm water discharges associated with industrial activity from oil and gas facilities to meet the BAT/BCT standards of the Clean Water Act. Rather than setting limits, this section establishes requirements for the development and implementation of a site-specific storm water pollution prevention plan consisting of a set of BMPs that are sufficiently flexible to address different sources of pollutants at different sites.

[70] Illicit connections are contributions of unpermitted non-storm water discharges to storm sewers from any of a number of sources including sanitary sewers, industrial facilities, commercial establishments, or residential dwellings. The probability of illicit connections at mineral mining and processing facilities is low yet it still may be applicable at some operations.

The selection of the most effective BMPs will be based on site-specific considerations such as: facility size, climate, geographic location, geology/hydrology and the environmental setting of each facility, and volume and type of discharge generated. Each facility will be unique in that the source, type and volume of contaminated storm water discharges will differ. In addition, the fate and transport of pollutants in these discharges will vary. EPA believes that the management practices discussed herein are well suited mechanisms to prevent or control the contamination of storm water discharges associated with facilities in this category.

Two types of BMPs which may be implemented to prevent, reduce or eliminate pollutants in storm water discharges are those which minimize exposure (e.g., covering, curbing, or diking) and treatment type BMPs which are used to reduce or remove pollutants in storm water discharges (e.g., oil/water separators, sediment basins, or detention ponds). EPA believes exposure minimization is an effective practice for reducing pollutants in storm water discharges from oil and gas facilities. Exposure minimization practices lessen the potential for storm water to come in contact with pollutants. These methods are often uncomplicated and inexpensive. They can be easy to implement and require little or no maintenance. EPA also believes that in some instances more resource intensive treatment type BMPs are appropriate to reduce pollutants such as suspended solids and oil/grease in storm water discharges associated with oil and gas facilities. Though these BMPs are somewhat more resource intensive, they can be effective in reducing pollutant loads and may be necessary depending on the type of discharge, types and concentrations of contaminants, and volume of flow.

The types of BMPs used may depend upon the methods of waste management utilized at a facility. Waste management and disposal practices at oil and gas facilities may vary significantly. For example, techniques for disposal of produced water and associated wastes include the following: landfarming/spreading (spreading wastes on land surfaces to stimulate biological degradation); backfilling (storing wastes in a pit and then covering with dirt or other materials); evaporation (in more arid parts of the country, liquid wastes are left exposed and eventually evaporate or percolate into the ground); discharging wastes (sometimes treated) to waters of the United States (NPDES permits are required for such discharges); injection (injecting wastes back into the ground for disposal); and offsite disposal (wastes are taken offsite to a commercial facility for disposal).

The pollutants of concern and the BMPs employed at an oil and gas facility depend upon which, if any, of the disposal techniques listed above are utilized. Where wastes are used for onsite road application, for example, all pollutant constituents of that waste need to be considered a potential contributor to contaminated storm water discharges. In addition, the areas at the facility where road application occurs must also be considered when BMPs are being implemented. In contrast, if all waste is taken to an offsite disposal facility, the waste will most likely not affect the storm water discharges and the areas of concern will not be expanded.

Table I–3 lists some BMPs which may be effective in limiting the amount of pollutants in storm water discharges from oil and gas facilities. The BMPs listed are not necessarily required to be implemented. Rather, BMPs should be chosen based on the specific nature of the storm water discharges at each oil and gas facility and implemented as appropriate. Some of these BMPs involve reducing the amount of waste produced and stored onsite which can potentially contaminate storm water. Based on part 1 information, several of the BMPs suggested are already in place at many of the facilities. Part 1 submittals indicate that diking or other types of diversion occur at approximately 57 percent of the sampling facilities. Thirty percent of the sampling facilities noted that they use some form of covering as a BMP, and catch basins are in place at 12 percent of the sampling facilities. In addition, 11 percent of the facilities designated as samplers in part 1 information reported they had a Spill Prevention Control and Countermeasure Plan in place, and 16 percent had a material management plan.

TABLE I–3.—SUGGESTED BMPS FOR OIL AND GAS FACILITIES

Suggested BMPs
Utilize diking and other forms of containment and diversion around storage tanks, drums of oil, acid, production chemicals, and liquids, reserve pits, and impoundments.
Use diking and other forms of containment and diversion around material handling and processing areas.
Use porous pads under drum and tank storage areas.
Use covers and/or lining for waste reserve and sludge pits to avoid overflows and leaks.
Use drip pans, catch basins, or liners during handling of materials such as tank bottoms.
Reinject or treat produced water instead of discharging it.
Limit the amount of land disturbed during construction of access roads and facilities.
Employ spill plans for pipelines, tanks, drums, etc.
Recycle oily wastes, drilling fluids and other materials onsite, or dispose of properly.
Take wastes offsite to be disposed of instead of burying them.
Use oil water separators.

4. Special Conditions

There are no additional requirements beyond those described in Part VI.B. of this fact sheet.

5. Storm Water Pollution Prevention Plan Requirements

a. Contents of the Plan. Specific requirements for the pollution prevention plan for oil and gas extraction facilities are described below. These requirements must be implemented in addition to the common prevention plan provisions discussed in Section VI.C. of this fact sheet.

(1) Description of Potential Pollutant Sources. Facilities under this section cover a broad range of oil field activities and service industries.

Drilling sites have large disturbed areas which will contribute additional sediments and suspended solids to the storm water runoff. Well drilling includes the use of many hazardous chemicals and materials. These include drilling muds, well casing cement, fractionating gels, and well treatments. The storage, mixing, and handling of these materials are potential pollutant sources.

Oil field service industries provide a variety of services for exploration and production activities. These service industries often store and mix chemicals for drilling muds, well casing cement, fractionating gels, and well treatments at the facility. The storage and mixing areas are potential pollutant sources. Often, mixing areas and equipment are exposed to storm water. Many oil field service facilities manufacture some oil field equipment components. The exposed raw materials, intermediate products, finished products, and waste products are potential sources of pollutants in storm water.

In its description of potential pollutant sources, a facility must include information about the RQ release which triggered the permit application requirements. Such information must include: the nature of the release (e.g., spill of oil from a drum storage area); the amount of oil or hazardous substance released; amount of substance recovered; date of the release; cause of the release (e.g., poor handling techniques as well as lack of containment in area); area affected by release, including land and waters; procedure to cleanup release; and remaining potential contamination of storm water from release.

(2) Measures and Controls.

(a) RQ Releases—The permittee must describe the measures taken to clean up RQ releases or related spills of materials, as well as measures proposed to avoid future releases of RQs. Such measures may include, among others: improved handling or storage techniques; containment around handling areas of liquid materials; and use of improved spill cleanup materials and techniques.

(b) Vehicle and Equipment Storage Areas—Vehicles and equipment associated with oil field activity are often coated with oil, oil field drilling muds, and the chemicals associated with drilling. These vehicles and equipment are a significant source of pollutants. The permittee must address these areas, and institute practices to minimize pollutant runoff from this area.

(c) Vehicle and Equipment Cleaning and Maintenance Areas—The plan must describe measures that prevent or minimize contamination of the storm water runoff from all areas used for vehicle and equipment cleaning. The facility may consider performing all cleaning operations indoors, covering the cleaning operation, and/or collecting the storm water runoff from the cleaning area and providing treatment or recycling. These cleaning and maintenance activities can result in the exposure of cleaning solvents, detergents, oil and grease and other chemicals to storm water runoff. The use of drip pans, maintaining an organized inventory of materials used in the shop, draining all parts of fluids prior to disposal, prohibiting the practice of hosing down the shop floor where the practice would result in the exposure of pollutants to storm water, using dry cleanup methods, and/or collecting the storm water runoff from the maintenance area and providing treatment or recycling may reduce the pollutants discharged in storm water runoff.

(d) Materials Storage Areas—Storage units of all chemicals and materials (e.g., fuels, oils, used filters, spent solvents, paint wastes, radiator fluids, transmission fluids, hydraulic fluids, detergents drilling mud components, acids, organic additives) may result in the contamination of storm water discharges. Labeling of all storage containers helps facility personnel to respond effectively to spills or leaks. Additionally, covered storage of the materials and/or installation of berming and diking at the area can be effective BMPs.

(e) Chemical Mixing Areas—Chemical mixing (e.g., the mixing of drilling muds, fractionating gels, mixing well casing cement, and well treatment acids and solvents) at both well sites and at facilities with service drilling activities have significant potential to contaminate storm water runoff. The facility should consider covering the mixing area, using spill and overflow protection, minimizing runon of storm water to the mixing area, using dry cleanup methods, and/or collecting the storm water runoff and providing treatment or recycling. The facility should consider installation of berming and diking of the area. The waste water pollutants associated with produced waters, drilling muds, drill cuttings and produced sand from any source associated with onshore oil and gas production, field exploration, drilling, well completion, or well treatment are prohibited from being discharged (40 CFR 435.32).

(f) Preventive Maintenance—The preventive maintenance program must include the inspection of all onsite and offsite mixing tanks and equipment, and inspection of all vehicles which carry supplies and chemicals to oil field activities. These mixing tanks and vehicles carry large volumes of fractionating chemicals and gels, cements, drilling muds, and well treatment chemicals and acids that potentially may contaminate waters of the United States if leaks or spills occur.

(g) Inspection Frequency—All equipment and areas addressed in the pollution prevention plan shall be inspected semiannually. Equipment and vehicles which store, mix or transport hazardous materials will be inspected quarterly. Inspections shall also include the inspection of all onsite mixing tanks and equipment, and inspection of all vehicles which carry supplies and chemicals to oil field activities. These mixing tanks and vehicles carry large volumes of fractionating chemicals and gels, cements, drilling muds, and well treatment chemicals and acids that potentially may contaminate waters of the United States if leaks or spills occur.

6. Numeric Effluent Limitation

There are no additional numerical effluent limitations beyond those listed in Part V.B. of today's permit.

7. Monitoring and Reporting Requirements

a. Monitoring Requirements. The regulatory modifications at 40 CFR 122.44 (i)(2) established on April 2, 1992, grant permit writers the flexibility to reduce monitoring requirements in storm water discharge permits. EPA has determined that the potential for storm water discharges to contain pollutants above benchmark levels, because of the industrial activities and materials exposed to precipitation, does not support sampling at oil and gas facilities. Based on a consideration of the BMPs typically used at these facilities, and generally low pollutant values from the application data, EPA believes that the pollution prevention plan with visual examinations of storm water discharges will help to ensure storm water contamination is minimized. Because permittees are not required to conduct sampling, they will be able to focus their resources on developing and implementing the pollution prevention plan.

Quarterly visual examinations of a storm water discharge from each outfall are required at oil and gas facilities. The examination must be of a grab sample collected from each storm water outfall. The examination of storm water grab samples shall include any observations of color, odor, turbidity, floating solids, foam, oil sheen, or other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on these samples.

The examination must be made at least once in each designated period during daylight hours unless there is insufficient rainfall or snow-melt to produce a runoff. Whenever practicable, the same individual should carry out the collection and examination of discharges throughout the life of the permit to ensure the greatest degree of consistency possible. Examinations shall be conducted in each of the following periods for the purposes of visually inspecting storm water quality associated with storm water runoff and snow melt: January through March; April through June; July through September; October through December. Grab samples shall be collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 60 minutes) of when the runoff begins discharging. Reports of the visual examination include: the examination date and time, examination personnel, visual quality of the storm water discharge, and probable sources of any observed storm water contamination. The visual examination reports must be maintained onsite with the pollution prevention plan.

EPA realizes that if a facility is inactive and unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly visual examination.

EPA believes that this quick and simple assessment will help the permittee to determine the effectiveness of his/her plan on a regular basis at very little cost. Although the visual examination cannot assess the chemical properties of the storm water discharged from the site, the examination will provide meaningful results upon which the facility may act quickly. The frequency of this visual examination will also allow for timely adjustments to be made to the plan. If BMPs are performing ineffectively, corrective action must be implemented. A set of tracking or follow-up procedures must be used to ensure that appropriate actions are taken in response to the examinations. The visual examination is intended to be performed by members of the pollution prevention team. This hands-on examination will enhance the staff's understanding of the storm water problems on that site and the effects of the management practices that are included in the plan.

When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the records of the visual examination. Adverse weather conditions which may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

As discussed above, EPA does not believe that chemical monitoring is necessary for oil and gas facilities. EPA believes that between quarterly visual examinations and site compliance evaluations potential sources of contaminants can be recognized, addressed, and then controlled with BMPs. In determining the monitoring requirements, EPA considered the nature of the industrial activities and significant materials exposed at these sites, and performed a review of data provided in Part 2 group applications.

J. Storm Water Discharges Associated With Industrial Activity From Mineral Mining and Processing Facilities

1. Industry Profile

On November 16, 1990 (55 FR 47990), EPA promulgated the regulatory definition of "storm water discharges associated with industrial activity." This definition included point source discharges of storm water from eleven major categories of facilities, including: "* * * (iii) facilities classified as Standard Industrial Classifications 10 through 14 (mineral industry) including active or inactive mining operations (except for areas of coal mining operations no longer meeting the definition of a reclamation area under 40 CFR 434.11(l) because the performance bond issued to the facility by the appropriate SMCRA authority has been released, or except for areas of noncoal mining operations which have been released from applicable State or Federal reclamation requirements after December 17, 1990) and oil and gas exploration, production, processing, or treatment operations, or storm water contaminated by contact with, any overburden, raw material, intermediate products, finished products, by-products or waste products located on the site of such operations."

This section only covers storm water discharges associated with industrial activities from active and inactive mineral mining and processing facilities. Mineral mining and processing facilities eligible to seek coverage under this section include the following types of operations: Dimension Stone (SIC Code 1411); Crushed and Broken Limestone (SIC Code 1422); Crushed and Broken Granite (SIC Code 1423); Crushed and Broken Stone (SIC Code 1429); Construction Sand and Gravel (SIC Code 1442); Industrial Sand and Gravel (SIC Code 1446); Kaolin and Ball Clay (SIC Code 1455); Clay, Ceramic, and Refractory Minerals (SIC Code 1459); Potash, Soda, and Borate Minerals (SIC Code 1474); Phosphate Rock (SIC Code 1475); Chemical and Fertilizer Mineral Mining (SIC Code 1479); and Miscellaneous Nonmetallic Minerals, Except Fuels (SIC Code 1499).

Storm water discharges covered by this section include all discharges where precipitation and storm water runon come into contact with significant materials including, but not limited to, raw materials, waste products, by-products, overburden, stored materials, and fuels. This includes storm water discharges from haul roads, access roads, and rail lines used or traveled by carriers of raw materials, manufactured products, waste materials, or by-products created by the facility.

This permit may authorize storm water discharges associated with industrial activity that are mixed with storm water discharges associated with industrial activity from construction activities, provided that the storm water discharge from the construction activity is in compliance with the terms, including applicable Notice of Intent (NOI) or application requirements, of a different NPDES general permit or individual permit authorizing such discharges.

This section does not cover any discharge subject to effluent limitation guidelines, unless otherwise specified, including storm water that combines with process wastewater. Storm water that does not come into contact with any overburden, raw material, intermediate product, finished product, by-product, or waste product located on the site of the operation are not subject to permitting under this section according to Section 402(l)(2) of the Clean Water Act. Today's permit contains additional coverage provisions applicable only to mineral mining and processing facilities located in Region VI and Region IX (the States of Louisiana, New Mexico, Oklahoma, and Texas and Arizona). Mine dewatering discharges, which are composed entirely of storm water or ground water seepage, and that are not commingled with any process waste water from construction sand and gravel, industrial sand, and crushed stone mine facilities located in Region VI and Region IX are eligible for coverage under today's permit. Such discharges, however, are subject to the numeric limitations and compliance monitoring provisions listed in the permit.

This section is applicable to all phases of mining operations, whether active or inactive, as long as there is exposure to significant materials. This includes land disturbance activities such as the expansion of current extraction sites, active and inactive mining stages, and reclamation activities.

This section does not apply to storm water discharges from inactive mining operations occurring on Federal lands, unless an operator can be identified. These discharges are more appropriately covered under a permit currently being developed by EPA.

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

There are typically three phases to a mining operation: the exploration and construction phase; the active phase; and the reclamation phase. The exploration and construction phase entails exploration and a certain amount of land disturbance to determine the financial viability of a site. Construction includes building of site access roads, and removal of overburden and waste rock to expose minable ore. These land-disturbing activities are significant potential sources of storm water contaminants. The active phase includes each step from extraction through production of a saleable product. The active phase may include periods of inactivity due to the seasonal nature of these mineral mining activities. The final phase of reclamation is intended to return the land to its pre-mining state.

Because of the land-disturbing nature of the mineral mining and processing industry, contaminants of concern generated by industrial activities in this industry include total suspended solids (TSS), total dissolved solids (TDS), turbidity, and pH. Table J–1 lists potential pollutant source activities, and related pollutants associated with mineral mining and processing facilities.

Industrial activities, significant materials, and material management practices associated with mineral mining and processing methods are typically similar, varying only in the type of rock being mined. Examples of mineral commodities obtained from mineral mining and processing facilities include: crushed stone; construction sand and gravel; industrial sand; gypsum; asphaltic minerals; asbestos and wollastonite; lightweight aggregates; mica and sericite; barite; fluorspar; salines from brine lakes; borax minerals; potash; sodium sulfate; trona; rock salt; phosphate rock; frasch sulfur; mineral pigments; lithium; bentonite; magnesite; diatomite; jade; novaculite; fire clay; attapulite and montmorillonite; kyanite; shale and common clay; aplite; tripoli; kaolin; ball clay; feldspar; talc, steatite, soapstone and pyrophylite; garnet; and graphite.

Industrial activities include, "* * * but [are] not limited to, storm water discharges from industrial plant yards; immediate access roads and rail lines used or traveled by carriers of raw materials, manufactured products, waste material, or by-products used or created by the facility; material handling sites; refuse sites; sites used for the application or disposal of process wastewaters (as defined at 40 CFR Part 401); sites used for the storage and maintenance of material handling equipment; sites used for residual treatment, storage, or disposal; shipping and receiving areas; manufacturing buildings; storage areas (including tank farms) for raw materials and intermediate and finished materials; and areas where industrial activity has taken place in the past and significant materials remain and are exposed to storm water" (40 CFR 122.26(b)(14)). The most common industrial activities at mineral mine sites include extraction of the mineral, material sizing by crushers, material sorting, and product washing.

TABLE J–1.—ACTIVITIES, POLLUTANT SOURCES, AND POLLUTANTS

Activity	Pollutant source	Pollutant
Site Preparation	Road Construction	Dust, TSS, TDS, turbidity.
	Removal of Overburden	Dust, TSS, TDS, turbidity.
	Removal of waste rock to expose the mineral body	Dust, TSS, TDS, turbidity.
Mineral Extraction	Blasting activities	Dust, TSS.
Mineral Processing Activities	Rock Sorting	Dust, TSS, TDS, turbidity, fines.
	Rock Crushing	Dust, TSS, TDS, turbidity, fines.
	Rock Washing	TSS, TDS, turbidity, pH.
	Raw Material Storage	Dust, TSS, TDS, turbidity.
	Waste Rock Storage	Dust, TSS, TDS, turbidity, pH.
	Raw Material Loading	Dust, TSS, TDS, turbidity.
	Processing materials unloading	Diesel fuel, gasoline, oil, lime.
	Raw or Waste Material Transportation	Dust, TSS, TDS, turbidity.
Other Activities	Sedimentation pond upsets	TSS, TDS, turbidity, pH.
	Sedimentation pond sludge removal and disposal	Dust, TSS, TDS, turbidity, pH.
	Air emission control cleaning	Dust, TSS, TDS, turbidity.
Equipment/Vehicle Maintenance.	Fueling activities	Diesel fuel, gasoline, oil.
	Parts cleaning	Solvents, oil, heavy metals, acid/alkaline wastes.
	Waste disposal of oily rags, oil and gas filters, batteries, coolants, degreasers.	Oil, heavy metals, solvents, acids.
	Fluid replacement including hydraulic fluid, oil, transmission fluid, radiator fluids, and grease.	Oil, arsenic, lead, cadmium, chromium, benzene, TCA, TCE, PAHs, solvents.
Reclamation Activities	Site preparation for stabilization	Dust, TSS, TDS, turbidity.

TABLE J–1.—ACTIVITIES, POLLUTANT SOURCES, AND POLLUTANTS—Continued

Activity	Pollutant source	Pollutant
	Fertilizers	Nitrogen, phosphorus.

Sources: Storm water group applications, Part 1 and 2 and EPA. "Development Document on the Mineral Mining and Processing Point Source Category." (EPA 440/1–76/059b). July 1979.

Significant materials include, "* * * but [are] not limited to: raw materials, fuels, materials such as solvents, detergents, and plastic pellets; finished materials such as metallic products; * * * hazardous substances designated under Section 101(14) of CERCLA; any chemical facilities required to report pursuant to Section 313 of Title III of SARA; fertilizers; pesticides; and waste products such as ashes, slag, and sludge that have the potential to be released with storm water discharge" (40 CFR 122.26(b)(12)). Significant materials commonly found at mining facilities include: overburden; waste rock; sub-ore piles; tailings; petroleum-based products; solvents and detergents; manufactured products; and other waste materials.

Materials management practices are defined as those practices employed to diminish contact by significant materials with precipitation and storm water runon, or practices utilized to reduce the offsite discharge of contaminants. To this end, sediment ponds, discharge diversion techniques, as well as methods of dispersion, are used to minimize impacts of significant materials on storm water. For mine sites requiring additional sources of water for processing operations, rainfall events as well as storm water runon will be managed for use in dust suppression, processing, and washing activities. Many mine sites are already equipped with sedimentation ponds and other established process wastewater treatment methods in order to meet effluent limitation guidelines. Additional storm water management practices used at mineral mining facilities include: discharge diversions; drainage/storm water conveyances; runoff dispersion; sediment control and collection practices; vegetation/soil stabilization; and capping contaminated sources.

Nonmetallic minerals are recovered using four basic forms of extraction techniques: open pit, open face or quarry mining; dredging; solution mining; and underground mining. Each type of extraction method may be followed by varying methods of beneficiation and processing. Presented below are brief descriptions of the industrial activities, significant materials, and materials management practices associated with these four extraction processes and associated beneficiation activities. Due to similarities in mining operations for many of the minerals within this sector, industrial activities, significant materials, and materials management practices are fairly uniform across this sector. Unique practices are noted.

a. Open Pit, Open Face, or Quarry Mining. Many mineral mining and processing industries access mineral deposits using open pit, open face or quarrying extraction techniques. For facilities producing dimension stone, crushed and broken stone, construction and industrial sand and gravel, clays, as well as other minerals (borate, phosphate, potash), surface mining is generally the most economical form of extraction.

(1) *Industrial Activities.* Extraction activities include removal of overburden and waste rock to access mineral deposits. These land-disturbing activities generate piles of topsoil and other overburden as well as waste rock, which are typically stored beside, or within, the pit or quarry. In addition, land disturbance, blasting, crushing, and materials handling activities create large amounts of dust that are either dispersed by local wind patterns or collected in air pollution control mechanisms. At closure, overburden and waste rock may or may not be used to reclaim the pit or quarry depending on Federal, State and local requirements. In addition, access roads and rail spurs, and associated loading and unloading areas, are found onsite.

Following extraction, the mined materials may be transferred to a nearby beneficiation/processing facility or may be beneficiated within the pit or quarry. At a beneficiation/processing facility, unfinished materials may be subjected to dry or wet processing methods. Dry forms of processing include crushing, grinding, sawing, and splitting of the mined material. Wet processing may include simple washing, flotation, or heavy media separation.

(2) *Significant Materials.* Significant materials generated by most extraction activities at open pit, open face, and quarry mines include overburden piles, waste rock piles, ore and subore piles, and materials spilled from loading and unloading activities. Other exposed materials that can be generated at these types of operations (as well as other mineral mines), include: tailings from flotation and other separation stages; soils impacted by fugitive dust emissions; other process wastes such as clays from phosphate mines; settling ponds that receive process wastewaters; dredged sediment disposal areas; as well as raw material and product storage. Dust and particulate matter collected in air pollution control mechanisms may also be disposed of in onsite waste piles.

(3) *Materials Management Practices.* Materials management practices at open pit or quarry mining facilities are typically designed to control dust emissions and soil erosion from extraction activities, and offsite transport of significant materials. At many facilities structural Best Management Practices (BMPs) may have already been implemented to manage process wastewaters subject to effluent limitation guidelines. Settling ponds and impoundments are commonly used to reduce Total Suspended Solids (TSS), Total Dissolved Solids (TDS), and other contaminants in process generated wastewaters. These controls may also be used to manage storm water runoff and runon with potentially few alterations to onsite drainage systems. Some facilities included in part 1 of the group applications reported the use of storm water diversions to divert storm water away from pits and quarries, raw material piles, overburden, and waste rock piles.

Tailings impoundments are used to manage tailings generated at facilities engaged in flotation or heavy media separation operations. These impoundments are used to manage beneficiation/processing wastewaters generated at the facility and may also be used to manage storm water runoff.

b. Dredging. Dredging is an extraction method used to access nonmetallic mineral deposits located in quarries or pits (where completely or partially below the water table); in rivers; or estuaries; or offshore, in open bays or sounds. For these types of operations, ore is recovered using scooping devices and suction dredges. Minerals commonly excavated by dredging include sand and gravel, and calcium carbonate.

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(1) Industrial Activities. The industrial activities at dredging facilities include excavation of ore from underwater deposits (e.g., in stream beds of perennial or ephemeral streams) by dredges. Processing operations may occur on the dredge barges or at adjacent facilities. On-board processing activities may include: screening; crushing of oversized material; washing; sand classification with hydraulic classifying tanks; gravel sizing; heavy media separation; and product loading/unloading.

Dredges that do not perform on-board processing operations load raw material on a tow-barge for transport to a land-based processing facility. Processing at land facilities typically includes washing to remove clay and other impurities; screening; sizing; crushing; classifying; and heavy media separation.

(2) Significant Materials. Significant materials generated at dredging facilities include ore material piles, waste material piles of oversized, or otherwise unusable materials, and float waste from heavy media separation. Clays and undersized fines are dredging waste by-products that may be returned to the water but may also be stored in piles. Sand fines from gravel crushing operations that cannot be sold, are a major source of exposed waste material at land-based processing facilities. In addition, land-based facilities may also manage dredged sediments removed from onsite settling ponds. Haul roads, storage piles, on-land waste piles, processing operations, and loading/unloading operations are other potential sources of storm water pollutants at these facilities.

(3) Materials Management Practices. Hydraulic dredging operations in open pits or quarries, or land-based processing facilities, use settling ponds for the removal of clay particles, fines, and impurities from process wastewaters. These ponds may also be used to manage contaminated storm water runoff. Water from the settling ponds or basins may be returned to the wet pit to maintain water levels in the pit, or may be discharged offsite. Worked out pits may also be used to contain solid wastes such as fines and oversized materials. These pits are another potential source of storm water contamination in the event of heavy precipitation and subsequent overflow.

Dredging operations in open waters typically discharge process wastewater containing fines to the water body without treatment under the operator's Clean Water Act Section 404 permit.

c. *Solution Mining.* Solution mining extracts minerals from hard rock mineral or natural brine sources by underground injection of a lixiviant into the ore zone. Minerals are recovered from solution, after the solution is brought to the surface, through evaporation or flotation. Since most solution mining extraction activities occur underground using water to extract values, the potential for these mineral deposits to be exposed to storm water is minimal. However, at the surface of solution mining operations, industrial activities and significant materials, such as haul roads, chemical storage areas, and raw material piles, are common to most sites. These industrial activities and significant materials are all susceptible to storm water exposure and require appropriate storm water management controls.

Descriptions of industrial activities performed by each type of solution mining are provided below. Since the mineral deposits are not exposed to storm water for this type of mining, "industrial activities" describes the type of extraction method used to obtain minerals, not activities susceptible to storm water exposure. Significant materials, and materials management practices do refer to those materials exposed to storm water, and to the subsequent management practices used to control storm water.

Some of the minerals extracted using solution mining include: potash; soda; rock salt; borate minerals; chemical and fertilizer minerals such as barite, fluorspar, salines from lake brines; lithium; and mineral pigments. Many of these minerals may also be recovered using surface and/or underground extraction methods.

(1) Solution Mining—Injection.

(a) Industrial Activities—Rock salt and potash minerals may be recovered by injecting water into subsurface deposits and removing minerals in solution. Water is injected through a cased pipe drilled into a deposit. Saturated solution is then pumped to the surface for processing or storage. Processing may include evaporation, and/or flotation to separate the final product.

(b) Significant Materials—Significant materials at an injection solution mining site may include product storage piles, chemical storage areas, and haul roads. Very little extracted solution remains onsite, since it is often re-injected into the formation.

(c) Materials Management Practices—Solution mining facilities typically operate in arid regions, and are able to use solar evaporation ponds to recover minerals from solution. Due to typically low precipitation and high evaporation rates in these areas, storm water materials management practices may not be prevalent.

(2) Solution Mining—Frasch Sulfur.

(a) Industrial Activities—Sulfur is recovered from deposits using the Frasch sulfur process, which injects hot, purified, water into the subsurface to melt the mineral. Molten sulfur is pumped directly to heated tanks at the surface to maintain a saleable product in liquid form.

(b) Significant Materials—Significant materials generated from Frasch sulfur mining include elemental sulfur, scrap sulfur, tank bottoms, water treatment sludge, bleedwater produced from bleed wells used to remove excess injection water, and drilling wastes such as muds, acidizing fluids and well workover fluids. Since molten sulfur product is piped directly from underground to enclosed storage tanks on the surface, it is not exposed to storm water.

(c) Materials Management Practices—Solid wastes such as elemental and scrap sulfur, tank bottoms, and water treatment sludge may be disposed of in onsite piles. Liquid wastes such as bleedwater, drilling muds, acidizing fluids and workover fluids are typically disposed of in reserve pits and/or workover pits. At the completion of drilling, pit contents may be dried prior to being covered by a liner and buried. Accumulated solids from these pits may also be mixed with clay for use as an additive in drilling muds.

Rainfall runoff and boiler blowdown may be discharged offsite without treatment. Other waste generated at these facilities include power plant wastes and wastewaters, wastewater from sealing wells, sanitary wastes, and miscellaneous other wastewaters collected in drips and drains.

(3) Solution Mining—Evaporation.

(a) Industrial Activities—Another form of solution mining uses evaporation and crystallization of saline waters to produce minerals. Potash, soda, borate, and other minerals, are produced from naturally occurring fluids such as sea water, or from evaporite mineral deposits such as western lake brines. Brines are typically pumped from beneath the crystallized surface of a lake and processed by evaporation and crystallization. Recovered salts are washed, dried and packaged for shipment.

(b) Significant Materials/Materials Management Practices—Significant materials associated with these facilities include raw material piles, evaporation ponds, and residual brines consisting of salts and end liquors, including various added process wastewaters. Residual brines generated may be left in solar

evaporation ponds or dissolved and returned to the lake or injection wells.

d. Underground Mining. Underground mining techniques are used to access mineral deposits located too far underground to access economically from the surface. Though typically a more expensive form of extraction, advantages to underground mining operations include year-round operation, less noise (applicable to facilities located near residential areas), and less surface land disturbance. While most nonmetallic minerals are extracted from surface operations, some minerals existing in bedded or other sedimentary deposits may be accessed by underground extraction techniques. Potash, salt, soda, and borate minerals, as well as chemical and fertilizer minerals, are some of the minerals extracted using this mining method.

(1) Industrial Activities/Significant Materials. Industrial activities that may be associated with storm water discharges include: loading/unloading activities; haul roads; products and materials storage; waste piles; and processing activities. Exposed materials associated with surface beneficiation and processing facilities at underground mines are similar to those associated with open pit, open face, and quarrying facilities.

(2) Materials Management Practices. Materials management practices for significant materials at the surface of underground mining facilities are similar to those materials management practices used at open pit, open face, and quarrying operations.

e. Inactive Mine Sites. Inactive mineral mining and processing operations are those where industrial activities are no longer occurring. When active, mineral extraction could have occurred from open pits or open face mines, solution mines, dredging operations, or underground mines. These sites are included in this section because significant materials may remain onsite. These materials, if exposed, are potential sources of storm water pollutants. Until an inactive mineral mining and processing facility has been reclaimed under applicable State or Federal laws, the site is considered associated with an "industrial activity" and is subject to this section. Due to the seasonal nature of this industry, many mine sites can become temporarily inactive for extended periods.

2. Pollutants in Storm Water Discharges Associated With Mineral Mining and Processing Facilities

Impacts caused by storm water discharges from active and inactive mineral mining and processing operations will vary. Several factors influence to what extent significant materials from mineral mining and processing operations may affect water quality. Such factors include: geographic location; hydrogeology; the type of mineral extracted; the mineralogy of the extracted resource and the surrounding rock; how the mineral was extracted (e.g., quarrying/open face, dredging, solution, or underground mining operations); the type of industrial activities occurring onsite (e.g., extraction, crushing, washing, processing, reclamation etc.); the size of the operation; and type, duration, and intensity of precipitation events. Each of these and other factors will interact to influence the quantity and quality of storm water runoff. For example, air emissions (i.e., settled dust) may be a significant source of pollutants at some facilities while materials storage is a primary source at others. In addition, sources of pollutants other than storm water, such as illicit connections,[71] spills, and other improperly dumped materials, may increase the pollutant loadings discharged into waters of the United States.

The part 2 group application data requirements did not identify individual site characteristics which may be responsible for elevated or insignificant conventional pollutant loadings.

Based on the wide variety of industrial activities and significant materials at the facilities included in this sector, EPA believes it is appropriate to divide the mineral mining and processing industry into subsectors to properly analyze sampling data and determine monitoring requirements. As a result, this sector has been divided into the following subsectors: dimension stone, crushed stone mining and nonmetallic minerals mining (except fuels); sand and gravel mining; clay, ceramic, and refractory materials mining; chemical and fertilizer mineral mining. The tables below include data for the eight pollutants that all facilities were required to monitor for under Form 2F. The tables also list those parameters that EPA has determined merit further monitoring. A table has not been included for the following facilities because less than 3 facilities submitted data in these subsectors: clay, ceramic, and refractory materials mining; and chemical and fertilizer mineral mining facilities.

TABLE J–2.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY DIMENSION STONE AND CRUSHED PRODUCTS FACILITIES SUBMITTING PART II SAMPLING DATA[i] (mg/L)

Pollutant	No. of facilities		No. of samples		Mean		Minimum		Maximum		Median		95th percentile		99th percentile	
Sample type	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	12	8	15	11	6.3	7.0	0.0	0.0	22.3	16.0	4.0	6.0	19.4	16.9	36.1	25.4
COD	12	8	16	10	37.9	46.4	0.0	0.0	140.0	140.0	33.0	44.0	136.1	159.8	243.3	284.8
Nitrate + Nitrite Nitrogen	6	2	10	4	0.59	0.08	0.00	0.00	3.00	0.30	0.10	0.00	2.89	.	7.96	.
Total Kjeldahl Nitrogen	12	8	15	10	1.56	1.91	0.10	0.34	5.71	6.89	0.67	1.15	6.12	6.47	13.70	13.09
Oil & Grease	11	N/A	15	N/A	1.7	N/A	0.0	N/A	10.0	N/A	0.0	N/A	9.8	N/A	27.4	N/A
pH	11	N/A	15	N/A	N/A	N/A	6.2	N/A	8.5	N/A	7.2	N/A	8.4	N/A	8.9	N/A
Total Phosphorus	12	8	15	10	0.70	0.24	0.00	0.00	7.06	0.71	0.20	0.17	3.12	1.18	10.36	2.89
Total Suspended Solids	12	8	15	10	2522	1920	0	0	27100	13300	124	636	27188	10641	217687	38624

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.

[ii] Composite samples.

[71] Illicit connections are contributions of unpermitted non-storm water discharges to storm sewers from any of a number of sources including sanitary sewers, industrial facilities, commercial establishments, or residential dwellings. The probability of illicit connections at mineral mining and processing facilities is low yet it still may be applicable at some operations.

TABLE J-3.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY SAND AND GRAVEL PRODUCTS FACILITIES SUBMITTING PART II SAMPLING DATA[i] (mg/L)

Pollutant	No. of facilities		No. of samples		Mean		Minimum		Maximum		Median		95th percentile		99th percentile	
Sample type	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	8	5	9	5	6.4	8.7	0.0	0.0	35.0	17.0	3.3	7.4	27.8	23.1	67.0	34.5
COD	7	5	8	5	145.9	102.8	0.0	12.0	404.0	185.0	54.2	116.0	635.5	441.5	1366.7	918.1
Nitrate + Nitrite Nitrogen	7	5	8	5	1.56	3.31	0.00	0.54	9.00	8.80	0.41	1.63	11.56	12.50	44.19	25.92
Total Kjeldahl Nitrogen	7	5	8	5	1.79	1.60	0.48	0.80	4.90	3.10	1.42	0.96	4.42	3.84	7.00	5.90
Oil & Grease	8	N/A	9	N/A	1.3	N/A	0.0	N/A	5.9	N/A	0.0	N/A	5.1	N/A	8.0	N/A
pH	9	N/A	10	N/A	N/A	N/A	6.0	N/A	10.0	N/A	8.2	N/A	10.8	N/A	12.2	N/A
Total Phosphorus	7	5	8	5	1.39	1.07	0.04	0.11	4.69	2.61	0.53	1.10	10.02	5.50	37.75	13.65
Total Suspended Solids	7	5	8	5	503	519	0	13	2400	1400	97	232	3981	4367	19143	15278

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.

[ii] Composite samples.

3. Options for Controlling Pollutants

There are two options for reducing pollutants in storm water discharges: end-of-pipe treatment and implementing Best Management Practices to prevent and/or eliminate pollution. Discharges from mining operations are in some ways dissimilar to other types of industrial facilities. Mining facilities are often in remote locations and may operate only seasonally or intermittently, yet need year-round controls because significant materials remain exposed to precipitation when reclamation is not completed. These characteristics make resource intensive end-of-pipe management controls less desirable.

A comprehensive storm water management program for a given plant may include controls from each of these categories. Development of comprehensive control strategies should be based on a consideration of site and facility plant characteristics.

a. End-of-Pipe Treatment. At many mineral mining and processing operations, it may be appropriate to collect and treat the runoff from targeted areas of the facility. This approach was taken with 12 industrial categories within the mineral mining and processing industry, subject to national effluent limitation guidelines for process water. Table J–4 identifies the effluent limitation guidelines for process water and for the mineral mining and processing sector. There are several areas where process wastewater guidelines influence the permitting strategy for storm water discharges. Whenever storm water and process wastewater combine, the storm water is treated as process wastewater. To meet the numeric effluent limitation for process water, most, if not all, facilities must collect and temporarily store onsite runoff from targeted areas of the plant. The effluent limitation guidelines do not apply to discharges whenever rainfall events, either chronic or catastrophic, cause an overflow of storage devices designed, constructed, and maintained to contain a 10-year, 24-hour storm. Most technology-based treatment standards, used for treating process waters, are based on relatively simple technologies such as settling of solids, neutralization, and drum filtration.

TABLE J–4.—Mineral Mining and Processing: Effluent Limitation Guidelines

SIC Code	Category	Subcategory	Effluent guidelines
1411	Dimension Stone	N/A	Reserved
1422	Crushed and Broken Limestone	N/A	For Facilities that recyle process waste water: pH 6.0–9.0.
1423	Crushed and Broken Granite		Mine dewatering discharges: pH 6.0–9.0.
1429	Crushed and Broken Stone, Not Elsewhere Classified.		In no case shall a pH limitation outside the range of 5.0–9.0 be permitted.
1442	Construction Sand and Gravel	N/A	For facilities that recycle process waste water: pH 6.0–9.0.
			Mine dewatering discharges: pH 6.0–9.0.
			In no case shall a pH limitation outside the range of 5.0–9.0 be permitted.
1446	Industrial Sand	N/A	All operations except HF flotation:
			TSS: Not to exceed 45mg/L maximum for any 1 day; Average over 30 days not to exceed 25 mg/L.
			pH Within range 6.0–9.0.
			For facilities using HF flotation:
			TSS: Not to exceed 0.046 mg/L maximum for any 1 day; Average over 30 days not to exceed 0.023 mg/L.
			Total Fluoride: Maximum for 1 day: 0.006 mg/L; Average over 30 days: 0.003 mg/L.
			pH Within range 6.0–9.0.
			Mine dewatering discharges:
			TSS: Maximum for 1 day: 45 mg/L; Average over 30 days: 25 mg/L.
			pH: Within range 6.0–9.0.
1455	Kaolin and Ball Clay	Ball Clay Kaolin	Reserved.
1459	Clay, Ceramic, and Refractory Minerals, Not Elsewhere Classified.	Bentonite Magnesite	No Discharge.

TABLE J–4.—Mineral Mining and Processing: Effluent Limitation Guidelines—Continued

SIC Code	Category	Subcategory	Effluent guidelines
		Feldspar, Fire Clay, Attapulgite, and Montmovillonite, Kyanite, Shale and Common Clay Aplite.	Reserved.
1474	Potash, Soda, and Borate Minerals	Borax, Potash, Sodium Sulfate	No Discharge.
		Trona, Rock Salt	Reserved.
1475	Phosphate Rock	N/A	Existing Sources.
			TSS: Maximum for any 1 day: 60 mg/L; Average over 30 days: 30 mg/L.
			pH: Within range 6.0–9.0.
			New sources, process generated wastewater and mine dewatering discharges:
			TSS: Maximum for any 1 day: 60 mg/L; Average over 30 days: 30 mg/L.
			pH: Within range 6.0–9.0.
1479	Chemical and Fertilizer Mineral Mining, Not Elsewhere Classified.	Barite, Fluorspar, Salines from Brine Lakes, Frasch Sulfur.	No Discharge.
		Mineral Pigments, Lithium	Reserved.
1499	Miscellaneous Nonmetallic Minerals, Except Fuels.	Graphite	Process waste water and mine drainage subject to ELG:
			TSS: Maximum for any 1 day: 20 mg/L; Average over 30 days: 10 mg/L.
			Total Fe: Maximum for any 1 day: 2 mg/L; Average over 30 days: 1 mg/L.
			pH: Within range 6.0–9.0.
		Gypsum, Asphaltic Minerals, Asbestos and Wollastonite, Diatomite, Jade, Tripoli (Dry Processes Only).	No discharge.
		Garnet, Talc, Steatite, Soapstone, Pyrophyllite, Mica and Sericite.	Reserved.

End-of-pipe treatments are effective means to control process wastewaters because the types of pollutants and the volume of water to be treated are known. However, storm water discharges from mineral mining and processing facilities can be numerous, intermittent, and of various volumes. Channelization of all storm water that comes into contact with significant materials into a single treatment facility, or construction of numerous treatment devices for each discharge is too burdensome for the regulated community. Therefore, EPA believes that the most appropriate means of storm water management at mineral mining and processing facilities are BMPs. BMPs allow the mine site operator to choose a particular BMP that is best for the characteristics of a particular site and to control parameters of concern.

b. Best Management Practices. EPA believes that the most effective storm water management controls for limiting the offsite discharge of storm water pollutants from mineral mining and processing facilities are source reduction BMPs. Source reduction BMPs are methods by which discharges of contaminants are controlled with little or no required maintenance. Examples of these types of controls include source reduction diversion dikes, vegetative covers, and berms. Source reduction practices are typically (but not always) low in cost and relatively easy to implement. In some instances, more resource intensive treatment BMPs, including sedimentation ponds, may be necessary depending upon the type of discharge, types and concentrations of contaminants, and volume of flow.

The selection of the most effective BMPs will be based on site-specific considerations such as: facility size, climate, geographic location, hydrogeology and the environmental setting of each facility, and volume and type of discharge generated. Each facility will be unique in that the source, type, and volume of contaminated storm water discharges will differ. In addition, the fate and transport of pollutants in these discharges will vary. EPA believes that the management practices discussed herein are well suited mechanisms to prevent or control the contamination of storm water discharges associated with mining activity.

The following six categories describe best management practice options for reducing pollutants in storm water discharges from mineral mining and processing operations: discharge diversions; drainage/storm water conveyance systems; runoff dispersion; sediment control and collection; vegetation/soil stabilization; capping of contaminated sources.

Typical land disturbance activities at mineral mining and processing sites include roads, open pits and quarries, topsoil, overburden, waste rock, subore, ore and product piles; materials storage, mill tailings, ponds and piles, as well as vehicle maintenance and storage areas. Because mineral mining and processing is largely a land disturbance activity, BMPs that minimize erosion and sedimentation will be most effective if installed at the inception of operations and maintained throughout active operations and reclamation of the site. From the construction of access and haul roads to closure and reclamation activities, implementation of BMPs is often essential to minimizing long-term environmental impacts to an area.

Part 1 group application data indicate that several types of BMPs have been implemented at sampling facilities. Commonly used BMPs were sediment control and collection and discharge diversion devices. However, the group application process did not require a description of BMP locations and did not require applicants to describe the number of identical BMPs implemented at each site. As a result, the effectiveness of BMPs for storm water management, at these facilities cannot be evaluated.

In addition, many of the BMPs listed by facilities may have been implemented as process wastewater treatment mechanisms and are not exclusively used for storm water management. For instance, 43 percent of the sampling subgroup reported using ponds for sediment control and collection. Since some facilities classified as SIC Code 14 are subject to process water effluent limitation guidelines, sedimentation ponds may have been implemented to meet the limit.

Because BMPs described in the part 1 data are limited, EPA is providing an overview of supplementary BMPs for use at mineral mining and processing facilities. However, due to the site-specific nature of facilities within this sector, BMPs cited do not preclude the use of other viable BMP options. Table J–5 summarizes BMP options as they apply to land disturbance activities at mineral mining and processing facilities. Sources of BMP information include: "Sediment and Erosion Control: An Inventory of Current Practices—Draft," EPA, April 20, 1990; "Storm Water Management for Industrial Activities: Developing Pollution Prevention Plans and Best Management Practices," EPA, September, 1992 (EPA 832–R–92–006); "Best Management Practices for Mining in Idaho," Idaho Department of Lands, November 1992; and "Erosion & Sediment Control Handbook," Goldman et al., McGraw-Hill Book Company, 1986.

TABLE J–5.—SUMMARY OF MINE AREAS AND APPLICABLE BEST MANAGEMENT PRACTICES

Land-disturbed area	Discharge diversions	Conveyance systems	Runoff dispersion	Sediment control & collection	Vegetation	Containment
Haul Roads and Access Roads.	Dikes, Curbs, Berms.	Channels, Gutters, Culverts, Rolling Dips, Road Sloping, Roadway Water Deflectors.	Check Dams, Rock Outlet Protection, Level Spreaders, Stream Alteration, Drop Structures.	Gabions, Riprap, Native Rock Retaining Walls, Straw Bale Barriers, Sediment Traps/Catch Basins, Vegetated Buffer Strips.	Seeding, Willow Cutting Establishment.	
Pits/Quarries or Underground Mines.	Dikes, Curbs, Berms.	Channels, Gutters	Serrated Slopes, Benched Slopes, Contouring, Stream Alteration.	Sediment Settling Ponds, Straw Bale Barrier, Siltation Berms.	Seeding	Plugging and Grouting
Overburden, Waste Rock and Raw Material Piles.	Dikes, Curbs, Berms.	Channels, Gutters	Serrated Slopes, Benched Slopes, Contouring, Stream Alteration.	Plastic Matting, Plastic Netting, Erosion Control Blankets, Mulch-straw, Compaction, Sediment/Settling Ponds, Silt Fences, Siltation Berms.	Topsoiling, Seedbed Preparation, Seeding.	Capping
Reclamation	Dikes, Curbs, Berms.	Channels, Gutters	Check Dams, Rock Outlet Protection, Level Spreaders, Serrated Slopes, Benched Slopes, Contouring, Drain Fields, Stream Alteration, Drop Structures.	Gabions, Riprap, and Native Rock Retaining Walls, Biotechnical Stabilization, Straw Bale Barriers, Sediment Traps/ Catch Basins, Vegetative Buffer Strips, Silt Fences, Siltation Berms, Brush Sediment Barriers.	Topsoiling, Seedbed Preparation, Seeding, Willow Cutting Establishment.	Capping, Plugging and Grouting

Haul Roads and Access Roads—Placement of haul roads or access roads should occur as far as possible from natural drainage areas, lakes, ponds, wetlands or floodplains where soil will naturally be less stable for heavy vehicle traffic. If a haul road must be constructed near water, as little vegetation as possible should be removed from between the road and the waterway, as vegetation is a useful buffer against erosion and is an efficient sediment collection mechanism. The width and grade of haul or access roads should be minimal and should be designed to match natural contours of the area. Construction of haul roads should be supplemented by BMPs that divert runoff from road surfaces, minimize erosion, and direct flow to appropriate channels for discharge to treatment areas.

Pits or Quarries—Excavation of a pit or quarry must be accompanied by BMPs to minimize impacts to area surface waters. As discussed in construction of haul roads, as little vegetation as possible should be removed from these areas during excavation activities to minimize exposed soils. In addition, stream channels and other sources of water that may discharge into a pit or quarry should be diverted around that area to prevent contamination.

Overburden, Waste Rock, and Raw Material Piles—Overburden, topsoil, and waste rock, as well as raw material and intermediate and final product stockpiles should be located away from surface waters and other sources of water, and from geologically unstable areas. If this is not practicable, surface water should be diverted around the piles. As many piles as possible should be revegetated (even if only on a temporary basis). At closure, remaining units should be reclaimed.

BMPs can be used to control total suspended solids levels in runoff from unvegetated areas. These can include sediment/settling ponds, check dams, silt fences, and straw bale barriers.

Reclamation Activities—When a mineral deposit is depleted and operations cease, a mine site must be reclaimed according to appropriate State or Federal standards. Closure activities typically include restabilization of any disturbed areas such as access or haul roads, pits or quarries, sedimentation ponds or work-out pits, and any remaining waste piles. Overburden and topsoil stockpiles may be used to fill in a pit or quarry (where practical). Recontouring and vegetation should be performed to stabilize soils, and prevent erosion.

Major reclamation activities such as recontouring roads and filling in a pit or quarry can only be performed after operations have ceased. However, reclamation activities such as stabilization of banks and reseeding and revegetation should be implemented in mined out portions, or inactive areas of a site as active mining moves to new areas.

EPA recognizes that quarries are frequently converted into reservoirs or recreational areas, after the mineral deposit is depleted. However, this does not preclude the reclamation of disturbed areas above the quarry rim.

(1) Discharge Diversions. Discharge diversions provide the first line of defense in preventing the contamination of discharges and the subsequent contamination of receiving waters of the United States. Discharge diversions are temporary or permanent structures installed to divert flow, store flow, or limit storm water runon and runoff.

These diversion practices have several objectives. First, diversion structures can be designed to prevent otherwise uncontaminated (or less contaminated) water from crossing disturbed areas or areas containing significant amounts of contaminated materials, where contact may occur between runon and significant materials. These source reduction measures may be particularly effective for mineral mining and processing operations to prevent runon of uncontaminated discharges from contacting exposed materials and/or reduce the flow across disturbed areas, thereby lessening the potential for erosion. Second, diversion structures can be used to collect or divert waters for later treatment if necessary. The usefulness of these control measures are limited by such factors as the size of the area to be controlled and the type and nature of materials exposed and precipitation events.

Diversion dikes, curbs, and berms are temporary or permanent diversion structures that prevent runoff from passing beyond a certain point, and divert runoff away from its intended path. Dikes, curbs or berms may be used to surround and isolate areas of concern at mineral mining and processing sites, diverting flow around piles of overburden, waste rock, and storage areas, to minimize discharge contact with contaminated materials and to limit discharges of contaminated water from confined areas.

(2) Drainage/Storm Water Conveyance Systems. Drainage or storm water conveyance systems can provide either a temporary or a permanent management practice which functions to channel water away from eroded or unstabilized areas, convey runoff without causing erosion, and/or carry discharges to more stabilized areas. The use of drainage systems as a permanent measure may be most appropriate in areas with extreme slopes, areas subject to high velocity runoff, and other areas where the establishment of substantial vegetation is infeasible or impractical. For instance, several BMPs described below may be useful storm water and erosion control methods applicable to road construction and maintenance activities.

Channels or Gutters—Channels or gutters collect storm water runoff and direct its flow. Like diversion systems, channels or gutters may act to divert runoff away from a potential source of contamination, but may also be used to channel runoff to a collection and/or treatment area including settling ponds, basins or work-out pits.

Open Top Box Culverts, and Waterbars—These structures are temporary or permanent structures that divert water from a roadway surface. Open top box culverts may be used on steeply graded, unpaved roads in place of pipe culverts to divert surface runoff and flow from inside ditches onto the downhill slope of a road. These structures are typically made of wood and should periodically be monitored and repaired if necessary.

Waterbars are berms built by a dozer or by hand to a one to two foot height. They serve to extend the entire width of the road, with a downslope angle between 30 and 40 percent. Waterbars are kept open at a discharge end to allow water to flow away from the road and require little maintenance. These berms may be used as temporary or permanent structures.

Rolling Dips and Road Sloping—Rolling dips and road sloping are permanent water diversion techniques installed using natural contours of the land during road construction. These BMPs prevent water accumulation on road surfaces and divert surface runoff toward road ditches which then convey the storm water to ponds or other management areas.

Roadway Surface Water Deflector—A roadway surface water deflector is another technique to prevent accumulation of water on road surfaces. The structure uses a conveyor belt sandwiched between two pieces of treated wood and placed within the road to deflect water. This is a useful technique for steeply graded, unpaved roads.

Culverts—Culverts are permanent surface water diversion mechanisms used to convey water off of, or underneath a road. Made of corrugated metal, they must extend across the entire width of the road and beyond the fill slope. Additional erosion control mechanisms may need to be installed at the discharge end of the culvert.

(3) Runoff Dispersion. Drainage systems are most effective when used in conjunction with runoff dispersion devices designed to slow the flow of water discharged from a site. These devices also aid storm water infiltration into the soil and flow attenuation. Some examples of velocity dissipation devices include check dams, rock outlet protection, level spreaders, and serrated and benched slopes.

Check Dams—Check dams are small temporary dams constructed across swales or drainage ditches to reduce the velocity of runoff flows thereby reducing erosion and failure of the swale or ditch. This slowing reduces erosion and gullying in the channel and allows sediments to settle.

Check dams may be installed in small temporary or permanent channels where vegetation of the channel lining is not feasible and where there is danger of erosion. These may be areas where installation of nonerosive liners are not cost effective.

Check dams diminish the need for more stringent erosion control practices in the drainage ditch since they decrease runoff velocity. When constructing check dams, the use of overburden or waste rock should be avoided where there is the potential for contamination.

Rock Outlet Protection—Rock protection placed at the outlet end of culverts, channels, or ditches reduces the depth, velocity, and destructive energy of water such that the flow will not erode the downstream reach. The use of some materials (e.g., mine waste rock or ore) should be avoided where contamination may occur. As with check dams, rock outlet protection may also be used as a source reduction treatment mechanism by using rocks containing limestone or other alkaline materials to neutralize acidic discharges.

Level Spreaders—Level spreaders are outlets for dikes and diversions consisting of an excavated depression constructed at zero grade across a slope. Level spreaders diffuse storm water point sources and release it onto areas stabilized by existing vegetation.

Serrated Slopes and Benched Slopes—These runoff dispersion methods break up flow of runoff from a slope, decreasing its ability to erode. Serrated and benched slopes provide flat areas that allow water to infiltrate, and space for vegetation to grow and reinforce soils. Serrated slopes are equipped with small steps, from one to two feet of horizontal surface exposed on each step. Benched slopes have larger steps with vertical cuts between two and four feet high.

Contouring—Surface contouring is the establishment of a rough soil surface amenable to revegetation through creating horizontal grooves, depressions, or steps that run with the contour of the land. Slopes may also be left in a roughened condition to reduce discharge flow and promote infiltration. Surface roughening aids in the establishment of vegetative cover by reducing runoff velocity and giving seed an opportunity to take hold and grow.

This technique is appropriate for all slopes steeper than 3:1 in order to facilitate stabilization of the slope and promote the growth of a vegetative cover. Once areas have been contoured, they should be seeded as quickly as possible.

Drain Fields—Drain fields are used to prevent the accumulation of water and/or ground water at a site by diverting infiltrating sources through gravity flow or pumping. Typically filled with porous, permeable materials such as graded rock, or perforated pipe, and lined with geotextile fabric, these mechanisms are useful underneath significant materials, reducing the amount of water that ultimately comes into contact with significant materials.

Stream Alteration—Altering or channelizing the path of a stream to bypass all or some disturbed areas on a site, allows additional mining activities and avoids contamination of stream water by disturbed lands. This practice is complicated, however, by the need to restore the channel when mining operations end.

Drop Structures—Drop structures are large angular rocks placed in a V-shaped pattern to slow the velocity of storm water runoff. These structures are typically reinforced by logs or large rocks imbedded in the streambanks.

(4) Sediment Control and Collection. Sediment control and collection limits movement and retains sediments from being transported offsite. Several structural collection devices have been developed to remove sediment from runoff before it leaves the site. Several methods of removing sediment from site runoff involve diversion mechanisms previously discussed, supplemented by a trapping or storage device. Structural practices typically involve filtering diffuse storm water flows through temporary structures such as straw bale dikes, silt fences, brush barriers or vegetated areas.

Structural practices are typically low in cost. However, structural practices require periodic removal of sediment to remain functional. As such, they serve as more active-type practices which may not be appropriate for permanent use at inactive mines. However, these practices may be effectively used as temporary measures during active operation and/or prior to the final implementation of permanent measures.

(a) Temporary Treatments

Plastic Matting, Plastic Netting, and Erosion Control Blankets—These BMPs are used to protect bare soils and control dust and erosion. Mats and blankets help to promote vegetative growth by maintaining moisture and heat within the soil. Plastic matting and netting improve slope stabilization and may be used as a permanent treatment to encourage grass growth. Plastic netting is a more effective material to use while promoting growth of vegetation as it permits sunlight to penetrate through to the soils. Erosion control blankets also stabilize slopes and control erosion. These blankets may be made of jute or plastic netting which are more expensive than straw.

Mulch-straw or Wood Chips—Mulches and wood chips are useful temporary covers for bare or seeded soils with an erosion control effectiveness rating of 75 to 98 percent.[72] Like matting, mulch-straw or wood chips help soils retain moisture and warmth to promote vegetative growth. Used on slopes and/or in combination with nylon netting, these materials may prevent erosion by wind and water. Over time, however, the mulch cover will decrease in effectiveness.

Compaction—Soil compaction using a roller or other heavy equipment increases soil "strength" by increasing its density. More dense soil is less prone to erosion and long-term soil settlement. The surface of compacted soils should be roughed and seeded or vegetated to increase its durability.

(b) Permanent Treatments

Sediment/Settling Ponds—Sediment ponds function as sediment traps by containing runoff for long periods of time, allowing suspended solids to settle. These structures can achieve a high removal rate of sediment for both process wastewater and storm water discharges. Sediment/settling ponds are easily constructed and require minimal maintenance. Their flexibility to treat both process wastewater and storm water makes the use of ponds a desirable treatment for discharges from mineral mining and processing facilities. Of course, site characteristics must be such that some or all discharges can be practically channeled to a centralized area for treatment. Where this is not practical, the cost of constructing multiple sediment ponds may become prohibitive. In addition, periodic dredging may be required in order to maintain the capacity of these ponds.

Discharge ponds may also be designed to act as surge ponds which are designed to contain storm surges and then completely drain in about 24 to 40 hours, and remain dry during times of no rainfall. They can provide pollutant removal efficiencies that are similar to those of detention ponds.[73] Storm surge ponds are typically designed to provide both water quality and water quantity (flood control) benefits.[74]

Gabions, Riprap, and Native Rock Retaining Walls—These BMPs are all forms of slope stabilization. Gabions consist of rocks (riprap) contained by rectangular wire boxes or baskets for use as permanent erosion control structures.

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[72] "Sediment and Erosion Control: An Inventory of Current Practices—Draft," EPA, April 20, 1990.

[73] "Urban Targeting and BMP Selection," EPA, Region V, November 1990.

[74] "Urban Surface Water Management," Walesh, S.G., Wiley, 1989.

Riprap consists of loose rocks placed along embankments to prevent erosion. Native rock retaining walls are another form of slope stabilization, with walls up to five feet in height, constructed from native rock to reinforce a steep slope.

Biotechnical Stabilization—Biotechnical stabilization uses live brush imbedded in the soils of a steep slope to prevent erosion. This method relies on the premise that the imbedded vegetation will eventually root and help stabilize the slope.

Straw Bale Barrier—Straw bales may be used as temporary berms, barriers, or diversions; capturing sediments, filtering runoff. When installed and maintained properly, these barriers remove approximately 67 percent of the sediment load.[75] These barriers are applicable across small swales, in ditches, and at the toe of bare slopes where there is a temporary large volume of sediment laden runoff.

Sediment Traps or Catch Basins—These temporary or permanent structures are useful for catching and storing sediment laden storm water runoff and are particularly useful during construction activities to contain runoff. The effectiveness of these BMPs is better in smaller drainage basin areas. Sediment traps are less than 50 percent effective in removing sediment from storm water runoff.[76]

Vegetated Buffer Strips—The installation of vegetated buffer strips will reduce runoff and prevent erosion at a removal efficiency rate of 75 to 99 percent depending upon the ground cover.[77] In addition, vegetated buffer strips catch and settle sediment contained in the storm water runoff prior to reaching receiving waters.

Silt Fence/Filter Fence—A low fence made of filter fabric, wire and steel posts, should be used on small ephemeral drainage areas where storm water collects or leaves a mine site. Silt fences remove 97 percent of the sediment load and are easier to maintain and remove without creating lasting impacts to the environment.[78] Silt and filter fences need to be inspected periodically and may not be as effective as straw bales, since fabric may become clogged with fine particles preventing water flow.

Silt fences may have limited applicability for large areas. They are most effective for use in a small drainage areas. These fences may also be used in conjunction with nonstructural practices to maintain the integrity of soil prior to the establishment of vegetation.

Siltation Berms—Siltation berms are typically placed on the downslope side of a disturbed area to act as an impermeable barrier for the capture and retention of sediments in surface water runoff. Plastic sheeting is typically used to cover the berm. The berm and the plastic sheeting may require periodic maintenance and repair.

Brush Sediment Barriers—Brush barriers are temporary sediment barriers composed of tree limbs, weeds, vines, root mat, soil, rock and other cleared materials placed at the toe of a slope. A brush barrier is effective only for small drainage areas, usually less than 1/4 acre, where the slope is minimal.

Brush barriers do not function as permanent barriers since over time the barrier itself will degrade. This BMP is most effective when located at the toe of a slope of an area in which vegetation is being grown or during temporary operations. The brush barriers remove any excessive sediment generated by erosion prior to the establishment of vegetation.

(5) Vegetation Practices. Vegetation practices involve establishing a sustainable ground cover by permanent seeding, mulching, sodding, and other such practices. A vegetative cover reduces the potential for erosion of a site by: absorbing the kinetic energy of raindrops which would otherwise impact soil; intercepting water so it can infiltrate into the ground instead of running off and carrying contaminated discharges; and by slowing the velocity of runoff to promote onsite deposition of sediment. Vegetative controls are often the most important measures taken to prevent offsite sediment movement and can provide a six-fold reduction in the discharge of suspended sediment levels.[79] Permanent seeding has been found to be 99 percent effective in controlling erosion for disturbed land areas.[80] Many States require that topsoil be segregated from other overburden for use during reclamation. While stored, topsoil stockpiles should be vegetated. This temporary form of vegetation can often be used for other piles of stored materials and for intermittent/seasonal operations.

Typically, the costs of vegetative controls are low relative to other discharge mitigation practices. Given the limited capacity to accept large volumes of runoff and potential erosion problems associated with large concentrated flows, vegetative controls should typically be used in combination with other management practices. These measures have been documented as particularly appropriate for mining sites.

Topsoiling, Seedbed Preparation—The addition of a layer of topsoil or plant growth material provides an improved soil medium for plant growth. Seedbed preparation may include the addition of topsoil ingredients to be mixed in with soils used for seedbed preparation. Ripping, dicing, and mixing soils promotes weed control and aerates the soil, encouraging seedling growth.

Broadcast Seeding and Drill Seeding—Seeding and vegetative planting are methods used to revegetate an area. Broadcast seeding spreads seeds uniformly, by hand or machine, to steep sloped or rocky areas, flat surfaces, and areas with limited access. Drill seeding is performed using a rangeland drill seeder and may not be used on rocky surfaces. Drill seeding is more suitably performed on flat, nonrocky surfaces, where the machine can insert seeds into the soil.

Willow Cutting Establishment—Willow cutting establishment describes a method of soil stabilization useful for stream banks and other areas located adjacent to water. Similar to biotechnical stabilization, willow cuttings are used to promote growth in an area needing stabilization. Willow cuttings are typically used to reinforce a streambank or other moist area. Willow cuttings require a great deal of moisture and must be planted in areas that remain moist for long periods in order to take hold and grow.

(6) Capping. In some cases, the elimination of a pollution source through capping contaminant sources may be the most cost effective control measure for discharges from inactive mineral mining and processing operations. Depending on the type of management practices chosen, the cost to eliminate the pollutant source may be very high. Once completed, however, maintenance costs will range from low to nonexistent.

Capping or sealing of waste materials is designed to prevent infiltration, as well as to limit contact between discharges and potential sources of

[75] "Sediment and Erosion Control: An Inventory of Current Practices—Draft," EPA, April 20, 1990, page IV–14.

[76] "Sediment and Erosion Control: An Inventory of Current Practices—Draft," EPA, April 20, 1990, page IV–26.

[77] "Sediment and Erosion Control: An Inventory of Current Practices—Draft," EPA, April 20, 1990, page IV–7.

[78] "Sediment and Erosion Control: An Inventory of Current Practices—Draft," EPA, April 20, 1990, page IV–15.

[79] "Performance of Current Sediment Control Measures at Maryland Construction Sites," January 1990, Metropolitan Washington Council of Governments, page X.

[80] "Sediment and Erosion Control: An Inventory of Current Practices—Draft," EPA, April 20, 1990, page IV–4.

contamination. Ultimately, capping should reduce or eliminate the contaminants in discharges. In addition, by reducing infiltration, the potential for seepage and leachate generation may also be lessened.

The use of this practice depends on the level of control desired, the materials available, and cost considerations. Many common liners may be effective including common soil, clay, and/or synthetic liners. Generally, soil liners will provide appreciable control for the lowest cost. Synthetic or clay liners may be appropriate to cover materials known to have a significant potential to impact water quality.

4. Storm Water Pollution Prevention Plan Requirements

Specific requirements for a pollution prevention plan for mineral mining and processing facilities are described below. These requirements must be implemented in addition to the common pollution prevention plan provisions discussed previously.

Under the description of potential pollution services, each storm water pollution prevention plan must describe activities, materials, and physical features of the facility that may contribute to storm water runoff or, during periods of dry weather, result in dry weather flows and mine pumpout. This assessment of storm water pollution will support subsequent efforts to identify and set priorities for necessary changes in materials, materials management practices, or site features, as well as aid in the selection of appropriate structural and nonstructural control techniques. Plans must describe the following elements:

The plan must contain a map of the site that shows the pattern of storm water drainage, structural features that control pollutants in storm water runoff[81] and process wastewater discharges, surface water bodies (including wetlands), places where significant materials[82] are exposed to rainfall and runoff, and locations of major spills and leaks that occurred in the 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit. The map also must show areas where the following activities take place: fueling, vehicle and equipment maintenance and/or cleaning, loading and unloading, material storage (including tanks or other vessels used for liquid or waste storage), material processing, and waste disposal, haul roads, access roads, and rail spurs. In addition, the site map must also indicate the outfall locations and the types of discharges contained in the drainage areas of the outfalls (e.g. storm water and air conditioner condensate). In order to increase the readability of the map, the inventory of the types of discharges contained in each outfall may be kept as an attachment to the site map.

Facility operators are required to carefully conduct an inspection of the site and related records to identify significant materials that are or may be exposed to storm water. The inventory must address materials that within 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit have been handled, stored, processed, treated, or disposed of in a manner to allow exposure to storm water. Findings of the inventory must be documented in detail in the pollution prevention plan. At a minimum, the plan must describe the method and location of onsite storage or disposal; practices used to minimize contact of materials with rainfall and runoff; existing structural and nonstructural controls that reduce pollutants in storm water runoff; existing structural controls that limit process wastewater discharges; and any treatment the runoff receives before it is discharged to surface waters or a separate storm sewer system. The description must be updated whenever there is a significant change in the types or amounts of materials, or material management practices, that may affect the exposure of materials to storm water.

The description of potential pollution sources culminates in a narrative assessment of the risk potential that those sources of pollution pose to storm water quality. This assessment should clearly point to activities, materials, and physical features of the facility that have a reasonable potential to contribute significant amounts of pollutants to storm water. Any such activities, materials, or features must be addressed by the measures and controls subsequently described in the plan. In conducting the assessment, the facility operator must consider the following activities: loading and unloading operations; outdoor storage activities; outdoor processing activities; significant dust or particulate generating processes; and onsite waste disposal practices. The assessment must list any significant pollution sources at the site and identify the pollutant parameter or parameters (i.e., total suspended solids, total dissolved solids, etc.) associated with each source.

Under the measures and controls section of the pollution prevention plan, the permittee must evaluate, select, and describe the pollution prevention measures, best management practices (BMPs), and other controls that will be implemented at the facility. The permittee must assess the applicability of the following BMPs for their site: discharge diversions, drainage/storm water conveyance systems, runoff dispersions, sediment control and collection mechanisms, vegetation/soil stabilization, and capping of contaminated sources. In addition, BMPs include processes, procedures, schedules of activities, prohibitions on practices, and other management practices that prevent or reduce the discharge of pollutants in storm water runoff.

The pollution prevention plan must discuss the reasons each selected control or practice is appropriate for the facility and how each will address the potential sources of storm water pollution. The plan also must include a schedule specifying the time or times during which each control or practice will be implemented. In addition, the plan should discuss ways in which the controls and practices relate to one another and, when taken as a whole, produce an integrated and consistent approach for preventing or controlling potential storm water contamination problems.

Under the preventive maintenance requirements of the pollution prevention plan, permittees are required to develop a preventive maintenance program that includes regular inspections and maintenance of storm water BMPs. The maintenance program requires periodic removal of debris from discharge diversions and conveyance systems. These activities should be conducted in the spring, after snowmelt, and during the fall season. Permittees already controlling their storm water runoff frequently use impoundments or sedimentation ponds. Maintenance schedules for these ponds must be provided in the pollution prevention plant.

Under the inspection requirements of the pollution prevention plan, operators

[81] Nonstructural features such as grass swales and vegetative buffer strips also should be shown.

[82] Significant materials include, "* * * but [are] not limited to: raw materials, fuels, materials such as solvents, detergents, and plastic pellets; finished materials such as metallic products; * * * hazardous substances designated under section 101(14) of CERCLA; any chemical facilities required to report pursuant to section 313 of title III of SARA; fertilizers; pesticides; and waste products such as ashes, slag, and sludge that have the potential to be released with storm water discharge." (40 CFR 122.26(b)(12)) Significant materials commonly found at mining facilities include: overburden; raw materials; waste rock piles; tailings; petroleum based products; solvents and detergents; and manufactured products, waste materials or by-products used or created by the facility.

of active facilities are required to conduct quarterly visual inspections of BMPs. Temporary and permanently inactive operations are required to perform annual inspections. Active sites have more frequent inspections than inactive sites because members of the pollution prevention team will be onsite, and the fact that they are active means there is a greater potential for pollution. The inspections shall include: (1) An assessment of the integrity of storm water discharge diversions, conveyance systems, sediment control and collection systems, and containment structures; (2) visual inspections of vegetative BMPs, serrated slopes, and benched slopes to determine if soil erosion has occurred; and (3) visual inspections of material handling and storage areas and other potential sources of pollution for evidence of actual or potential pollutant discharges of contaminated storm water.

The inspection must be made at least once in each designated period during daylight hours. Inspections for active facilities shall be conducted in each of the following periods: January through March; April through June; July through September; October through December.

EPA believes that this quick and simple description will allow the permittee to assess the effectiveness of his/her plan on a regular basis at very little cost. The frequency of this visual inspection will also allow for timely adjustments to be made to the plan. If BMPs are performing ineffectively, corrective action must be implemented. A set of tracking or follow up procedures must be used to ensure that appropriate actions are taken in response to the inspections. The visual inspection is intended to be performed by facility staff. This hands-on inspection will also enhance the staff's understanding of the storm water problems on that site and effects on the management practices that are included in the plan.

Under the recordkeeping and internal reporting procedures of the pollution prevention plan, the permittee must describe procedures for developing and retaining records on the status and effectiveness of plan implementation. The plan must address spills, monitoring, and BMP inspection and maintenance activities. Ineffective BMPs must be reported and the date of their corrective action noted.

Under the sediment and erosion control requirements of the pollution prevention plan, permittees must indicate the location and design for proposed BMPs to be implemented prior to land disturbance activities. For sites already disturbed but without BMPs, the permittee must indicate the location and design of BMPs that will be implemented. The permittee is required to indicate plans for grading, contouring, stabilization, and establishment of vegetative cover for all disturbed areas, including road banks. Reclamation activities must continue until final closure notice has been issued.

According to the pollution prevention runoff requirements, the permittee must evaluate the appropriateness of each storm water BMP that diverts, infiltrates, reuses, or otherwise reduces the discharge of contaminated storm water. In addition, the permittee must describe the storm water pollutant source area or activity (i.e., loading and unloading operations, raw material storage piles etc.) to be controlled by each storm water management practice.

a. Comprehensive Site Compliance Evaluation. The storm water pollution prevention plan must describe the scope and content of comprehensive site evaluations that qualified personnel will conduct to (1) confirm the accuracy of the description of potential pollution sources contained in the plan, (2) determine the effectiveness of the plan, and (3) assess compliance with the terms and conditions of this section. Comprehensive site compliance evaluations should be conducted once a year. When annual comprehensive site compliance evaluations are shown in the plan to be impractical for inactive mining sites, due to remote location and inaccessibility, site evaluations must be conducted at least once every 3 years. The individual or individuals who will conduct the evaluations must be identified in the plan and should be members of the pollution prevention team. Evaluation reports must be retained for at least 3 years after the date of the evaluation.

Based on the results of each evaluation, the description of potential pollution sources, and measures and controls, the plan must be revised as appropriate within 2 weeks after each evaluation. Changes in the measures and controls must be implemented on the site in a timely manner, and never more than 12 weeks after completion of the evaluation.

5. Numeric Effluent Limitation

Except as discussed below, there are no additional numeric effluent limitations under this section beyond those stated in section V.B of today's permit. Part XI.J.4. of today's permit establishes numeric effluent limitations for mine dewatering discharges that are composed entirely of storm water or ground water seepage from construction sand and gravel, industrial sand and crushed stone mines that are located in Region VI (the States of Louisiana, New Mexico, Oklahoma, and Texas). Discharges from these areas may not exceed a maximum TSS concentration of 45 mg/L for any one day or 25 mg/L for the average of daily values for 30 consecutive days. The pH of the discharges from these areas must be within the range of 6.0 to 9.0. These effluent limitations are in accordance with the Crushed Stone, Construction Sand and Gravel, and Industrial Sand Subcategories of the Mineral Mining and Processing Point Source Categories (40 CFR 436.20, 436.30 and 40 CFR 436.40). These limitations represent the degree of effluent reduction attainable by the application of best practicable control technology and best conventional pollutant control technology. Dischargers subject to these numeric effluent limitations must be in compliance with the limits upon commencement of and for the entire term of this permit.

6. Monitoring and Reporting Requirements

a. Monitoring Requirements. Under the revised methodology for determining pollutants of concern in the various industrial categories, dimension and crushed stone and nonmetallic minerals (except fuels) mining and sand and gravel mining facilities are required to monitor for the pollutants listed in the applicable table below (Table J–6 or J–7). The pollutants listed in this table were found to be above benchmark levels. EPA is requiring monitoring after the pollution prevention plan has been implemented to assess the effectiveness of the pollution prevention plan and to help ensure that a reduction of pollutants is realized.

TABLE J–6.—MONITORING REQUIREMENTS FOR DIMENSION AND CRUSHED STONE AND NONMETALLIC MINERALS (EXCEPT FUELS) (MG/L)

Pollutant of concern	Monitoring cut-off concentration
Total suspended solids.	100 mg/L.

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TABLE J-7.—MONITORING REQUIREMENTS FOR SAND AND GRAVEL MINING

Pollutants of concern	Monitoring cut-off concentration
Total suspended solids.	100 mg/L.
Nitrate plus Nitrite Nitrogen.	0.68 mg/L.

At a minimum, storm water discharges from dimension and crushed stone, sand and gravel and nonmetallic mineral (except fuels) mining must be monitored quarterly during the second year of permit coverage. Samples must be collected at least once in each of the following periods: January through March; April through June; July through September; and October through December. At the end of the second year of permit coverage, a facility must calculate the average concentration for each parameter listed in the applicable table (Table J-6 or J-7). If the permittee collects more than four samples in this period, then they must calculate an average concentration for each pollutant of concern for all samples analyzed.

If the average concentration for a parameter is less than or equal to the cut-off concentration, then the permittee is not required to conduct quantitative analysis for that parameter during the fourth year of the permit. If, however, the average concentration for a parameter is greater than the cut-off concentration, then the permittee is required to conduct quarterly monitoring for that parameter during the fourth year of permit coverage. Monitoring is not required during the first, third, and fifth year of the permit. The exclusion from monitoring in the fourth year of the permit is conditional on the facility maintaining industrial operations and BMPs that will ensure a quality of storm water discharges consistent with the average concentrations recorded during the second year of the permit. The schedule for monitoring is presented in Table J-8.

TABLE J-8.—SCHEDULE OF MONITORING

2nd year of permit coverage.	• Conduct quarterly monitoring. • Calculate the average concentration for all parameters analyzed during this period. • If average concentration is greater than the value listed in Table J-6 or J-7, then quarterly sampling is required during the fourth year of the permit. • If average concentration is less than or equal to the value listed in Table J-6 or J-7, then no further sampling is required for that parameter.
4th year of permit coverage.	• Conduct quarterly monitoring for any parameter where the average concentration in year 2 of the permit is greater than the value listed in Table J-6 or J-7. • If industrial activities or the pollution prevention plan have been altered such that storm water discharges may be adversely affected, quarterly monitoring is required for all parameters of concern.

In cases where the average concentration of a parameter exceeds the cut-off concentration, EPA expects permittees to place special emphasis on methods for reducing the presence of those parameters in storm water discharges. Quarterly monitoring in the fourth year of the permit will be used to reassess the effectiveness of the adjusted pollution prevention plan.

EPA realizes that if a facility is inactive and unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly chemical sampling.

Alternative Certification. Throughout today's permit, EPA has included monitoring requirements for facilities which the Agency believes have the potential for contributing significant levels of pollutants to storm water discharges. The alternative certification described below is necessary to ensure that monitoring requirements are only imposed on those facilities that do, in fact, have storm water discharges containing pollutants at concentrations of concern. EPA has determined that if materials and activities are not exposed to storm water at the site, then the potential for pollutants to contaminate storm water discharges does not warrant monitoring.

Therefore, a discharger is not subject to the monitoring requirements of this Part provided the discharger makes a certification for a given outfall or on a pollutant-by-pollutant basis in lieu of monitoring reports described in paragraph (*2*) below, under penalty of law, signed in accordance with Part VII.G. (Signatory Requirements), that material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, industrial machinery or operations, significant materials from past industrial activity, and that are located in areas of the facility that are within the drainage area of the outfall are not presently exposed to storm water and will not be exposed to storm water for the certification period. Such certification must be retained in the storm water pollution prevention plan and submitted to EPA in lieu of monitoring reports required under paragraph (*2*) below. The permittee is required to complete any and all sampling until the exposure is eliminated. If the facility is reporting for a partial year, the permittee must specify the date exposure was eliminated. If the permittee is certifying that a pollutant was present for part of the reporting period, nothing relieves the permittee from the responsibility to sample that parameter up until the exposure was eliminated and it was determined that no significant materials remained. This certification option is not applicable to compliance monitoring requirements associated with effluent limitations. EPA does not expect facilities to be able to exercise this certification for indicator parameters, such as TSS and BOD.

(2) Reporting Requirements. Permittees are required to submit all monitoring results obtained during the second and fourth year of permit coverage within 3 months of the conclusion of each year. For each outfall, one signed Discharge Monitoring Report Form must be submitted to the Director per storm event sampled. For facilities conducting monitoring beyond the minimum requirements, an additional signed Discharge Monitoring Report Form must be filed for each analysis. The permittee must include a measurement or estimate of the total precipitation, volume of runoff, and peak flow rate of runoff for each storm event sampled.

(3) Sample Type. All discharge data shall be reported for grab samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The required 72-hour storm event interval is waived where the preceding measurable storm event did not result in a measurable discharge from the facility. The required 72-hour storm event interval may also be waived where the permittee documents that less than a 72-

hour interval is representative for local storm events during the season when sampling is being conducted. The required 72-hour storm event interval is waived where the preceding measurable storm event did not result in a measurable discharge from the facility. The required 72-hour storm event interval may also be waived where the permittee documents that less than a 72-hour interval is representative for local storm events during the season when sampling is being conducted. The grab sample shall be taken during the first 30 minutes of the discharge. if the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable.

If storm water discharges associated with industrial activity commingle with process or nonprocess water, then where practicable, permittees must attempt to sample the storm water discharge before it mixes with the non-storm water discharge.

(4) Representative Discharge. When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may test the effluent of one of such outfalls and report that the quantitative data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluent. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

(5) Adverse Conditions. When a discharger is unable to collect samples within a specified sampling period due to adverse climatic conditions, the discharger shall collect a substitute sample from a separate qualifying event in the next period and submit the data along with data for the routine sample in that period. Adverse weather conditions which may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

B. Quarterly Visual Examination of Storm Water Quality. Mineral mining and processing facilities shall perform and document a visual examination of a storm water discharge associated with industrial activity from each outfall, except discharges exempted below. The examination(s) must be made at least once in each of the following three-month periods: January through March, April through June, July through September, and October through December. The examination shall be made during daylight hours unless there is insufficient rainfall or snow melt to produce a runoff event.

(1) Examinations shall be made of grab samples collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 1 hour) or when the runoff or snowmelt begins discharging. The examinations shall document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on the samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. Where practicable, the same individual should carry out the collection and examination of discharges for entire permit term.

(2) Visual examination reports must be maintained onsite in the pollution prevention plan. The report shall include the examination date and time, examination personnel, the nature of the discharge (i.e., runoff or snow melt), visual quality of the storm water discharge (including observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution), and probable sources of any observed storm water contamination.

(3) When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may collect a sample of effluent of one of such outfalls and report that the examination data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

(4) When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the records of the visual examinations. Adverse weather conditions that may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes,electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(5) EPA realizes that if a facility is inactive and unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly visual examination.

EPA believes that this quick and simple assessment will help the permittee to determine the effectiveness of his/her plan on a regular basis at very little cost. Although the visual examination cannot assess the chemical properties of the storm water discharged from the site, the examination will provide meaningful results upon which the facility may act quickly. The frequency of this visual examination will also allow for timely adjustments to be made to the plan. If BMPs are performing ineffectively, corrective action must be implemented. A set of tracking or follow-up procedures must be used to ensure that appropriate actions are taken in response to the examinations. The visual examination is intended to be performed by members of the pollution prevention team. This hands-on examination will enhance the staff's understanding of the storm water problems on that site and the effects of the management practices that are included in the plan.

EPA believes that between quarterly visual examinations, site compliance evaluations and the limited analytical monitoring required of the specified subsectors, potential sources of contaminants can be recognized, addressed, and then controlled with BMPs. In determining the monitoring requirements, EPA considered the nature of the industrial activities and significant materials exposed at these sites and performed a review of data provided in Part 2 group applications.

c. Compliance Monitoring Requirements. Today's permit requires permittees with mine dewatering discharges from construction sand and gravel, industrial sand, and crushed stone mine facilities to monitor for the presence of TSS and pH. These monitoring requirements are necessary to evaluate compliance with the numeric effluent limitation established for these discharges. Monitoring shall be performed quarterly upon a minimum of one grab sample. All samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The grab sample shall be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable. Monitoring results shall be submitted on signed Discharge Monitoring Report Form(s) postmarked no later than the 31st day of the month following collection of the sample. Facilities which discharge through a large or medium municipal separate storm sewer system (systems serving a population of 100,000 or more) must also submit signed copies of discharge monitoring reports to the operator of the municipal separate storm sewer system.

Alternative Certification provisions described in Section XI.J.5 do not apply to facilities subject to compliance monitoring requirements in this section. Compliance monitoring is required at least annually for discharges subject to effluent limitations. Therefore, EPA cannot permit a facility to waive compliance monitoring.

Construction sand and gravel, industrial sand and crushed stone mining facilities are not required to collect and analyze separate samples for the presence of TSS to satisfy the Compliance Monitoring requirements of Section XI.J.5.d. during a year in which the facilities have collected and analyzed samples for TSS in accordance with the Analytical Monitoring requirements of Section XI.J.5.a. The results of all TSS Analytical Monitoring analyses may also be reported as Compliance Monitoring results in accordance with Section XI.J.5.d.(3) where the monitoring methodologies are consistent.

7. Definitions

"Overburden" means any material of any nature, consolidated or unconsolidated, that overlies a mineral deposit, excluding topsoil or similar naturally occurring surface materials that are not disturbed by mining operations.

"Overflow" means a precipitation induced overflow of a facility that is designed, constructed, and maintained to contain, or treat, the volume of wastewater which would result from 10-year, 24-hour precipitation events.

Storm Water Discharges Associated With Industrial Activity from Hazardous Waste Treatment, Storage, or Disposal Facilities

Industry Profile

On November 16, 1990 (55 FR 47990), EPA promulgated the regulatory definition of "storm water discharge associated with industrial activity." This definition includes point source discharges of storm water from 11 categories of facilities, including "* * * (iv) Hazardous waste treatment, storage, or disposal facilities, including those that are operating under interim status or a permit under Subtitle C of RCRA * * * ." Part XI.K. of today's permit only covers storm water discharges from facilities that treat, store, or dispose of hazardous wastes.

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

Some industrial facilities that generate hazardous waste have onsite capacity to store, treat, and even dispose of their waste. Many hazardous waste generators, however, send their waste offsite to a treatment, storage, or disposal facility (TSDF). Generators of hazardous waste must arrange for a transporter who has obtained an EPA ID number to transport the generator's waste to a designated facility (i.e., a facility that is permitted under RCRA to receive and treat, store, or dispose of hazardous waste).

Once wastes are accepted by the TSDF, any number of activities may follow. For example, some wastes are disposed without any intervening storage or treatment, while other wastes are held in storage prior to treatment or disposal. Hazardous wastes are generally stored in containers and tanks, which are enclosed by a bermed area to prevent any releases to the environment from the storage units.

The processes for treating hazardous wastes can be divided into two major categories based on whether the waste is organic or inorganic in nature. Organic wastes are treated by destructive technologies, like incineration, whereas inorganic wastes are treated using fixation technologies, like stabilization, in which the hazardous constituents are immobilized in the residual matrix. Residuals from fixation processes are usually land-disposed where the stabilized constituents are much less likely to leach into the environment.

As mentioned above, some wastes are treated prior to disposal while others are disposed as-generated. Hazardous waste disposal units include landfills, surface impoundments, waste piles, and land treatment units. Such disposal units may have specific requirements under RCRA Subtitle D. Wastes are also disposed by being burned in incinerators. Some liquid hazardous wastes are underground-injected into deep wells regulated under the Underground Injection Control (UIC) program in 40 CFR Parts 144 to 148. The RCRA regulations governing the different types of hazardous waste treatment, storage, and disposal units are located in 40 CFR Part 264, Subparts I through O and Subpart W.

Hazardous wastes are also recycled at TSDFs. Recycling is considered a form of treatment, however, the recycling process itself is not generally regulated under RCRA. Recycling activities include reclamation, regeneration, reuse, burning for energy or materials recovery, and use in a manner constituting disposal (i.e., land application of hazardous waste or products containing hazardous waste).

2. Pollutants in Storm Water Discharges Associated With Hazardous Waste Treatment, Storage, or Disposal Facilities

Given the diversity and amount of hazardous wastes handled at TSDFs, pollutants in storm water discharges may vary considerably. Contaminated storm water discharges may result from precipitation coming in contact with spills or leaks of hazardous waste. TSDFs regulated under RCRA Subtitle C, however, are required to control much of their storm water runoff through secondary containment (e.g., secondary containment for tank systems; 40 CFR 264.193). When a spill of a listed hazardous waste occurs, for example, the spilled material and any storm water that comes into contact with the material is a hazardous waste under RCRA and must be cleaned up and managed in accordance with all applicable regulations.

In addition to the types of hazardous materials handled and the procedures for controlling runoff at a particular TSDF, several other factors influence to what extent significant materials from these types of facilities and processing operations can affect water quality. Such factors include: hydrology/geology; volume of wastes handled; extent of industrial activities at a TSDF (i.e., only storage, or storage plus treatment and disposal); and type, duration, and intensity of precipitation events. These and other factors will interact to influence the quantity and quality of storm water runoff. In addition, sources of pollutants other than storm water, such as illicit connections,[16] spills, and other improperly dumped materials, may increase the pollutant loadings discharged into waters of the United States.

Pollutants in storm water discharges from TSDFs may consist of, in the case of spills or leaks which are not properly contained or cleaned up, hazardous wastes and/or their constituents. 40 CFR Part 261 Subpart D contains the lists of hazardous wastes, and Appendix VII to Part 261 is a list of the hazardous constituents for which each of these wastes is listed.

Based on the similarities of the facilities included in this sector in terms of industrial activities and significant materials, EPA believes it is appropriate to discuss the potential pollutants at TSDFs facilities as a whole and not subdivide this sector. Therefore, Table K–1 lists data for selected parameters from facilities in the TSDF sector. These data include the eight pollutants that all facilities were required to monitor for under Form 2F.

TABLE K–1.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY HAZARDOUS WASTE TREATMENT STORAGE OR DISPOSAL FACILITIES SUBMITTING PART II SAMPLING DATA [i] (mg/L)

Pollutant	No. of facilities		No. of Samples		Mean		Minimum		Maximum		Median		95th Percentile		99th Percentile	
Sample type	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	3	4	8	9	17.8	9.44	0.0	0.0	45.0	45.0	11.5	7.0	49.7	35.7	82.3	62.9
COD	3	4	8	9	117.6	51.9	12.0	10.0	500.0	131.0	56.5	45.0	419.2	158.9	910.3	285.8
Nitrate + Nitrite Nitrogen	4	4	9	9	0.46	0.39	0.15	0.07	0.79	0.67	0.47	0.34	1.07	1.06	1.59	1.72
Total Kjeldahl Nitrogen	4	4	9	9	1.43	1.07	0.64	0.25	3.00	3.92	1.30	0.92	2.64	2.96	3.52	5.21
Oil & Grease	4	N/A	9	N/A	9.3	N/A	0.0	N/A	74.0	N/A	0.0	N/A	56.3	N/A	251.8	N/A
pH	2	N/A	7	N/A	N/A	N/A	5.6	N/A	7.8	N/A	7.3	N/A	8.7	N/A	9.6	N/A
Total Phosphorus	4	4	9	9	0.24	0.11	0.00	0.00	1.60	0.32	0.07	0.09	0.67	0.28	1.51	0.43
Total Suspended Solids	3	4	8	9	338	82.7	4	5	1100	304	128	32	2463	397	8651	1083

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.
[ii] Composite samples.

3. Pollutant Control Measures Required Through Other EPA Programs

As part of the RCRA program, 40 CFR Part 264 sets standards for treatment, storage and disposal facilities. EPA realizes that some of the conditions of this section are already addressed by the requirements set forth in Part 264. Under the RCRA program, for example, secondary containment is required for tank systems in order to prevent the release of hazardous waste or hazardous constituents to the environment. Such secondary containment must either be capable of preventing storm water runon from entering the system, or have the capacity to contain the volume of the tank plus precipitation from a 25-year, 24-hour rainfall event (40 CFR 264.193).

Conditions such as those set forth for secondary containment at TSDFs are pertinent because they may overlap with aspects of the pollution prevention plan (PPP) required as part of this section. Therefore, in developing a storm water pollution prevention plan, a TSDF should include as Best Management Practices (BMPs) any controls relevant to storm water that have already been implemented under 40 CFR Part 264.

Other areas where RCRA requirements may overlap with the conditions set forth in this section include inspections and employee training. Daily and weekly inspections of tank systems and containers are required, respectively, under Part 264. Therefore, these inspections will be incorporated into the pollution prevention plan for this storm water permit. Similarly, employee training, required under 40 CFR 264.16, does not need to be repeated as part of implementation of the pollution prevention plan, but rather expanded as necessary to include issues concerning storm water management.

4. Options for Controlling Pollutants

In evaluating options for controlling pollutants in storm water discharges, EPA must achieve compliance with the

[16] Illicit connections are contributions of unpermitted non-storm water discharges to storm sewers from any of a number of sources including sanitary sewers, industrial facilities, commercial establishments, or residential dwellings. The probability of illicit connections at mineral mining and processing facilities is low yet it still may be applicable at some operations.

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technology-based standards of the Clean Water Act [Best Available Technology (BAT) and Best Conventional Technology (BCT)]. The Agency does not believe that it is appropriate to establish specific numeric effluent limitations or a specific design or performance standard in this section for storm water discharges associated with industrial activity from hazardous waste treatment, storage, and disposal facilities to meet BAT/BCT standards of the Clean Water Act at this time. Instead, this section establishes requirements for the development and implementation of site-specific storm water pollution prevention plans consisting of a set of Best Management Practices (BMPs) that are sufficiently flexible to address different sources of pollutants at different sites.

Generally, BMPs are implemented to prevent and/or minimize exposure of pollutants from industrial activities to storm water discharges. EPA believes the most effective BMPs for reducing pollutants in storm water discharges are exposure minimization practices. Exposure minimization practices lessen the potential for storm water to come into contact with pollutants. Good housekeeping practices ensure that facilities are sensitive to routine and nonroutine activities which may increase pollutants in storm water discharges. The BMPs which address good housekeeping and exposure minimization are easily implemented, inexpensive, and require little, if any, maintenance. BMP expenses may include construction of roofs for storage areas or other forms of permanent cover and the installation of berms/dikes. Other BMPs such as detention/retention ponds and filtering devices may be needed at these facilities because of the contaminant level in the storm water discharges.

The selection of the most effective BMPs will be based on site-specific considerations such as: facility size, climate, geographic location, hydrogeology and the environmental setting of each facility, and volume and type of discharge generated. Each facility will be unique in that the source, type, and volume of contaminated storm water discharges will differ. In addition, the fate and transport of pollutants in these discharges will vary. EPA believes that the management practices discussed herein are well suited mechanisms to prevent or control the contamination of storm water discharges associated with hazardous waste treatment, storage, or disposal facilities that are not already addressed by RCRA subtitle C.

Facilities covered under this section must already be in compliance with the standards for operating a hazardous waste treatment, storage, or disposal facility as established by 40 CFR Part 264. As discussed in greater detail in the previous section (Pollutant Control Measures Required Through Other EPA Programs), EPA believes that because of the requirements previously imposed on hazardous waste treatment, storage, or disposal facilities, storm water BMPs are already employed at most TSDFs. This belief is supported by part 1 group application data, which indicated that 97 percent of the representative sampling facilities already have SPCC plans in place at their sites.

Because of the potential for spills of hazardous materials during loading and unloading operations, and the absence of an individual discussion of these operations in 40 CFR Part 264, Table K–2 is provided to identify BMPs associated with these activities at hazardous waste treatment, storage, or disposal facilities.

TABLE K–2.—GENERAL LOADING AND UNLOADING STORM WATER BMPS FOR HAZARDOUS WASTE TREATMENT, STORAGE, OR DISPOSAL FACILITIES

Activity	Best management practices (BMPs)
Outdoor Unloading and Loading	Confine loading/unloading activities to a designated area. Consider performing loading/unloading activities indoors or in a covered area. Consider covering loading/unloading area with permanent cover (e.g., roofs) or temporary cover (e.g., tarps). Close storm drains during loading/unloading activities in surrounding areas. Avoid loading/unloading materials in the rain. Inspect the unloading/loading areas to detect problems before they occur. Inspect all containers prior to loading/unloading of any raw or spent materials. Consider berming, curbing, or diking loading/unloading areas. Use dry clean-up methods instead of washing the areas down. Train employees on proper loading/unloading techniques.

Sources: NPDES Storm Water Group Applications—Part 1. Received by EPA, March 18, 1991 through December 31, 1992 EPA, Office of Water. September 1992. "Storm Water Management for Industrial Activities: Developing Pollution Prevention Plans and Best Management Practices." EPA 832–R–92–006.

5. Storm Water Pollution Prevention Plan Requirements.

EPA believes that pollution prevention is the most effective approach for controlling contaminated storm water discharges from hazardous waste treatment, storage, or disposal facilities. The requirements included in the pollution prevention plans provide a flexible framework for the development and implementation of site-specific controls to minimize the pollutants in storm water discharges. This flexibility is necessary because each facility is unique in that the source, type, and volume of contaminated storm water discharge will vary from site to site.

There are two major objectives to a pollution prevention plan: (1) to identify sources of pollution potentially affecting the quality of storm water discharges associated with industrial activity from a facility; and (2) to describe and ensure implementation of practices to minimize and control pollutants in storm water discharges associated with industrial activity from a facility.

The pollution prevention plan requirement reflects EPA's decision to allow hazardous waste treatment, storage, or disposal facilities to utilize BMPs as the BAT/BCT level of control for the storm water discharges covered by this section.

As previously discussed, many of the storm water pollution prevention plan requirements discussed in this section of today's permit and fact sheet are already addressed by the RCRA program and employed at hazardous waste treatment, storage, or disposal facilities. Please note that if RCRA does not address a particular condition which is stipulated in the storm water pollution prevention plan, the facility still must comply with that requirement of the plan.

6. Numeric Effluent Limitations.

There are no additional requirements under this section other than those stated in Part V.B of the permit.

7. Monitoring and Reporting Requirements

a. Analytical Monitoring Requirements. EPA believes that treatment, storage, or disposal facilities (TSDFs) may reduce the level of pollutants in storm water runoff from their sites through the development and proper implementation of the storm water pollution prevention plan requirements discussed in today's permit. In order to provide a tool for evaluating the effectiveness of the pollution prevention plan and to characterize the discharge for potential environmental impacts, the permit requires TSDFs to collect and analyze samples of their storm water discharges for the pollutants listed in Table K–3. The pollutants listed in Table K–3 were not found to be above benchmark levels in the limited amount of data that was submitted in the group application process, but are believed to be present based upon the description of industrial activities and significant materials exposed. EPA is requiring monitoring after the pollution prevention plan has been implemented to assess the effectiveness of the pollution prevention plan and to help ensure that a reduction of pollutants is realized.

At a minimum, storm water discharges from TSDFs must be monitored quarterly during the second year of permit coverage. Samples shall be collected at least once in each of the following periods: January through March; April through June; July through September; and October through December. At the end of the second year of permit coverage, a facility must calculate the average concentration for each parameter listed in Table K–3. If the permittee collects more than four samples in this period, then they must calculate an average concentration for each pollutant of concern for all samples analyzed.

TABLE K–3.—Industry Monitoring Requirements

Pollutants of concern	Cut-off concentration (mg/L)
Ammonia	19
Total Recoverable Magnesium*	0.0636
Chemical Oxygen Demand (COD)	120
Total Recoverable Arsenic.	16854
Total Recoverable Cadmium	0.0159
Total Cyanide**	0.0636
Total Recoverable Lead	0.0816
Total Recoverable Mercury	0.0024
Total Recoverable Selenium	0.2385
Total Recoverable Silver	0.0318

*The MDL for magnesium is 0.02 mg/L method 200.6.

**The MDL for cyanide is 0.02 mg/L method 335.1, .2, or .3.

If the average concentration for a parameter is less than or equal to the value listed in Table K–3, then the permittee is not required to conduct quantitative analysis for that parameter during the fourth year of the permit. If, however, the average concentration for a parameter is greater than the cut-off concentration listed in Table K–3, then the permittee is required to conduct quarterly monitoring for that parameter during the fourth year of permit coverage. Monitoring is not required during the first, third, and fifth year of the permit. The exclusion from monitoring in the fourth year of the permit is conditional on the facility maintaining industrial operations and BMPs that will ensure a quality of storm water discharges consistent with the average concentrations recorded during the second year of the permit. The schedule for monitoring is presented in Table K–4.

TABLE K–4.—SCHEDULE OF MONITORING

2nd Year of Permit Coverage	• Conduct quarterly monitoring. • Calculate the average concentration for all parameters analyzed during this period. • If average concentration is greater than the value listed in Table K–3, then quarterly sampling is required during the fourth year of the permit. • If average concentration is less than or equal to the value listed in Table K–3, then no further sampling is required for that parameter.
4th Year of Permit Coverage	• Conduct quarterly monitoring for any parameter where the average concentration in year 2 of the permit is greater than the value listed in Table K–3. • If industrial activities or the pollution prevention plan have been altered such that storm water discharges may be adversely affected, quarterly monitoring is required for all parameters of concern.

In cases where the average concentration of a parameter exceeds the cut-off concentration, EPA expects permittees to place special emphasis on methods for reducing the presence of those parameters in storm water discharges. Quarterly monitoring in the fourth year of the permit will reassess the effectiveness of the adjusted pollution prevention plan.

EPA realizes that if a facility is inactive and unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly chemical sampling.

b. Alternative Certification. Throughout today's permit, EPA has included monitoring requirements for facilities which the Agency believes have the potential for contributing significant levels of pollutants to storm water discharges. The alternative described below is necessary to ensure that monitoring requirements are only imposed on those facilities that do, in fact, have storm water discharges containing pollutants at concentrations of concern. EPA has determined that if materials and activities are not exposed to storm water at the site, then the potential for pollutants to contaminate storm water discharges does not warrant monitoring.

Therefore, a discharger is not subject to the monitoring requirements of this Part provided the discharger makes a certification for a given outfall or on a pollutant-by-pollutant basis in lieu of monitoring described in Table K–3, under penalty of law, signed in accordance with Part VII.G. (Signatory Requirements), that material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, industrial machinery or operations, significant materials from past industrial activity, that are located in areas of the facility that are within the drainage area of the outfall are not presently exposed to storm water and will not be exposed to storm water for the certification period. Such certification must be retained in the storm water pollution prevention plan and submitted to EPA in accordance with Part VI.B. of this permit. In the case of certifying that a pollutant is not present, the permittee must submit the certification along with the monitoring reports required under paragraph (C) below. If the permittee cannot certify for an entire period, they must submit the date exposure was eliminated and any monitoring required up until that date. This certification option is not applicable to compliance monitoring requirements associated with effluent limitations. EPA does not expect facilities to be able to exercise this certification for indicator parameters, such as TSS and BOD.

c. Reporting Requirements. Permittees are required to submit all monitoring results obtained during the second and fourth year of permit coverage within 3 months of the conclusion of each year. For each outfall, one signed Discharge Monitoring Report form must be submitted to the Director per storm event sampled. For facilities conducting monitoring beyond the minimum quarterly requirements an additional Discharge Monitoring Report Form must be filed for each analysis.

d. Sample Type. All discharge data shall be reported for grab samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The required 72-hour storm event interval is waived where the preceding measurable storm event did not result in a measurable discharge from the facility. The required 72-hour storm event interval may also be waived where the permittee documents that less than a 72-hour interval is representative for local storm events during the season when sampling is being conducted. The grab sample shall be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable.

If storm water discharges associated with industrial activity commingle with process or non-process water, then where practicable permittees must attempt to sample the storm water discharges before it mixes with the non-storm water discharge.

e. Representative Discharge. When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may test the effluent of one of such outfalls and report that the quantitative data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluent. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

f. Quarterly Visual Examination of Storm Water Quality. Quarterly visual examinations of storm water discharges from each outfall are required at TSDFs. The examination must be of a grab sample collected from each storm water outfall. The examination of storm water grab samples shall include any observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, or other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on these samples.

The examination must be made at least once in each of the following designated periods: January through March; April through June; July through September; and October through December, during daylight unless there is insufficient rainfall or snow-melt to runoff. Whenever practicable, the same individual should carry out the collection and examination of discharges throughout the life of the permit to ensure the greatest degree of consistency possible. Grab samples shall be collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 1 hour) of when the runoff begins discharging. Reports of the visual examination include: the examination date and time, examination personnel, visual quality of the storm water discharge, and probable sources of any observed storm water contamination. The visual examination reports must be maintained onsite with the pollution prevention plan.

EPA realizes that if a facility is inactive and unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly visual examination.

EPA believes that this quick and simple assessment will allow the permittee to approximate the effectiveness of his/her plan on a regular basis at very little cost. Although the visual examination cannot assess the chemical properties of the storm water discharged from the site, the examination will provide meaningful results upon which the facility may act quickly. The frequency of this visual examination will also allow for timely adjustments to be made to the plan. If BMPs are performing ineffectively, corrective action must be implemented. A set of tracking or follow-up procedures must be used to ensure that appropriate actions are taken in response to the inspections. The visual examination is intended to be performed by members of the pollution prevention team. This hands-on examination will enhance the staff's understanding of storm water problems on that site and the effects of the management practices that are included in the plan.

When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not collecting samples. Adverse weather conditions which may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

8. Region-specific Conditions

Region VI intends for this permit to cover all eligible hazardous waste treatment, storage, and disposal facilities, except those that treat and dispose exclusively commercial hazardous waste. Region VI believes that more careful compliance tracking is warranted for facilities that treat and dispose of commercially produced hazardous waste due to the wide range of chemicals and large quantities of hazardous waste materials that are generally disposed as a service to generators. Region VI has determined this to be a priority industry and required individual permits in the past with limits. This affects permits issued by EPA Region VI for Louisiana (LAR05*###), New Mexico (NMR05*###), Oklahoma (OKR05*###), Texas (TXR05*###), and Federal Indian Reservations in these States (LAR05*##F, NMR05*##F, OKR05*##F, or TXR05*##F).

L. Storm Water Discharges Associated With Industrial Activity From Landfills and Land Application Sites

1. Industry Profile.

This section of today's permit addresses special requirements for storm water discharges associated with industrial activity from landfill and land application sites. Pursuant to 40 CFR 122.26, storm water discharges from landfills, land application sites, and open dumps that receive or have received industrial waste, including sites subject to regulation under Subtitle D of the Resource Conservation and Recovery Act (RCRA), are required to seek permit coverage. Under this section, industrial waste is defined as waste generated by any of the industrial activities described at 40 CFR 122.26(b)(14).

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

Special conditions contained in this section apply to land disposal sites that meet the definition of a landfill under RCRA Subtitle D contained at 40 CFR Part 257, which establishes criteria for the classification of solid waste disposal facilities and practices. Part 257 defines landfills as areas of land or excavation in which wastes are placed for permanent disposal, and that are not land application units, surface impoundments, injection wells, or waste piles. Included in this definition are municipal solid waste landfills (MSWLFs) and industrial solid nonhazardous waste landfills. (Many of the 1,410 landfill facilities participating in the group application process are classified as MSWLFs). Therefore, the special conditions in this section apply to both MSWLFs and industrial landfills as defined under Part 257. This section also applies to industrial waste land application sites. Land application sites are defined as facilities at which wastes are applied onto or incorporated into the soil surface for the purpose of beneficial use or waste treatment and disposal. No open dumps were included in the facilities participating in the group application process (open dumps are defined as solid waste disposal units not in compliance with State/Federal criteria established under RCRA Subtitle D) and operation of an open dump is prohibited under RCRA Section 4004. Therefore, storm water discharges from open dumps are not addressed by this section. This section also does not apply to inactive landfills or inactive land application sites located on Federal lands, unless an operator can be identified. These discharges are more appropriately covered under a permit currently being developed by EPA.

The following sections describe industrial and municipal solid waste landfills and industrial waste land application sites.

a. Municipal Solid Waste Landfills. In 1988, EPA estimated that there were approximately 9,300 MSWLFs in the United States. The wastes which are disposed of in MSWLF landfills are highly variable. Examples include household waste (including household hazardous waste which is excluded from RCRA hazardous waste regulation), nonhazardous incinerator ashes, commercial wastes, yard wastes, tires, white goods, construction wastes, municipal and industrial sludges, asbestos, and other industrial wastes. Only a small percentage of all wastes disposed of in MSWLFs are industrial wastes. In 1988, EPA's Report to Congress on solid waste generation indicated that nearly 90 percent of wastes disposed of in all MSWLFs were household or commercial (office) wastes. Industrial process wastes represented only 2.73 percent of the total wastestream (although most MSWLFs currently or have previously accepted industrial wastes and are therefore subject to storm water permitting requirements). The Report also indicated that about half of the total number of MSWLFs received small quantity generator hazardous wastes. In addition, MSWLFs that operated prior to the implementation of RCRA hazardous waste management requirements in 1980 may have received wastes that after that date that would have been classified as hazardous wastes under current RCRA requirements.

A typical MSWLF is a constantly evolving facility which is constructed over its operating life as received wastes are spread, compacted, and covered. Most modern landfills contain one or more separate "units," planned final waste containment areas. Active units continue to receive wastes until they have reached disposal capacity. When capacity is reached, a unit is capped with a final cover, and additional wastes must be placed in other active units. As a result, a landfill may consist of multiple inactive and active units at various stages of completion.

Within each unit, wastes are added in layers referred to as lifts. Received wastes are spread across the working face of the landfill to a depth of six to twenty feet and then compacted. At the end of each working day a thin layer of soil (daily cover) is spread on top of the added wastes and compacted. A large unit may consist of multiple lifts, depending on the planned final depth.

Historically, landfills have been constructed according to one of two generic designs, the trench method and the area method, or a combination of these. The trench method requires the excavation of a trench into which wastes will be placed. Soil from the excavation provides the cover material as disposal continues. In the area method, wastes are placed directly on the ground surface and disposal follows the natural contours of the land. Some landfills use combinations of the two methods at different times depending on the location of the active unit.

MSWLF construction creates constant changes in the contours of the facility resulting in changing patterns of storm water runon and runoff. Controlling erosion of landfill slopes is among the primary concerns of the landfill operator. Current practices generally include a combination of temporary controls (straw bales, silt fences, etc.), in active disposal areas, and permanent controls (recontouring, revegetation, etc.), in areas where waste disposal has been completed.

Daily and intermediate covers serve primarily to protect against disease vectors and to prevent fires and the blowing of refuse. Typically, daily covers consist of the minimum amount of soil excavated from the site needed to cover exposed wastes in the active areas of the landfill. After spreading, the cover is usually compacted to reduce loss from erosion. Intermediate covers, which are also typically soil excavated from the site, are often applied to areas of a unit which will be inactive for periods of 30 days or more. Deeper than daily covers, intermediate covers may be applied in conjunction with runoff control measures to minimize pooling and high-velocity flow patterns. Both daily and intermediate covers promote infiltration to some extent, depending on depth and soil material.

When a landfill (or landfill unit) has reached disposal capacity, a final cover is applied. Final covers generally provide a relatively impermeable cap over which topsoil is placed and vegetation is established. Permanent runoff controls (diversion channels, recontouring, terracing, etc.) may be constructed to minimize erosion and ponding. Final cover materials in older landfills, which are generally subject to limited regulatory requirements, often consist of a single layer of natural soils. However, at newer landfills subject to more stringent regulatory requirements, other cover materials (polymers, sand and gravel, sewage sludge, etc.) are frequently combined with soil in multiple layers.[84]

b. Industrial Landfills. Industrial landfills only receive wastes from industrial facilities such as factories, processing plants, and manufacturing sites. These facilities may also receive hazardous wastes from very small quantity hazardous waste generators (less than 100 kilograms per month), as defined in RCRA Subtitle C. Included in these waste streams are some PCB-contaminated wastes. The Toxic Substances Control Act PCB disposal regulations allow limited categories of PCB materials to be disposed of in RCRA Subtitle D landfills.[85] In 1988, EPA estimated that there were at least 3,511 industrial Subtitle D landfills (this would presumably be the maximum number of non-MSWLF facilities regulated by the storm water program). The specific number of these units that are onsite and offsite facilities (i.e., centralized waste management units) was not available. Because wastes generated by industrial facilities vary considerably, both between and within industries, the wastes disposed of at industrial landfills can be highly variable. For example, the industrial nonhazardous waste category includes wastes from the pulp and paper industry, the organic chemical industry, the textile manufacturing industry, and a variety of other industries. Consequently, these waste streams may vary in chemical composition and/or physical form. Most industrial landfills are privately owned.[86]

Currently, there are limited data available on industrial landfills. Specific industrial waste streams have not been well characterized and little is known about the hazards they may pose. Limited data are also available regarding the design, operation, and location of these facilities. It has been documented, however, that there has been only sporadic application of design and operating controls at industrial landfills. In 1988, only about 12 percent of industrial landfills (including both onsite and offsite facilities) had any type of liner, and fewer than 35 percent employed runon/runoff controls.[87] The use of these controls (including runon and runoff controls) at industrial waste landfills is likely to increase as State industrial waste programs continue to evolve.

c. Land Application Sites. In 1988, EPA estimated that there were approximately 5,605 land application sites in the United States. These sites receive wastes (primarily wastewaters and sludges) from facilities in virtually every major industrial category. More than half of all land application sites cover less than 50 acres and receive less than 50 tons of waste annually. The largest number of active land application sites in 1988 were observed in the food and kindred products industry, however the pulp and paper industry managed the largest gross quantity of waste using this practice. Similar to landfills, the variability in types of waste that are land applied precludes any general characterization of the materials that may be exposed to storm water. Typically, individual land applications will only dispose of wastes with specific characteristics. However, the criteria for selection are site-specific depending on type of process used and the soil characteristics. Waste application techniques are dependent on waste characteristics.

In 1988, EPA found that 68.5 percent of all industrial waste land application units had runon and runoff controls. No information was available on the extent of closure requirements applicable to land application units.

2. Potential Pollutant Sources and Options for Controlling Pollutants at Landfill and Land Application Sites

a. Landfills. At landfill sites, runoff carrying suspended sediments and commingling of runoff with uncontrolled leachate are the two primary sources of pollutants that this section is intended to address. Other potential sources of pollutants at landfills, those from ancillary areas of the landfill and which are not directly associated with landfill activities (i.e., vehicle maintenance, truck washing, etc.) may be subject to requirements in other sections of today's permit.

Total Suspended Solids. Storm water discharges from landfill sites often contain high TSS levels because of the extensive land disturbance activities associated with landfill operations. Suspended solids can adversely affect fisheries by covering the bottom of a stream or lake with a blanket of material that destroys the fish food bottom fauna or spawning grounds. In addition, while they remain in suspension, suspended solids can increase turbidity, reduce light penetration, and impair the photosynthetic activity of aquatic plants.[88] Specific sources of TSS loadings from landfill operations and typical Best Management Practices (BMPs) used to control TSS levels in storm water runoff are shown in Table L–1. The listed BMPs are consistent with the BMPs identified in part 1 of the permit applications submitted by landfill group applicants.

[84] "Report to Congress: Solid Waste Disposal in the United States," Vol. II, Office of Solid Waste and Emergency Response, Oct. 1988.

[85] Ibid.

[86] Ibid.

[87] Ibid.

[88] EPA. 1974 (October). "Development Document for the Effluent Limitations Guidelines and New Source Performance Standards for the Steam Electric Power Point Source Category."

TABLE L–1.—SOURCES OF TSS LOADINGS AND TYPICAL BMPs USED FOR EROSION CONTROL AT LANDFILLS

Potential pollutant sources	BMPs
Erosion from: Exposed soil from excavating cells/trenches. Exposed stockpiles of cover materials. Inactive cells with final cover but not yet finally stabilized. Daily or intermediate cover placed on cells or trenches. Erosion from haul roads (including vehicle tracking of sediments).	Stabilize soils with temporary seeding, mulching, and geotextiles; leave vegetative filter strips along streams. Implement structural controls such as dikes, swales, silt fences, filter berms, sediment traps and ponds, outlet protection, pipe slope drains, check dams, and terraces to convey runoff, to divert storm water flows away from areas susceptible to erosion, and to prevent sediments from entering water bodies. Frequently inspect all stabilization and structural erosion control measures and perform all necessary maintenance and repairs. Stabilize haul roads and entrances to landfill with gravel or stone. Construct vegetated swales along road. Clean wheels and body of trucks or other equipment as necessary to minimize sediment tracking (but contain any wash waters [process wastewaters]). Frequently inspect all stabilization and structural erosion control measures and perform all necessary maintenance and repairs.

(2) *Other Pollutants.* Table L–2 presents potential sources of other pollutants in storm water discharges from landfill operations. The specific pollutants associated with each of these sources are highly variable, depending upon individual site operations and waste types received. Table L–2 also lists BMPs that would be expected to be used in these areas to minimize potential pollutant loadings. Several of these BMPs were identified in the group permit applications submitted by landfill operators.

TABLE L–2.—SOURCES AND BMP CONTROLS OF POTENTIAL POLLUTANTS (OTHER THAN TSS)

Potential pollutant source	BMPs
Application of fertilizers, pesticides, and herbicides.	Observe all applicable Federal, State, and local regulations when using these products. Strictly follow recommended application rates and methods (i.e., do not apply in excess of vegetative requirements).
Exposure of chemical material storage areas to precipitation (including pesticides, fertilizers, and herbicides).	Have materials such as absorbent pads easily accessible to clean up spills. Provide barriers such as dikes to contain spills. Provide cover for outside storage areas.
Exposure of waste at open face	Have materials such as absorbent pads easily accessible to clean up spills. Minimize the area of exposed open face as much as is practicable. Divert flows around open face using structural measures such as dikes, berms, swales, and pipe slope drains. Frequently inspect erosion and sedimentation controls.
Waste tracking onsite and haul roads, solids transport on wheels and exterior of trucks or other equipment (common with incinerator ash).	Clean wheels and exterior of trucks or other equipment as necessary to minimize waste tracking (but contain any wash waters [process wastewaters]).
Uncontrolled leachate (commingling of leachate with runoff or runon).	Frequently inspect leachate collection system and landfill for leachate leaks. Maintain landfill cover and vegetation. Maintain leachate collection system.

Based on the similarities of the facilities included in this sector in terms of industrial activities and significant materials, EPA believes it is appropriate to discuss the potential pollutants at landfills and land applications sites as a whole and not subdivide this sector. Therefore, Table L–3 lists data for selected parameters from facilities in the landfill and land application sector. These data include the eight pollutants that all facilities were required to monitor for under Form 2F, as well as any pollutants that EPA has determined may merit further monitoring.

TABLE L–3.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY LANDFILLS AND LAND APPLICATION SITES SUBMITTING PART II SAMPLING DATA [i] (mg/L)

Pollutant Sample type	No. of facilities		No. of samples		Mean		Minimum		Maximum		Median		95th percentile		99th percentile	
	Grab	Comp [ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	30	28	52	50	13.6	8.88	0.0	0.0	140.0	78.0	7.0	4.40	39.8	29.6	76.3	54.5
COD	30	28	52	49	112.9	100.6	0.0	0.0	1220.0	1200.0	31.0	28.0	340.7	278.7	799.1	587.5
Nitrate + Nitrite Nitrogen	29	27	51	48	1.55	1.36	0.00	0.00	22.20	16.6	0.50	0.50	4.07	3.88	8.35	8.14
Total Kjeldahl Nitrogen	30	28	52	49	3.58	3.02	0.20	0.0	37.90	25.9	1.10	1.07	10.90	10.29	25.88	24.6
Oil & Grease	30	N/A	54	N/A	2.9	N/A	0.0	N/A	40.0	N/A	0.0	N/A	12.3	N/A	24.9	N/A
pH	32	N/A	59	N/A	N/A	N/A	3.0	N/A	8.9	N/A	7.3	N/A	9.3	N/A	10.2	N/A
Total Phosphorus	29	27	51	48	0.89	0.93	0.00	0.0	4.28	4.49	0.50	0.36	3.92	4.30	9.30	11.46
Total Suspended Solids	30	27	52	48	2922	1812	0	0	39900	18220	628	336	19476	10933	98449	49016

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TABLE L-3.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY LANDFILLS AND LAND APPLICATION SITES SUBMITTING PART II SAMPLING DATA[i] (mg/L)—Continued

Pollutant Sample type	No. of facilities		No. of samples		Mean		Minimum		Maximum		Median		95th percentile		99th percentile	
	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
Iron, Total	6	6	8	8	65.7	30.2	0.0	0.2	210.0	150.0	17.0	9.4	1736.4	244.8	17684	1105.9

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.

[ii] Composite samples.

b. Land Application Sites. At land application sites, TSS may also be found at elevated levels in storm water discharges (because of the extensive soil disturbance). The occurrence and levels of other pollutants in storm water discharges are dependent on the types of wastes applied and facility design and operation (including use of storm water management/treatment practices. No part 2 data for TSS or any other pollutants were submitted for land application sites nor was such data available from other sources.

There are no Federal criteria for industrial landfill or land application unit design, operation, closure or post-closure care. State programs that address industrial landfills and land application sites vary considerably. As noted above, in 1988, only 35 percent of all industrial landfills had runon/runoff controls. However, many are subject to closure requirements.

3. Pollutant Control Measures Required by Other EPA Programs

EPA recognizes that requirements under other Federal and State programs currently address reclamation/closure of and storm water management at landfill and land application sites. In developing requirements under this section, the Agency has considered how these other program requirements affect the characteristics of storm water discharges (e.g., by limiting contact with potential pollutant sources). Of specific note are recently imposed RCRA criteria at 40 CFR Parts 257 and 258 that address the design, operation, and closure of MSWLFs. These regulations are summarized below.

Regulations at 40 CFR Part 257 classify solid waste disposal facilities and practices. Regulations at 40 CFR Part 258 establish criteria for municipal solid waste landfills. The types of criteria required include: location restrictions, operating criteria, design criteria, ground water monitoring and corrective action, closure and postclosure care, and financial assurance criteria. All States must implement the Federal MSWLF criteria primarily through State solid waste management plans.

As part of the operating criteria, Part 258 requires that all discrete units within MSWLFs receiving waste provide for the following by October 1993 (it should be noted that EPA has proposed an extension of this deadline to April 1994):

(a) Owners or operators of all MSWLF units must design, construct, and maintain:

(1) A runon control system to prevent flow onto the active portion of the landfill during the peak discharge from a 25-year storm:

(2) A runoff control system from the active portion of the landfill to collect and control at least the water volume resulting from a 24-hour, 25-year storm event.

In addition, all MSWLF units that received wastes after October 1991 are required to meet specific closure standards (see 40 CFR 258.60). These standards include installation of a final cover consisting of a minimum of 6 inches of topsoil over a minimum of 18 inches of clay. The cover must be no more permeable than the unit's liner. The criteria also imply, but do not explicitly require, that revegetation should be performed.

These criteria indicate that for all but the most severe storm events (i.e., greater than the 24-hour, 25-year storm event), new units within MSWLFs will be required to separate storm water discharges from active and inactive areas. (Active areas are defined as those that have not yet received a final cover [as required under 258.60].) Further, the closure/final cover criteria described above are intended to prevent contact with waste materials and minimize erosion.

4. Storm Water Pollution Prevention Plans Requirements

The requirements for storm water pollution prevention plans under this section build upon the requirements included in the common pollution prevention requirements discussed in the front of this fact sheet. As such, the following discussion focuses on the plan requirements that are specific to landfills and land application sites. The rationale for the common requirements applicable to all types of facilities covered under today's permit (including landfills) is provided in Part VI of this fact sheet.

a. Description of Potential Pollutant Sources. The first step in preventing pollution of storm water from landfills is to identify potential sources of storm water contamination. Consequently, EPA is requiring that landfill and land application site operators include, in their pollution prevention plan, a narrative description of activities at their facilities. The Agency is also requiring landfill permittees to identify on a site map the locations of active and closed cells or trenches, any known leachate springs or other areas where leachate may commingle with runoff, the locations of any leachate collection and handling systems, and the locations of stockpiles of landfill cover material. The Agency is requiring land application site permittees to identify on their site maps the locations of active and inactive land application areas and the types of wastes applied in those areas, any known leachate springs or other areas where leachate may commingle with runoff, the locations of any leachate collection and handling systems, and the locations of temporary waste storage areas. EPA believes these requirements will, in the event contamination is detected in storm water, facilitate the identification of any source of contamination.

EPA is also requiring owners or operators to summarize all available sampling data for storm water and leachate generated at the site because the Agency believes these data will help to determine whether storm water is commingling with any leachate produced at the site. Finally, operators must identify any current NPDES-permitted discharges at their sites.

b. Measures and Controls. EPA is requiring good housekeeping practices for materials storage areas exposed to precipitation and for vehicle tracking of sediment and waste. EPA believes good housekeeping practices provide a simple and inexpensive means of controlling pollutants from entering storm water and therefore will not be overly burdensome to regulated facilities.

EPA believes that frequent and thorough inspections are necessary to ensure adequate functioning of: sediment and erosion controls, leachate collection systems, intermediate and final covers, and significant materials storage containers. Failure of any of the aforementioned items could cause contamination of storm water with sediment, leachate, or significant materials stored onsite. EPA believes it is necessary to conduct inspections both during storm events and during dry weather. Inspections during dry periods allow facilities to identify and address any problems prior to a storm event, thereby minimizing the chance for storm water contamination. Inspections during significant storm events ensure that measures are functioning as originally intended and provide an opportunity for facilities to observe what materials and/or activities are exposed to storm water. Pollution prevention plans must address the specific inspection requirements for active and inactive landfills and land application sites described in Part XI.L.3.a.(3).(d) of today's permit.

Failures of significant materials storage containers, leachate collection and treatment systems, cover materials, and sedimentation and erosion controls can result in storm water contamination. EPA believes it is necessary to maintain these items in good working order to prevent storm water contamination. Consequently, EPA is requiring (in pollution prevention plans) that owners or operators ensure the maintenance of material storage areas to prevent leaking or rupture and all elements of leachate collection and treatment systems to prevent commingling of leachate with storm water. Pollution prevention plans must also describe measures to be taken to protect the integrity and effectiveness of any intermediate and final covers.

EPA believes controls are needed to reduce potential TSS contamination of storm water and to reduce suspended solids which have been carried by storm water before the discharge leaves the site. Therefore, EPA has chosen to require that pollution prevention plans address both stabilization and structural controls to reduce potential TSS loadings to surface waters.

5. Monitoring and Reporting Requirements

a. Analytical Monitoring Requirements. This section establishes separate requirements for municipal solid waste landfills (MSWLFs) and industrial landfills. These requirements are discussed below.

(1) MSWLFs. The Agency believes that the MSWLF criteria in 40 CFR 258.60 will effectively separate runoff from active and inactive areas at newer landfills. As a result, separate requirements have been established for active and inactive areas at MSWLF sites.

For discharges from active landfill areas, the Agency believes that there is reasonable potential for runoff to contact waste materials. In these areas, runoff may also become commingled with leachate. In fact, a significant percentage of landfill facilities that submitted group applications, identified leachate and wastes as "exposed materials." In addition, total suspended solids (TSS) levels are also likely to be elevated where contact occurs with wastes, disturbed areas, and daily/intermediate cover materials.

At this time, the Agency does not believe that there are sufficient data available to establish numeric limits based on best available technology for storm water discharges from active MSWLF areas. The data submitted in the part 2 applications, as well as leachate data from available literature, suggest that a variety of constituents may be present at levels that are highly site-specific depending on the types and extent of contact with exposed wastes and extent of commingling with leachate. Furthermore, the volumes of runoff generated will be dependent on the frequency and intensity of precipitation events. For TSS, little or no data are available to characterize the TSS levels in active landfill area runoff and to assess the performance of treatment technologies/best management practices currently in use.

Therefore, in this section, EPA is requiring that landfill operators develop storm water pollution prevention plans. For active landfill areas, these plans should be tailored toward minimizing contact of storm water with waste materials. The plans should also include design and implementation of best management practices and/or treatment methods to control the pollutants likely to be found in runoff at the site. For the active portion of the landfill, this section also requires quarterly monitoring for TSS and total recoverable iron (see below) to quantify the performance of BMPs/treatment measures. These data may be used in the future in the development of individual and/or general permits to establish numeric limitations based on best available technology. It should also be noted that EPA is currently in the process of developing effluent limitation guidelines for discharges of leachate from waste management facilities (including MSWLFs). Where these effluent guidelines apply to discharges from active areas, facilities will be required to comply with these requirements on the effective date.

For units/areas that ceased receiving wastes after October 1991, EPA believes that closure criteria under 40 CFR 258.60 will minimize or eliminate pollutant loadings from waste materials to storm water. For MSWLF units closed in accordance with these criteria, TSS should be the only pollutant of concern. Again, EPA does not believe that adequate data are currently available to establish a numeric limitation based on best available technology (BAT) for TSS in storm water discharges from inactive areas. TSS concentrations in untreated storm water discharges have not been sufficiently well characterized to address the site-specific variability arising from local geology and topography along with individual cover materials and reclamation practices. Furthermore, the available data do not support an assessment of the relative performance of specific BMPs/treatment measures. Quarterly TSS monitoring is required to provide additional data to evaluate the effectiveness of specific control measures.

The Agency is uncertain whether all MSWLF units which ceased receiving wastes prior to October 1991 will have been closed in such a manner to ensure long term stability and minimize the potential for runoff to contact wastes and leachate. Therefore, operators of units that were closed prior to October 1991 are required to conduct the same monitoring as required for active areas. This monitoring is intended to evaluate the integrity and performance of final cover materials in minimizing pollutant loadings to storm water discharges. Based on the results of this monitoring, the permitting authority may elect to continue/modify or terminate the required monitoring, provide for additional permit conditions (including specific BMPs and/or numeric limitations), or terminate coverage under the permit, as appropriate.

An exception from most monitoring requirements is provided for older landfill areas closed prior to October 1991 in accordance with State requirements that meet or exceed the final cover criteria in 40 CFR 258.60. Similar to newer units, TSS should be the only pollutant of concern at these sites and only quarterly TSS monitoring is required.

(2) Industrial Landfills. As discussed above, minimal data are available to characterize storm water discharges or management practices for industrial solid waste landfills. EPA recognizes that onsite landfills are likely to be dedicated waste management units. However, the 1988 Report to Congress indicates that these onsite units can be found at sites in virtually every major industrial category. Offsite landfills can receive industrial wastes from almost any sources. Further, there are no current or planned Federal minimum requirements for runon/runoff control and closure of these onsite and offsite facilities. As a result, existing State programs vary. Some States have extensive permitting and design standard requirements for industrial landfills, often for specific waste types. In contrast, other States have much more limited industrial solid waste programs.

Because of the variability between sites, the need for representative runoff characterization data, and the lack of information on BMP/treatment method performance, this section does not establish effluent limitations for storm water discharges from industrial landfills. At this time, best available technology shall consist of development and implementation of pollution prevention plans. In addition, to ensure protection of water quality, the Agency has established monitoring requirements based on the potential for elevated TSS levels (due to erosion) and the concern that runoff from industrial landfills may contact waste materials and/or leachate.

(3) Land Application Sites. This section includes the same requirements for land application sites as for industrial landfills (as described above). The Agency does not currently have sufficient data to identify specific pollutants common to land application sites and develop numeric limitations. Therefore, the Agency believes that requiring implementation of pollution prevention plans along with TSS and Total Recoverable iron monitoring requirements is appropriate.

In summary, EPA believes that landfill/land application sites may reduce the level of pollutants in storm water runoff from their sites through the development and proper implementation of the storm water pollution prevention plan requirements discussed in today's permit. In order to provide a tool for evaluating the effectiveness of the pollution prevention plan and to characterize the discharge for potential environmental impacts, the permit requires landfill/land application sites to collect and analyze samples of their storm water discharges for the pollutants listed in Table L–5.

At a minimum, storm water discharges from landfill/land application sites must be monitored quarterly during the second year of permit coverage. At the end of the second year of permit coverage, a facility must calculate the average concentration for each parameter listed in Table L–5. If the permittee collects more than four samples in this period, then they must calculate an average concentration for each pollutant of concern for all samples analyzed.

TABLE L–5.—INDUSTRY MONITORING REQUIREMENTS

Pollutants of concern	Cut-off concentration
Total Suspended Solids (TSS) [i]	100 mg/L.
Total Recoverable Iron [ii]	1.0 mg/L.

[i] Applicable to all landfill and land application sites.
[ii] Applicable to all facilities except MSWLF areas closed in accordance with 40 CFR 258.60 requirements.

If the average concentration for a parameter is less than or equal to the value listed in Table L–5, then the permittee is not required to conduct quantitative analysis for that parameter during the fourth year of the permit. If, however, the average concentration for a parameter is greater than the cut-off concentration listed in Table L–5, then the permittee is required to conduct quarterly monitoring for that parameter during the fourth year of permit coverage. Monitoring is not required during the first, third, and fifth year of the permit. The exclusion from monitoring in the fourth year of the permit is conditional on the facility maintaining industrial operations and BMPs that will ensure a quality of storm water discharges consistent with the average concentrations recorded during the second year of the permit. The schedule of monitoring is presented in Table L–6.

TABLE L–6.—SCHEDULE OF MONITORING

2nd Year of Permit Coverage	• Conduct quarterly monitoring. • Calculate the average concentration for all parameters analyzed during this period. • If average concentration is greater than the value listed in Table L–5, then quarterly sampling is required during the fourth year of the permit. • If average concentration is less than or equal to the value listed in Table L–5, then no further sampling is required for that parameter.
4th Year of Permit Coverage	• Conduct quarterly monitoring for any parameter where the average concentration in year 2 of the permit is greater than the value listed in Table L–5. • If industrial activities or the pollution prevention plan have been altered such that storm water discharges may be adversely affected, quarterly monitoring is required for all parameters of concern.

In cases where the average concentration of a parameter exceeds the cut-off concentration, EPA expects permittees to place special emphasis on methods for reducing the presence of those parameters in storm water discharges. Quarterly monitoring in the fourth year of the permit will reassess the effectiveness of the adjusted pollution prevention plan.

The monitoring cut off concentrations listed in Table L–5 are not numerical effluent limitations. These values represent a level of pollutant discharge which facilities may achieve through the implementation of pollution prevention plans. At least half of the facilities which submitted Part 2 data, reported concentrations greater than or equal to the values listed in Table L–5. Facilities that achieve average discharge concentrations which are less than or equal to the values in Table L–5 are not relieved from the pollution prevention plan requirements or any other requirements of the permit.

EPA realizes that if a facility is inactive and unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly chemical sampling.

b. Alternative Certification. Throughout today's permit, EPA has included monitoring requirements for facilities which the Agency believes have the potential for contributing significant levels of pollutants to storm water discharges. The alternative described below is necessary to ensure that monitoring requirements are only imposed on those facilities that do, in fact, have storm water discharges containing pollutants at concentrations of concern. EPA has determined that if materials and activities are not exposed to storm water at the site, then the potential for pollutants to contaminate storm water discharges does not warrant monitoring.

Therefore, a discharger is not subject to the monitoring requirements of this Part provided the discharger makes a certification for a given outfall, or on a pollutant-by-pollutant basis in lieu of monitoring reports described in (*c*) below, under penalty of law, signed in accordance with Part VII.G. (Signatory Requirements), that material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, industrial machinery or operations, significant materials from past industrial activity, that are located in areas of the facility that are within the drainage area of the outfall are not presently exposed to storm water and will not be exposed to storm water for the certification period. Such certification must be retained in the storm water pollution prevention plan and submitted to EPA in accordance with Part VI.C. of this permit. In the case of certifying that a pollutant is not present, the permittee must submit the certification along with the monitoring reports required under paragraph (*c*) below. If the permittee cannot certify for an entire period, they must submit the date exposure was eliminated and any monitoring required up until that date. This certification option is not applicable to compliance monitoring requirements associated with effluent limitations. EPA does not expect facilities to be able to exercise this certification for indicator parameters, such as TSS and BOD.

c. Reporting Requirements. Permittees are required to submit all monitoring results obtained during the second and fourth year of permit coverage within 3 months of the conclusion of each year. Such permittees must submit monitoring results on signed Discharge Monitoring Report Forms to the Director. For each outfall, one Discharge Monitoring Reporting Form must be submitted per storm event sampled. For facilities conducting monitoring beyond the minimum quarterly requirements an additional Discharge Monitoring Report Form must be filed for each analysis.

d. Sample Type. All discharge data shall be reported for grab samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The required 72-hour storm event interval is waived where the preceding measurable storm event did not result in a measurable discharge from the facility. The required 72-hour storm event interval may also be waived where the permittee documents that less than a 72-hour interval is representative for local storm events during the season when sampling is being conducted. The grab sample shall be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable.

If storm water discharges associated with industrial activity commingle with process or nonprocess water, then where practicable permittees must attempt to sample the storm water discharge before it mixes with the non-storm water discharge.

e. Representative Discharge. When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may test the effluent of one of such outfalls and report that the quantitative data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluent. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

f. Quarterly Visual Examination of Storm Water Quality. Landfills and land application sites shall perform and document a visual examination of a storm water discharge associated with industrial activity from each outfall, except discharges exempted under paragraph (3) below. The examination(s) must be made at least once in each of the following three-month periods: January through March, April through June, July through September, and October through December. The examination shall be made during daylight hours unless there is insufficient rainfall or snow melt to produce a runoff event.

(1) Examinations shall be made of grab samples collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 1 hour) of when the runoff or snowmelt begins discharging. The examinations shall document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on the samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. Where practicable, the same individual should carry out the collection and examination of discharges for entire permit term.

(2) Visual examination reports must be maintained onsite in the pollution prevention plan. The report shall include the examination date and time, examination personnel, the nature of the discharge (i.e., runoff or snow melt), visual quality of the storm water discharge (including observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution), and probable sources of any observed storm water contamination.

(3) When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials,

and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may collect a sample of effluent of one of such outfalls and report that the observation data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage are (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

(4) When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the records of the visual examinations. Adverse weather conditions that may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(5) EPA realizes that if a facility is inactive and unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly visual examination.

EPA believes that this quick and simple assessment will allow the permittee to approximate the effectiveness of his/her plan on a regular basis at very little cost. Although the visual examination cannot assess the chemical properties of the storm water discharged from the site, the examination will provide meaningful results upon which the facility may act quickly. The frequency of this visual examination will also allow for timely adjustments to be made to the plan. If BMPs are performing ineffectively, corrective action must be implemented. A set of tracking or follow-up procedures must be used to ensure that appropriate actions are taken in response to the examinations. The visual examination is intended to be performed by members of the pollution prevention team. This hands-on examination will enhance the staff's understanding of the storm water problems on that site and effects on the management practices that are included in the plan.

M. Storm Water Discharges Associated With Industrial Activity From Automobile Salvage Yards

1. Industry Profile

On November 16, 1990 (55 FR 47990), EPA promulgated the regulatory definition of "storm water discharges associated with industrial activity." This definition included point source discharges of storm water from eleven categories of facilities, including "* * * battery reclaimers, salvage yards, and automobile recyclers, including but limited to those classified as Standard Industrial Classification 5015.* * *"

This section establishes special conditions for the storm water discharges associated with industrial activities at automobile salvage yards. Washwaters from vehicle, equipment, and parts cleaning areas are process wastewaters. Discharges of process wastewater and discharges subject to process wastewater effluent limitation guidelines are not eligible for coverage under this section.

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

This section has been developed for storm water discharges associated with activities related to dismantling of used motor vehicles for the purpose of selling parts. As stated above, category (vi) of the definition of storm water discharges associated with industrial activity includes facilities primarily engaged in the wholesale or retail distribution of used motor vehicle parts and classified as SIC code 5015. Dismantlers are a major source for replacement parts for motor vehicles in service.

The following description summarizes operations that might occur at a typical automobile dismantling facility. The primary activity involves the dismantling or wrecking of used motor vehicles. Some facilities, however, perform vehicle maintenance and may rebuild vehicles for resale.

Typically, automobile dismantling facilities receive vehicles that are either uneconomical to run or wrecks that are uneconomical to repair. The nature of operations generally depends on the size and location of the facility. In urban areas where land is more valuable, vehicles are typically dismantled upon arrival, parts are segregated, cleaned, and stored. Remaining hulks are generally sold to scrap dealers rather than stored onsite due to limited space. In more rural areas, discarded vehicles are typically stored on the lot and parts removed as necessary. Remaining hulks are sold to scrap dealers less frequently.

Once a used vehicle is brought to the site, fluids may be drained and the tires, gas tank, radiator, engine and seats may be removed. The dismantler may separate and clean parts. Such cleaning may include steam cleaning of the engine and transmission as well as the use of solvents to remove oil and grease and other residues. Usable parts are then inventoried and stored for resale. The remaining car and/or truck bodies are stored onsite for future sale of the sheet metal and glass. Stripped vehicles and parts that have no resale value are typically crushed and sold to a steel scrapper. Some operations may, however, convert used vehicles and parts into steel scrap as a secondary operation. This is accomplished by incineration, shearing (bale shearer), shredding, or baling.

According to the 1987 census, 6,075 establishments reported SIC code 5015 as their primary SIC code, although some estimates indicate that there may be as many as 11,000 to 12,000 of these facilities.[89] Vehicle wreckers and dismantlers are generally small, privately owned businesses. Most facilities employ 10 or fewer employees and derive the majority of their profits from the sale of usable parts. Only a small percentage of this universe consists of large establishments with fleets of trucks, cranes, mobile balers and computers to maintain inventories of parts.[90]

Table M–1 below lists potential pollutant sources from activities that commonly take place at automobile salvage yards.

[89] "The Automobile Scrap Processing Industry," Howard Ness, P.E., 1984.

[90] Ibid.

TABLE M–1.—COMMON POLLUTANT SOURCES

Activity	Pollutant source	Pollutants
Vehicle Dismantling	Oil, anti-freeze, batteries, gasoline, diesel fuel, hydraulic fluids.	Oil and grease, ethylene glycol, heavy metals.
Used Parts Storage	Batteries, chrome bumpers, wheel balance weights, tires, rims, filters, radiators, catalytic converters, engine blocks, hub caps, doors, drivelines, galvanized metals, mufflers.	Sulfuric acid, galvanized metals, heavy metals, petroleum hydrocarbons, suspended solids.
Outdoor Vehicle and Equipment Storage	Leaking engines, chipping/corroding bumpers, chipping paint, galvanized metal.	Oil and grease, arsenic, organics, heavy metals, TSS.
Vehicle and Equipment Maintenance	Parts cleaning	Chlorinated solvents, oil and grease, heavy metals, acid/alkaline wastes.
	Waste disposal of greasy rags, oil filters, air filters, batteries, hydraulic fluids, transmission fluids, radiator fluids, degreasers.	Oil, heavy metals, chlorinated solvents, acid/alkaline wastes oil, heavy metals, chlorinated solvents, acid/alkaline wastes, ethylene glycol.
	Spills of oil, degreasers, hydraulic fluids, transmission fluid, and radiator fluids.	Oil, arsenic, heavy metals, organics, chlorinated solvents, ethylene glycol
	Fluids replacement, including oil, hydraulic fluids, transmission fluid, and radiator fluids.	Oil, arsenic, heavy metals, organics, chlorinated solvents, ethylene glycol.
Vehicle, Equipment, and Parts Washing Areas.	Washing and steam cleaning waters	Oil and grease, detergents, heavy metals, chlorinated solvents, phosphorus, salts, suspended solids.
Liquid Storage in Above Ground Storage Tanks	External corrosion and structural failure	Fuel, oil and grease, heavy metals, materials being stored.
	Installation problems	Fuel, oil and grease, heavy metals, materials being stored.
	Spills and overfills due to operator error	Fuel, oil and grease, heavy metals, materials being stored.
Illicit Connection to Storm Sewer	Process wastewater	Dependent on operations.
	Sanitary water	Bacteria, biochemical oxygen demand (BOD), suspended solids.
	Floor drain	Oil and grease, heavy metals, chlorinated solvents, fuel, ethylene glycol.
	Vehicle washwaters	Oil and grease, detergents, metals, chlorinated solvents, phosphorus, suspended solids.
	Radiator flushing wastewater	Ethylene glycol.
	Leaking underground storage tanks	Materials stored or previously stored.

Sources:
NPDES Storm Water Group Applications—Part 1. Received by EPA March 18, 1991 through December 31, 1992.
Alabama Department of Environmental Management. September 30, 1992. "Best Management Plan for Automobile Salvage Yards—Final Report."
EPA, Office of Research and Development. October 1991. "Guides to Pollution Prevention—The Automotive Refinishing Industry." EPA/625/7–91/016.
EPA, Office of Research and Development. October 1991. "Guides to Pollution Prevention—The Automotive Repair Industry." EPA/625/7–91/013.
EPA, Office of Research and Development. May 1992. "Facilities Pollution Prevention Guide." EPA/600/R–92/088.
EPA, Office of Water. September 1992. "Storm Water Management for Industrial Activities—Developing Pollution Prevention Plans and Best Management Practices." EPA 832–R–92–006.

2. Pollutants in Storm Water Discharges Associated With Automobile Salvage Yards.

Impacts caused by storm water discharges from automobile salvage yards will vary. Several factors influence to what extent operations at the site can affect water quality. Such factors include: geographic location; hydrogeology; the types of industrial activity occurring outside (e.g., dismantling, vehicle and parts storage, or steam cleaning); the size of the operation; and the type, duration, and intensity of precipitation events. Each of these, and other factors, will interact to influence the quantity and quality of storm water runoff. For example, outdoor storage of leaking engine blocks may be a significant source of pollutants at some facilities, while dismantling operations is the primary source at others. In addition, sources of pollutants other than storm water, such as illicit connections,[91] spills, and other improperly dumped materials, may increase the pollutant loading discharged into waters of the United States.

[91] Illicit connections are contributions of unpermitted non-storm water discharges to storm sewers from any number of sources including improper connections, dumping or spills from industrial facilities, commercial establishments, or residential dwellings. The probability of illicit connections at used motor vehicle parts facilities is low yet it may be applicable at some operations.

EPA has identified the storm water pollutants and sources resulting from various automobile salvage yard activities in Table M–1. Table M–1 identifies oil, heavy metals, acids, and ethylene glycol as some of the parameters of concern at automobile salvage yards.

Based on the similarities of the facilities included in this sector in terms of industrial activities and significant materials, EPA believes it is appropriate to discuss the potential pollutants at automobile salvage yards as a whole and not subdivide this sector. Therefore, Table M–2 lists data for selected parameters from facilities in the automobile salvage yards sector. These data include the eight pollutants that all facilities were required to monitor under Form 2F, as well as the pollutants that EPA determined merit further monitoring.

TABLE M–2.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY AUTOMOBILE SALVAGE YARDS SUBMITTING PART II SAMPLING DATA [i] (mg/L)

Pollutant Sample type	No. of facilities		No. of samples		Mean		Minimum		Maximum		Median		95th percentile		99th percentile	
	Grab	Comp [ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	45	59	58	74	15.9	12.37	2.0	0.0	216.0	84.0	7.0	6.0	42.3	38.62	82.5	77.33
COD	65	43	83	54	123.8	73.52	0.0	11.0	1660.0	215.0	62.0	54.5	365.2	177.2	722.3	279.3
Nitrate + Nitrite Nitrogen	45	58	58	73	1.02	2.38	0.00	0.0	6.50	69.3	0.60	0.67	3.23	6.96	6.52	17.0
Total Kjeldahl Nitrogen	37	51	50	68	3.19	2.20	0.04	0.04	18.0	011.0	2.00	1.68	10.22	6.01	19.48	10.2
Oil & Grease	41	N/A	58	N/A	7.0	N/A	0.0	N/A	84.0	N/A	3.0	N/A	26.8	N/A	60.5	N/A
pH	67	N/A	87	N/A	N/A	N/A	3.1	N/A	9.1	N/A	7.3	N/A	9.0	N/A	9.9	N/A
Total Phosphorus	39	54	52	66	0.76	1.22	0.00	0.00	11.20	45.0	0.15	0.11	2.61	2.49	7.70	7.79
Total Suspended Solids	47	60	60	76	552	524.9	0	1.0	4200	8565	196	166.00	2473	2462.6	6951	7999.9
Aluminum, Total	37	34	37	34	13.38	9.14	0.30	0.40	88.00	45.20	8.50	5.95	61.05	36.47	158.90	81.08
Iron, Total	37	34	37	34	19.1	11.2	0.9	0.7	95.0	54.0	10.7	7.5	82.3	43.9	212.2	98.6
Lead, Total	22	22	24	22	0.340	0.200	0.100	0.100	1.400	0.600	0.21	0.10	0.884	0.467	1.512	0.731

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.
[ii] Composite samples.

3. Options for Controlling Pollutants

In evaluating options for controlling pollutants in storm water discharges, EPA must achieve compliance with the technology-based standards of the Clean Water Act [Best Available Technology (BAT) and Best Conventional Technology (BCT)]. The Agency does not believe that it is appropriate to establish specific numeric effluent limitations or a specific design or performance standard in this section for storm water discharges associated with industrial activity from automobile salvage yard operations to meet the BAT/BCT standards of the Clean Water Act. Because of the diversity of operations at automobile salvage yards and the lack of sufficient storm water water quality data currently available to EPA, establishing numeric effluent limitations is not feasible at this time. Rather, this section establishes requirements for the development and implementation of a site-specific storm water pollution prevention plan consisting of a set of Best Management Practices that are sufficiently flexible to address different sources of pollutants at different sites.

Best Management Practices (BMPs) are implemented to prevent and/or eliminate pollutants in storm water discharges. EPA believes the most effective BMPs for reducing pollutants in storm water discharges from automobile salvage yards is through exposure minimization practices. Exposure minimization practices minimize the potential for storm water to come in contact with pollutants. These BMP methods are generally uncomplicated and inexpensive practices. They are easy to implement, and require little or no maintenance. In some instances, more resources-intensive BMPs, including detention ponds or filtering devices, may be necessary depending on the type of discharge, types and concentrations of contaminants, and volume of flow.

The selection of the most effective BMPs will be based on site-specific considerations such as: facility size, climate, geographic location, hydrogeology and the environmental setting of each facility, and volume and type of discharge generated. Each facility will be unique in that the source, type, and volume of contaminated storm water discharges will differ. In addition, the fate and transport of pollutants in these discharges will vary. EPA believes that the management practices discussed herein are well suited mechanisms to prevent or control the contamination of storm water discharges associated with automobile salvage yards.

Part 1 group application data indicate that BMPs have not been widely implemented at the representative sampling facilities. Less than 5 percent of the sampling subgroup list indoor storage as a material management practice. Less than 8 percent of the representative sampling facilities use covering at their storage areas. Less than 3 percent of the representative facilities utilize waste minimization practices. The most commonly listed (approximately 20 percent) material management practice is draining fluids from vehicles prior to storage. Because BMPs described in part 1 data are limited, Table M–3 is provided to identify BMPs associated with activities that may be employed at automobile salvage yards.

TABLE M–3.—STORM WATER BMPS FOR AUTOMOBILE SALVAGE YARDS

Activity	BMPs
Dismantling and vehicle maintenance	Drain all fluids from vehicles upon arrival at the site. Segregate the fluids and properly store or dispose of them. Maintain an organized inventory of materials used in the maintenance shop. Keep waste streams separate (e.g., waste oil and mineral spirits). Nonhazardous substances that are contaminated with a hazardous substance is considered a hazardous substance. Recycle anti-freeze, gasoline, used oil, mineral spirits, and solvents. Dispose of greasy rags, oil filters, air filters, batteries, spent coolant, and degreasers properly. Label and track the recycling of waste material (e.g., used oil, spent solvents, batteries). Drain oil filters before disposal or recycling.

TABLE M-3.—STORM WATER BMPS FOR AUTOMOBILE SALVAGE YARDS—Continued

Activity	BMPs
	Store cracked batteries in a nonleaking secondary container. Promptly transfer used fluids to the proper container. Do not leave full drip pans or other open containers around the shop. Empty and clean drip pans and containers. Do not pour liquid waste down floor drains, sinks, or outdoor storm drain inlets. Plug floor drains that are connected to the storm or sanitary sewer. If necessary, install a sump that is pumped regularly. Inspect the maintenance area regularly for proper implementation of control measures. Filtering storm water discharges with devices such as oil-water separators. Train employees on proper waste control and disposal procedures.
Outdoor vehicle, equipment, and parts storage .	Use drip pans under all vehicles and equipment waiting for maintenance and during maintenance. Store batteries on impervious surfaces. Curb, dike or berm this area. Confine storage of parts, equipment and vehicles to designated areas. Cover all storage areas with a permanent cover (e.g., roofs) or temporary cover (e.g., canvas tarps). Install curbing, berms or dikes around storage areas. Inspect the storage yard for filling drip pans and other problems regularly. Train employees on procedures for storage and inspection items.
Vehicle, equipment and parts washing areas	Avoid washing parts or equipment outside. Use phosphate-free biodegradable detergents. Consider using detergent-based or water-based cleaning systems in place of organic solvent degreasers. Designate an area for cleaning activities. Contain steam cleaning washwaters or discharge under an applicable NPDES permit. Ensure that washwaters drain well. Inspect cleaning area regularly. Install curbing, berms or dikes around cleaning areas. Train employees on proper washing procedures.
Liquid storage in above ground containers	Maintain good integrity of all storage containers. Install safeguards (such as diking or berming) against accidental releases at the storage area. Inspect storage tanks to detect potential leaks and perform preventive maintenance. Inspect piping systems (pipes, pumps, flanges, couplings, hoses, and valves) for failures or leaks. Train employees on proper filling and transfer procedures.
Improper connection with storm sewers	Plug all floor drains if it is unknown whether the connection is to storm sewer or sanitary sewer systems. Alternatively, install a sump that is pumped regularly. Perform dye testing to determine if interconnections exist between sanitary water system and storm sewer system. Update facility schematics to accurately reflect all plumbing connections. Install a safeguard against vehicle washwaters and parts cleaning waters entering the storm sewer unless permitted. Maintain and inspect the integrity of all underground storage tanks; replace when necessary. Train employees on proper disposal practices for all materials.

Sources: NPDES Storm Water Group Applications—Part 1. Received by EPA March 18, 1991 through December 31, 1992.
EPA, Office of Research and Development. October 1991. "Guides to Pollution Prevention—The Automotive Refinishing Industry." EPA/625/7-91/0.
EPA, Office of Research and Development. October 1991. "Guides to Pollution Prevention—The Automotive Repair Industry." EPA/625/7-91/013.
EPA, Office of Research and Development. May 1992. "Facility Pollution Prevention Guide." EPA/600/R-92/088.
EPA, Office of Water. September 1992. "Storm Water Management for Industrial Activities—Developing Pollution Prevention Plans and Best Management Practices." EPA 832-R-92-006.
Minnesota Technical Assistance Program. September 1988. "Waste minimization—Auto Salvage Yards."

4. Pollutant Control Measures Required Through Other EPA Programs

Because hazardous substance including oil, gasoline, and lead are commonly found at automobile salvage yards, such facilities may be subject to other State or Federal environmental protection programs. In particular, as described below, the Resource Conservation and Recovery Act (RCRA) and the Underground Storage Tank (UST) programs require careful management of materials used onsite which decreases the probability that storm water from such areas will be contaminated by these materials.

Under the RCRA program, on September 10, 1992, EPA promulgated standards in 40 CFR Part 279 for the management of used oils that are recycled (57 FR 41566). These standards include requirements for used oil generators, transporters, processors/re-refiners, and burners. The standards for used oil generators apply to all generators, regardless of the amount of used oil they generate. Do-it-yourself (DIY) generators which generate used oil from the maintenance of their personal vehicles, however, are not subject to the management standards in 40 CFR 279.20(a)(1)).

The requirements for used oil generators were designed to impose a minimal burden on generators while protecting human health and the environment from the risks associated with managing used oil. Under Subpart C of 40 CFR Part 279, used oil generators must not store used oil in units other than tanks, containers, or units subject to regulation under 40 CFR Parts 264/265 (Section 279.22(a)). In other words, generators may store used oil in tanks or containers that are not subject to Subpart J (hazardous waste

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tanks) or Subpart I (containers) of 40 CFR Parts 264/265, as long as such tanks or containers are maintained in compliance with the used oil management standards. This does not preclude generators from storing used oil in Subpart J tanks or Subpart I containers or other units, such as surface impoundments (Subpart K), that are subject to regulation under 40 CFR Part 264 or 265.

Storage units at generator facilities must be maintained in good condition and labeled with the words "used oil." Upon detection of a release of used oil to the environment, a generator must take steps to stop the release, contain the released used oil, and properly manage the released used oil and other materials [40 CFR 279.22 (b) to (d)]. Generators storing used oil in underground storage tanks are subject to the UST regulations in 40 CFR Part 280.

If used oil generators ship used oil offsite for recycling, they must use a transporter who has notified EPA and obtained an EPA identification number [40 CFR 279.24].

The technical standards for USTs at 40 CFR Part 280 require that new UST systems (defined as systems for which installation commenced after December 12, 1988) use overfill prevention equipment that will: 1) automatically shut off flow into the tank when the tank is no more than 95 percent full; or 2) alert the transfer operator when the tank is no more than 90 percent full by restricting the flow into the tank or triggering a high level alarm. The preceding requirements do not apply to systems that are filled by transfers of no more than 25 gallons at one time. Existing UST systems (defined as systems for which installation has commenced on or before December 12, 1988) are required to have installed the described overfill prevention equipment by December 12, 1998.

5. Storm Water Pollution Prevention Plan Requirements

EPA believes that pollution prevention is the most effective approach for controlling contaminated storm water discharges from automobile salvage yards. Pollution prevention plans allow the operator of a facility to select BMPs based on site-specific considerations such as: facility size; climate; geographic location; geology/hydrology; the environmental setting of each facility; and volume and type of discharge generated. This flexibility is necessary because each facility will be unique in that the source, type, and volume of contaminated surface water discharges will differ from site to site.

Under today's general permit, all facilities must prepare and implement a storm water pollution prevention plan. The establishment of a pollution prevention plan requirement reflects EPA's decision to allow operators of automobile salvage yards to utilize BMPs as the BAT/BCT level of control for the storm water discharges covered by this section. The requirements included in pollution prevention plans provide a flexible framework for the development and implementation of site specific controls to minimize pollutants in storm water discharges. This approach and associated deadlines are consistent with EPA's storm water general permits finalized on September 9, 1992 and September 25, 1992 for discharges in nonauthorized NPDES States (57 FR 41236).

There are two major objectives to a pollution prevention plan: 1) to identify sources of pollution potentially affecting the quality of storm water discharges associated with industrial activity from a facility; and 2) to describe and ensure implementation of practices to minimize and control pollutants in storm water discharges associated with industrial activity from a facility.

Specific requirements for a pollution prevention plan for automobile salvage yards are described below. These requirements must be implemented in addition to the baseline pollution prevention plan provisions discussed previously.

a. Contents of the Plan. Storm water pollution prevention plans are intended to aid operators of automobile salvage yards to evaluate all potential pollution sources at a site, and assist in the selection and implementation of appropriate measures designed to prevent, or control, the discharge of pollutants in storm water runoff. EPA has developed guidance entitled "Storm Water Management for Industrial Activities: Developing Pollution Prevention Plans and Best Management Practices," EPA, 1992, (EPA 832–R–92–006) to assist permittees in developing and implementing pollution prevention measures.

(1) Description of Potential Pollution Sources. There are no requirements beyond those described in Part VI.C.2 of this fact sheet.

(2) Measures and Controls. Following completion of the source identification and assessment phase, the permittee must evaluate, select, and describe the pollution prevention measures, best management practices (BMPs), and other controls that will be implemented at the facility. For the following areas at the site, the permittee must assess the applicability of the corresponding BMPs:

Vehicle Dismantling and Maintenance Areas—The plan must describe measures that prevent or minimize contamination of the storm water runoff from all areas used for vehicle dismantling and maintenance. The facility must consider draining and segregating all fluids from vehicles upon arrival at the site, or as soon as feasible thereafter. The facility must consider performing all maintenance activities indoors, maintaining an organized inventory of materials used in the shop, draining all parts fluids prior to disposal, prohibiting the practice of hosing down the shop floor, using dry cleanup methods, and/or collecting the storm water runoff from the maintenance area and providing treatment. Where dismantling and maintenance activities can not take place indoors, facilities may consider methods for containing oil or other fluid spillage during parts removal. Drip pans, large plastic sheets, or canvas may be considered for placement under vehicles or equipment during maintenance and dismantling activities. Where drip pans are used, they should not be left unattended to prevent accidental spills.

Vehicle, Parts, and Equipment Storage Areas—The storage of vehicles, parts, and equipment must be confined to designated areas (delineated on the site map). The plan must describe measures that prevent or minimize contamination of the storm water runoff from these areas. The facility must consider the use of drip pans, large sheets of plastic, canvas (or equivalent measures) under vehicles, parts, and equipment. Canvas or sheets of plastic may be used as temporary coverage of storage areas. Indoor storage of vehicles, parts and equipment, as well as the installation of roofs, curbing, berming and diking of these areas must be considered. Large plastic or metal bins with secure lids should be used to store oily parts (e.g., small engine parts). Used batteries should be stored within nonleaking secondary containment or by other equivalent means to prevent leaks of acid into storm water discharges.

Material Storage Areas—As part of a good housekeeping program, consider labeling storage units of all materials (e.g., used oil, used oil filters, spent solvents, paint wastes, radiator fluids, transmission fluids, hydraulic fluids). Maintain such containers and units in good condition, so as to prevent contamination of storm water. The plan must describe measures that prevent or minimize contamination of the storm water runoff from such storage areas. The facility may consider indoor storage of the materials and/or installation of berming and diking of the area.

Vehicle, Equipment, and Parts Cleaning Areas—The plan must describe measures that prevent or minimize contamination of storm water from all areas used for vehicle, equipment, and parts cleaning. The facility must consider performing all cleaning operations indoors. In addition, the facility must consider covering or berming the cleaning operation area. Washwaters from vehicle, equipment, and parts cleaning areas are process wastewaters that are not authorized discharges under this section.

These four areas are sources of pollutants in storm water from automobile salvage yards. EPA believes that the incorporation of BMPs such as those suggested, in conjunction with a pollution prevention plan, will substantially reduce the potential of storm water contamination from these areas. In addition, EPA believes that these requirements continue to provide the necessary flexibility to address the variable risk for pollutants in storm water discharges associated with different facilities.

(a) Preventive Maintenance—Permittees are required to develop a preventive maintenance program that includes regular inspections and maintenance of storm water BMPs. The purpose of the inspections, which may coincide with the inspections required in (b) below, is to check on the effectiveness of the storm water pollution prevention plan. The inspections allow facility personnel to monitor the success or failure of elements of the plan on a regular basis. The use of an inspection checklist should be considered. The checklist will ensure that all required areas are inspected, as well as help to meet the recordkeeping requirements. In addition to regular inspections, employees identifying potential problems during their daily activities, such as leaks or spills, shall take appropriate measures to address these problems as soon as feasible.

(b) Inspections—This section requires that in addition to the comprehensive site evaluation required under Part XI.M.3.a. of today's permit, qualified facility personnel shall be identified to inspect: upon arrival, or as soon as feasible thereafter, all vehicles for leaks; any equipment containing oily parts, hydraulic fluids, or any other fluids, at least quarterly for leaks; and any outdoor storage containers for liquids, including, but not limited to, brake fluid, transmission fluid, radiator water, and anti-freeze, at least quarterly for leaks.

In addition, qualified facility personnel are required to conduct, at a minimum, quarterly visual inspections of BMPs. The inspections shall include: (1) an assessment of the integrity of any flow diversion or source minimization systems; and (2) visual inspections of dismantling areas; outdoor vehicle, equipment, and parts storage area; vehicle and equipment maintenance areas; vehicle, equipment, and parts washing areas; and liquid storage in above ground containers. A set of tracking or follow-up procedures shall be used to ensure that appropriate actions are taken in response to the inspections.

The quarterly inspections must be made at least once in each of the following designated periods during daylight hours: January through March (storm water runoff or snow melt); April through June (storm water runoff); July through September (storm water runoff); October through December (storm water runoff). Records of inspections shall be maintained as part of the plan.

(c) Employee Training—Permittees are required to include a schedule for conducting training in the plan. EPA recommends that facilities conduct training annually at a minimum. However, more frequent training may be necessary at facilities with high turnover of employees or where employee participation is essential to the storm water pollution prevention plan. Employee training must, at a minimum, address the following areas when applicable to a facility: used oil management; spill prevention and response; good housekeeping practices; used battery management; and proper handling (i.e., collection, storage, and disposal) of all fluids. This training should serve as: (1) training for new employees; (2) a refresher course for existing employees; and (3) training for all employees on any storm water pollution prevention techniques recently incorporated into the plan, where appropriate, contractor personnel also must be trained in relevant aspects of storm water pollution prevention.

(d) Recordkeeping and Internal Reporting—Permittees must describe procedures for developing and retaining records on the status and effectiveness of plan implementation. The plan must address spills, monitoring, and BMP inspection and maintenance activities. Ineffective BMPs must be reported and the date of their corrective action noted.

(e) Storm Water Management—The permittee must evaluate the appropriateness of each storm water BMP that diverts, infiltrates, reuses, or otherwise reduces the discharge of contaminated storm water. In addition, the permittee must describe the storm water pollutant source area or activity (i.e., loading and unloading operations, raw material storage piles etc.) to be controlled by each storm water management practice.

(3) Comprehensive Site Compliance Evaluation. The storm water pollution prevention plan must describe the scope and content of comprehensive site evaluations that qualified personnel will conduct to: (1) confirm the accuracy of the description of potential pollution sources contained in the plan; (2) determine the effectiveness of the plan; and (3) assess compliance with the terms and conditions of this section. Comprehensive site compliance evaluations should be conducted at least once a year for automobile salvage yards. These evaluations are intended to be more in depth than the quarterly visual inspections. The individual or individuals who will conduct the evaluations must be identified in the plan and should be members of the pollution prevention team. Evaluation reports must be retained for at least 3 years after the date of the evaluation.

Based on the results of each evaluation, the description of potential pollution sources, and measures and controls, the plan must be revised as appropriate within 2 weeks after each evaluation. Changes in the measures and controls must be implemented on the site in a timely manner, and never more than 12 weeks after completion of the evaluation.

6. Monitoring and Reporting Requirements

a. Analytical Monitoring Requirements. EPA believes that automobile salvage yards may reduce the level of pollutants in storm water runoff from their sites through the development and proper implementation of the storm water pollution prevention plan requirements discussed in today's permit. In order to provide a tool for evaluating the effectiveness of the pollution prevention plan and to characterize the discharge for potential environmental impacts, the permit requires automobile yards to collect and analyze samples of their storm water discharges for the pollutants listed in Table M–4. The pollutants listed in Table M–4 were found to be above benchmark levels for a significant portion of sampling facilities that submitted quantitative data in the group application process. EPA is requiring monitoring for these pollutants after the pollution prevention plan has been implemented to assess the effectiveness of the pollution prevention plan and to help ensure that a reduction of pollutants is realized.

At a minimum, storm water discharges from automobile salvage yards must be monitored quarterly during the second year of permit coverage, unless the facility exercises the Alternative Certification in Section VI.E.3 of this fact sheet. At the end of the second year of permit coverage, a facility must calculate the average concentration for each parameter listed in Table M–4. If the permittee collects more than four samples in this period, then they must calculate an average concentration for each pollutant of concern for all samples analyzed.

TABLE M–4.—INDUSTRY MONITORING REQUIREMENTS

Pollutants of concern	Cut-off concentration
Total Suspended Solids	100 mg/L.
Total Recoverable Aluminum	0.75 mg/L.
Total Recoverable Iron	1.0 mg/L.
Total Recoverable Lead	0.0816 mg/L.

If the average concentration for a parameter is less than or equal to the value listed in Table M–4, then the permittee is not required to conduct quantitative analysis for that parameter during the fourth year of the permit. If, however, the average concentration for a parameter is greater than the cut-off concentration listed in Table M–4, then the permittee is required to conduct quarterly monitoring for that parameter during the fourth year of permit coverage. Monitoring is not required during the first, third, and fifth year of the permit. The exclusion from monitoring in the fourth year of the permit is conditional on the facility maintaining industrial operations and BMPs that will ensure a quality of storm water discharges consistent with the average concentrations recorded during the second year of the permit. The schedule of monitoring is presented in Table M–5.

TABLE M–5.—SCHEDULE OF MONITORING

2nd Year of Permit Coverage	• Conduct quarterly monitoring. • Calculate the average concentration for all parameters analyzed during this period. • If average concentration is greater than the value listed in Table M–4, then quarterly sampling is required during the fourth year of the permit. • If average concentration is less than or equal to the value listed in Table M–4, then no further sampling is required for that parameter.
4th Year of Permit Coverage	• Conduct quarterly monitoring for any parameter where the average concentration in year 2 of the permit is greater than the value listed in Table M–4. • If industrial activities or the pollution prevention plan have been altered such that storm water discharges may be adversely affected, quarterly monitoring is required for all parameters of concern.

In cases where the average concentration of a parameter exceeds the cut-off concentration, EPA expects permittees to place special emphasis on methods for reducing the presence of those parameters in storm water discharges. Quarterly monitoring in the fourth year of the permit will reassess the effectiveness of the adjusted pollution prevention plan.

EPA realizes that if a facility is inactive and unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly chemical sampling.

b. Alternative Certification. Throughout today's permit, EPA has included monitoring requirements for facilities which the Agency believes have the potential for contributing significant levels of pollutants to storm water discharges. The alternative certification described below is necessary to ensure that monitoring requirements are only imposed on those facilities that do, in fact, have storm water discharges containing pollutants at concentrations of concern. EPA has determined that if materials and activities are not exposed to storm water at the site, then the potential for pollutants to contaminate storm water discharges does not warrant monitoring.

Therefore, a discharger is not subject to the monitoring requirements of this Part provided the discharger makes a certification for a given outfall or on a pollutant-by-pollutant basis, in lieu of sampling described under Part VIII.M.6.a of this factsheet, under penalty of law, signed in accordance with Part VII.G (Signatory Requirements), that material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, industrial machinery or operations, significant materials from past industrial activity, that are located in areas of the facility that are within the drainage area of the outfall are not presently exposed to storm water and will not be exposed to storm water for the certification period. Such certification must be retained in the storm water pollution prevention plan and submitted to EPA in lieu of monitoring reports. The permittee is required to complete any and all sampling until the exposure is eliminated. If the facility is reporting for a partial year, the permittee must specify the date exposure was eliminated. If the permittee is certifying that a pollutant was present for part of the reporting period, nothing relieves the permittee from the responsibility to sample that parameter up until the exposure was eliminated and it was determined that no significant materials remained. This certification is not to be confused with the low concentration sampling waiver. The test for the application of this certification is whether the pollutant is exposed, or can reasonably be expected to be present in the storm water discharge. If the facility does not and has not used a parameter, or if exposure is eliminated and no significant materials remain, then the facility can exercise this certification. The Agency does not expect that

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facilities will be able to use the alternative certification for indicator parameters such as TSS and BOD. This certification option is not applicable to compliance monitoring requirements associated with effluent limitations. EPA does not expect facilities to be able to exercise this certification for indicator parameters, such as TSS and BOD.

c. Reporting Requirements. Permittees are required to submit all monitoring results obtained during the second and fourth year of permit coverage within 3 months of the conclusion of each year. For each outfall, one signed Discharge Monitoring Report Form must be submitted per storm event sampled. For facilities conducting monitoring beyond the minimum requirements an additional Discharge Monitoring Report Form must be filed for each analysis.

d. Sample Type. All discharge data shall be reported for grab samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The 72-hour storm event interval is waived where the preceding measurable storm event did not result in a measurable discharge from the facility. The required 72-hour storm event interval may also be waived where the permittee documents that less than a 72-hour interval is representative for local storm events during the season when sampling is being conducted. The grab sample shall be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable. If storm water discharges associated with industrial activity commingle with process or nonprocess water, then where practicable permittees must attempt to sample the storm water discharge before it mixes with the non-storm water discharge.

e. Representative Discharge. When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may test the effluent of one of such outfalls and report that the quantitative data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluent. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

f. Quarterly Visual Examination of Storm Water Quality. All automobile salvage yard facilities are required to conduct quarterly visual examinations of storm water discharges from each outfall. The examination of storm water grab samples shall include any observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, or other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on these samples. The examinations must be of a grab sample collected from each storm water outfall.

The examination must be made at least once in each of the following three-month periods: January through March, April through June, July through September, and October through December. The examinations shall be made during daylight unless there is insufficient rainfall or snow-melt to runoff. Whenever practicable, the same individual should carry out the collection and examination of discharges throughout the life of the permit to ensure the greatest degree of consistency possible. Grab samples shall be collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 1 hour) of when the runoff begins discharging. Reports of the visual examination include: the examination date and time, examination personnel, visual quality of the storm water discharge, and probable sources of any observed storm water contamination. The visual examination reports must be maintained onsite with the pollution prevention plan.

When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the records of the visual examinations. Adverse weather conditions which may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

EPA realizes that if a facility is inactive and unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly visual examination.

EPA believes that this quick and simple assessment will allow the permittee to approximate the effectiveness of his/her plan on a regular basis at very little cost. Although the visual examination cannot assess the chemical properties of the storm water discharged from the site, the examination will provide meaningful results upon which the facility may act quickly. The frequency of this visual examination will also allow for timely adjustments to be made to the plan. If BMPs are performing ineffectively, corrective action must be implemented. A set of tracking or follow-up procedures must be used to ensure that appropriate actions are taken in response to the examinations. The visual examination is intended to be performed by members of the pollution prevention team. This hands-on examination will enhance the staff's understanding of the storm water problems on that site and the effects of the management practices that are included in the plan.

N. Storm Water Discharges Associated With Industrial Activity From Scrap Recycling and Waste Recycling Facilities

1. Industry Profile

Specific requirements have been established for those facilities that are engaged in the processing, reclaiming and wholesale distribution of scrap and recyclable waste materials. As background, the storm water regulations define 11 categories of storm water discharges associated with industrial activity in 40 CFR 122.26(b)(14). Category (vi) includes facilities that are engaged in the recycling of materials, including metal scrapyards, battery reclaimers, and salvage yards, including but limited to those classified Standard Industrial Classification (SIC) 5093. For purposes of this section, special conditions have been included for those facilities engaged in the reclaiming and retail/wholesale distribution of used

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motor vehicle parts identified as SIC 5015 in Part XI.M.

SIC 5093 includes establishments engaged in assembling, breaking up, sorting and the wholesale distribution of scrap and recyclable waste materials including bag, bottle and box wastes, fur cuttings, iron and steel scrap, metal and nonferrous metal scrap, oil, plastics, rags, rubber, textiles, waste paper, aluminum and tin cans, and rag wastes. For purposes of this permit, the term waste recycling facility applies to those facilities that receive a mixed wastestream of non-recyclable and recyclable wastes. The term recycling facility applies to those facilities that receive only source-separated recyclable materials primarily from non-industrial and residential sources. For purposes of this permit the term recycling facility also applies to those facilities commonly identified as material recovery facilities (MRF).

Part XI.N of the permit is segregated into three separate classes of recycling facilities: (1) scrap recycling and waste recycling facilities (non-liquid recyclable wastes); (2) liquid recyclable waste facilities; and (3) recycling facilities. Each of these three classes of recycling facilities have separate pollution prevention plan and monitoring requirements. EPA further clarifies that battery reclaimers engaged in the breaking up of used lead-acid batteries are not eligible for coverage under this permit. Facilities that participated in U.S. Environmental Protection Agency (EPA) Group Permit Applications 195, 274, 467, 896, 647 (except facilities identified as SIC 4212), 828, 1035, 1145 and 1204 are eligible for coverage under this section.

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

2. Pollutants Found in Storm Water Discharges

This fact sheet is organized into three major subsections: scrap and waste recycling facilities (nonliquid wastes); industrial activities engaged in reclaiming and recycling liquid wastes, e.g., used oils, solvents, mineral spirits and antifreeze; and recycling facilities (including material recovery facilities) that receive only source-separated recyclable materials primarily from non-industrial and residential sources including waste paper, newspaper, glass bottles, plastic containers, aluminum and tin cans, and cardboard. Industrial operations and BMPs associated with these three groups are dissimilar enough to warrant establishing separate permit conditions for each group. Therefore, conditions for each of these three groups are identified separately.

a. Scrap and Waste Recycling Facilities (SIC 5093) (nonliquid recyclable wastes). The scrap recycling and waste recycling industry reclaims, processes and provides wholesale distribution of a diversity of materials and products. Typical recyclable materials include ferrous and nonferrous metals, paper, cardboard, animal hides, glass and plastic. Inbound recyclable materials are processed onsite in order to achieve a uniform grade product that meets a particular manufacturer's specifications. A significant inventory of processing equipment is frequently required to process recyclable waste material into a uniform grade. Processing equipment typically employ enormous physical forces such as shearing, shredding, and compacting in the process of eventually achieving a desired uniform grade product.

Individual scrap and waste recycling facilities may process one or more types of recyclable materials at a single site. Depending on the requirements of a manufacturer, recyclable waste materials, e.g., paper and cardboard, may need to be stored under cover to prevent deterioration. The bulk size of the recyclable waste materials and the processing equipment associated with these facilities frequently necessitates stockpiling materials and equipment outdoors. Consequently, there is significant opportunity for exposure of storm water runoff to pollutants. The extent of material potentially exposed to storm water runoff is illustrated in the following table based on information provided from one group application consisting of approximately 1,100 members.

TABLE N–1.—PERCENTAGE OF APPLICANTS IN ONE GROUP APPLICATION THAT PROVIDE COVER OVER MATERIALS OR PROCESSES

Material/processes	Percent of applicants
Ferrous Materials	6.6
Nonferrous Materials	53
Glass/plastic/paper	14
Other Materials	1.7
Material Processing Equipment	43

There are at least four types of activities that are common to most scrap and waste recycling facilities, they include: scrap waste material stockpiling, material processing, segregating processed materials into uniform grades, and collecting nonrecyclable materials for disposal. This fact sheet outlines pollutants of concern associated with each of these types of activities. Other operations of concern, including vehicle and equipment maintenance, are also discussed in this fact sheet.

(1) Pollutants Associated With Material Stockpiling. During material stockpiling, including unloading and loading areas, the potential exists for some types of inbound recyclable materials to deposit residual fluids on the ground. Used automotive engines, radiators, brake fluid reservoirs, transmission housings, and lead-acid from batteries may contain residual fluids that, if not properly managed, can eventually come in contact with storm water runoff. For example, sampling data from two group applications indicated the presence of oil and grease in 103 individual grab samples. In response to other Federal and State environmental regulations, such as the Resource Conservation and Recovery Act (RCRA), many scrap recycling and waste recycling facilities have instituted inspection and supplier education programs to minimize or eliminate the amount of inbound recyclable materials containing fluids and other potentially hazardous materials prior to their acceptance. Part XI.N.3.a.(3)(a)(i) of today's permit imposes conditions that will make an inbound recyclable materials inspection program part of the pollution prevention plan.

Another concern of outdoor stockpiling, including unloading and loading areas, is associated with deterioration of materials. Metal surfaces that are stockpiled for extended periods may be subject to corrosion. Corrosion is the deterioration of metal surfaces that typically results in the loss of metal to a solution, i.e., water. The following metals are referred to as the

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galvanic (or electromotive) series and have a tendency to corrode and become soluble in water; magnesium, aluminum, cadmium, zinc, steel or iron, cast iron, chromium, tin, lead, nickel, soft and silver solder, copper, stainless steel, silver, gold, platinum, brass and bronze. For some metals, the extent and rate of corrosion is dependent on whether it occurs in an oxygen-starved or oxygen-abundant atmosphere.

Corrosion of stockpiled materials at scrap recycling facilities is a potential source of pollutants given that metals such as copper, lead, nickel, zinc, chromium and cadmium were frequently detected in sampling data. In addition, the majority of these metals are associated with recyclable materials handled by the scrap recycling industry. Part XI.N.3.a.(3) of today's permit identifies BMP options to address these sources.

Another significant material of concern is the acceptance and temporary storage of scrap lead acid batteries from automotive vehicles and equipment. If a battery casing becomes cracked or damaged, special precautions are necessary to ensure that the contents do not come in contact with storm water runoff. This includes battery terminals with visible corrosion. In all cases, used batteries shall be handled and stored in such a manner as to prevent exposure to either precipitation or runoff. Part XI.N.3.a.(3) addresses conditions for these sources.

The following table presents a list of typical materials that may be received and processed at a scrap and waste recycling facility and which may be potential pollutant sources if they are not managed properly.

TABLE N–2.—SIGNIFICANT MATERIALS POTENTIALLY EXPOSED TO STORM WATER RUNOFF AT SCRAP AND WASTE RECYCLING FACILITIES[1]

Significant materials	Potential sources	Pollutants of concern
White goods (appliances)	Leaking oil-filled capacitors, ballasts, leaking compressors, pumps, leaking pressure vessels, reservoirs, sealed electrical components and chipped or deteriorated painted surfaces.	PCBs, oil, lubricants, paint pigments or additives such as lead, and other heavy metals.
Ferrous and nonferrous turnings and cuttings	Cutting oil residue, metallic fines	Oil, heavy metals.
Materials from demolition projects	Deteriorated/damaged insulation, chipped painted surfaces, lead, copper, and steel pipes.	Asbestos fibers, lead, copper, zinc, cadmium, other metals, TKN.
Electrical components, transformers, switch gear, mercury float switches, sensors.	Leaking oil-filled transformer casings, oil-filled switch, float switches, radioactive materials in gauges, sensors.	PCBs, oils, mercury, ionizing radioactive isotopes.
Fluorescent lights, light fixtures	Leaking ballasts	PCBs, oil.
Food/beverage dispensing equipment	Leaking fluorescent light ballasts, chipped painted surfaces.	PCBs, oil, heavy metals from paint pigments and additives.
Hospital and dental waste and equipment	Drums/containers of hospital waste, shielding from diagnostic and other medical equipment, radioactive materials from gauges, sensors and diagnostic equipment.	Infectious/bacterial contamination, lead, ionizing radioactive isotopes.
Instruments	Radioactive material from thickness gages	Ionizing radioactive isotopes.
Insulated wire	Insulation and other coatings, wire	Lead, zinc, copper.
Lawnmowers, snowmobiles, motorcycles	Leaking engines, transmissions, fuel, oil reservoirs,leaking batteries.	Oils, transmission and brake fluids, fuel, grease, battery acid, lead acid.
Light gage materials	Deteriorating insulation, painted surfaces and other coatings.	Asbestos, lead, chromium.
Locomotives, rail cars	Leaking fuel reservoirs, fittings, hydraulic components, engines, bearings, compressors, oil reservoirs, worn brake pads, damaged insulation.	PCBs, diesel fuel, hydraulic oil, oil, brake fluid, grease from fittings, asbestos.
Motor vehicle bodies, engines, transmissions, exhaust systems.	Leaking fuel tanks, oil reservoirs, transmission housings, brake fluid reservoir and lines, brake cylinders, shock absorber casing, engine coolant, wheel weights, leaking battery casings/housings and corroded terminals, painted surfaces and corrosion inhibitors, exhaust system, catalytic converters.	Fuel, benzene, oil, hydraulic oil, transmission fluids, brake fluids, ethylene glycol (antifreeze), lead, lead acid, lead oxides, cadmium, zinc, other heavy metals.
Miscellaneous machinery and obsolete equipment.	Leaking reservoirs, damaged or chipped painted surfaces coatings.	Fuel, oil, lubricants, lead, cadmium, zinc.
Pipes/materials from chemical and industrial plants.	Chemical residue, insulation, lead piping, chipped or damaged painted surfaces and protective coatings.	Chemical residue, oil, lubricants, damaged insulation (asbestos), lead, cadmium, zinc, copper.
Sealed containers, hydraulic cylinders	Leaking liquid reservoirs, containers, cylinders, miscellaneous chemicals.	Oil, PCBs, solvents, chemical residue.
Salvaged construction materials	Chemical residues, oils, solvents, lubricants, damaged insulation, chipped painted surfaces and protective coatings.	Chemical residue, oily wastes, asbestos, lead, cadmium, zinc.
Tanks, containers, vessels, cans, drums	Leaking or damaged containers	Chemical residue, oily wastes, petroleum products, heating oil.
Transformers (oil filled)	Leaking transformer housings	PCBs, oil.

[1] Institute of Scrap Recycling Industries, Inc.'s "Environmental Operating Guidelines." (April 1992)

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(2) Material Processing. The type of processes employed at a particular facility depends on the type of recyclable and waste material. Typical processes include: torch cutting, shredding, baling, briquetting, wire stripping and chopping, and compacting. Processes such as shredding and shearing reduce the bulk size of recyclable scrap and waste into a size that is more easily transportable and which allows separation into uniform grades based on manufacturer specifications. Processes such as shredding of automotive bodies include a means of segregating materials into their ferrous and nonferrous fractions.

Process equipment at scrap recycling and waste recycling facilities are also potential sources of pollutants in storm water runoff. The sources of concern will be discussed separately. Scrap process equipment such as shearers are often actuated by a hydraulic system. Components such as hydraulic reservoirs, hydraulic pumps, motors, cylinders, control valves, accumulators, filters, and fittings are prone to leaking hydraulic fluid. Some hydraulic machinery also require frequent lubrication of cutting and wear surfaces. Storm water runoff exposure to hydraulic fluids and other lubricants is very likely unless adequate source control measures such as good housekeeping, preventive maintenance, diversion and/or containment are provided.

Stationary process equipment also produce a substantial amount of residual particulate material that tends to accumulate on and around the equipment, particularly rotating machinery, moving parts, bearings, conveyors and at the output of the equipment, e.g., storage containers. Particulate material that accumulates can become a source of contamination if it comes in contact with both precipitation and storm water runoff. Other sources of residual particulate and waste material include air pollution equipment, material handling equipment and processing equipment. In the case of shredding equipment, there are typically three (3) separate material streams produced. Shredded material is ultimately separated into its ferrous and nonferrous fractions, and a third stream referred to as fluff. The fluff material consists of a heterogeneous mix of materials including, but not limited to, small metal fragments, plastics, rubber, wood and textiles. After the material exits the shredder (hammermill), it typically enters an air classification system that separates the lightweight fraction, e.g., particulates, from the more dense fraction. The ferrous metal fraction is then separated from the nonferrous fraction and fluff by the use of a magnetic separator (typically a belt- or drum-type magnetic separator). The separated material may be collected in a hopper or it may accumulate on the ground. If recyclable and nonrecyclable waste material is allowed to accumulate on the ground, a greater potential exists for this material to come in contact with either precipitation or storm water runoff.

The scrap and recycling industry uses a diversity of processes to reclaim and recycle materials that can contribute pollutants to storm water runoff. The following table presents a list of typical scrap equipment operations which are potential pollutant sources.

TABLE N-3.—TYPICAL PROCESS AND EQUIPMENT OPERATIONS THAT ARE LIKELY SOURCES OF POLLUTANTS[1]

Activity	Potential sources	Pollutants of concern
Air Pollution Equipment (including incinerators, furnaces, wet scrubbers, filter houses, bag houses).	Normal equipment operations that include the collection and disposal of filter bag material and ash, process wastewater from scrubbers, accumulation of particulate matter around leaking joint connections, malfunctioning pumps and motors, e.g., leaking gaskets, seals or pipe connections, leaking oil-filled transformer casings.	Hydraulic fluids, oils, fuels, grease and other lubricants, accumulated particulate matter, chemical additives, PCBs from oil-filled electrical equipment.
Combustion Engines	Spills and/or leaks from fueling tanks, spills/leaks from oil/hydraulic fuel reservoirs, faulty/leaking hose connections, worn gaskets, leaking transmission crankcases and brake systems (if applicable), leaking battery casings and/or corroded terminals.	Accumulated particulate matter, oil/lubricants, fuel (gas/diesel), fuel additives, antifreeze (ethylene glycol), battery acid, products of incomplete combustion.
Material Handling Systems (forklifts, cranes, conveyors).	Normal operations including spills and leaks from fuel tanks, hydraulic and oil reservoirs due to malfunction parts, e.g., worn gaskets and parts, leaking hose connections, and faulty seals. Damaged or faulty electrical switches (mercury filled) Damaged or leaking battery casings, including exposed corroded battery terminals. Damaged or worn bearing housings.	Hydraulic fluids, oils, fuels and fuel additives, grease and other lubricants, accumulated particulate matter, chemical additives, mercury, lead, battery fluids.
Stationary Scrap Processing Facilities (balers, briquetters, shredders, shearers, compactors, engine block/cast iron breakers, wire chopper, turnings crusher).	Normal equipment operations including leaks from hydraulic reservoirs, hose and fitting connections, worn gaskets, spills or leaks from fuel tanks, particulates/residue from scrap processing, malfunctioning pumps and motors, e.g., leaking gaskets, seals or pipe connections, leaking oil-filled transformer casings.	Heavy metals, e.g., zinc, copper, lead, cadmium, chromium, hydraulic fluids.
Hydraulic equipment and systems, balers/briquetter, shredders, shearers, compactors, engine block/cast iron breaker, wire chopper, turnings crusher.	Particulate/residue from material processing, spills and/or leaks from fueling tanks, spills/leaks from oil/hydraulic fuel reservoirs, faulty/leaking hose connections/fittings, leaking gaskets.	Hydraulic fluids/oils, lubricants, particulate matter from combustion engines, PCBs (oil-filled electrical equipment components), heavy metals (nonferrous, ferrous).

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TABLE N-3.—TYPICAL PROCESS AND EQUIPMENT OPERATIONS THAT ARE LIKELY SOURCES OF POLLUTANTS[1]—Continued

Activity	Potential sources	Pollutants of concern
Electrical Control Systems (transformers, electrical switch gear, motor starters).	Oil leakage from transformers, leakage from mercury float switches, faulty detection devices.	PCBs, mercury (float switches), ionizing radioactive material (fire/smoke detection systems).
Torch cutting	Residual/accumulated particulates	Heavy metal fragments, fines.

[1] Institute of Scrap Recycling Industries, Inc.'s "Environmental Operating Guidelines." (April 1992)

(3) Segregation of Processed Materials into Uniform Grades. Processing, e.g., shearing, shredding, baling, etc., of recyclable materials is followed by its segregation into uniform grades to meet a particular manufacturer's specifications. If segregated recyclable material remains exposed to precipitation, the potential still exists for storm water contamination.

(4) Disposal of Nonrecyclable Waste Materials. During recycling of scrap and waste materials, a significant fraction of nonrecyclable waste materials is generated and must be disposed of properly. The volume or quantity of material that remains nonrecyclable may be too large to allow covered storage prior to shipment. Consequently, nonrecyclable waste materials may be left exposed to both precipitation and runoff and, therefore, they are a likely source of storm water pollutants.

(5) Other Operations of Concern. There are a number of activities of concern that frequently occur at scrap and waste recycling facilities including, heavy vehicle traffic over unstabilized areas, vehicle maintenance and fueling, and material handling operations. Operations associated with the receipt, handling, and processing of scrap and waste material frequently occur over areas that are not stabilized to prevent erosion. Unless specific measures or controls are provided to either prevent erosion or trap the sediment, this material will be carried away in storm water runoff and eventually exit the site. Suspended solids are of significant concern given the potential amount of unstabilized area and the significant amount of particulate matter that is often produced at these facilities. For example, many facilities use spray water for dust control on heavily traveled areas. Both organic and inorganic pollutants can become bound up or absorbed to suspended solids in runoff. For this reason, today's proposed permit identifies conditions to minimize the contribution of suspended solid loadings from these facilities.

Some scrap and waste recycling facilities may also conduct vehicle maintenance onsite. Although vehicle maintenance frequently occurs indoors, there are specific activities which could contribute pollutants to storm water. This includes washdown of vehicle maintenance areas, leaks or spills of fuel, hydraulic fluids and oil and outdoor storage of lubricants, fluids, oils and oily rags. Fueling stations are also frequently located outdoors without any roof cover. Activities such as topping off fuel tanks, or overfilling storage tanks (without high-level alarms or automatic shut-offs) are also activities that can cause contamination of runoff. Vehicle washing can result in accumulated residue material being discharged to a storm sewer system.

The following table highlights activities associated with vehicle maintenance and material handling that are potential sources of storm water contamination.

TABLE N-4.—OTHER POTENTIAL POLLUTANT SOURCE ACTIVITIES

Activity	Potential sources	Pollutants of concern
Material Handling Systems (forklifts, cranes, conveyors).	Spills and/or leaks from fueling tanks, spills/leaks from oil/hydraulic fuel reservoirs, faulty/leaking hose connections/fittings, leaking gaskets.	Accumulated particulate matter (ferrous and nonferrous metals, plastics, rubber, other), oil/lubricants, PCBs (electrical equipment), mercury (electrical controls), lead/battery acids.
Vehicle Maintenance	Parts cleaning, waste disposal of rags, oil filters, air filters, batteries, hydraulic fluids, transmission fluids, brake fluids, coolants, lubricants, degreasers, spent solvents.	Fuel (gas/diesel), fuel additives, oil/lubricants, heavy metals, brake fluids, transmission fluids, chlorinated solvents, arsenic.
Fueling Stations	Spills and leaks during fuel transfer, spills due to "topping off" tanks, runoff from fueling areas, washdown of fueling areas, leaking storage tanks, spills of oils, brake fluids, transmission fluids, engine coolants.	Gas/diesel fuel, fuel additives, oil, lubricants, heavy metals.
Vehicle and Equipment Cleaning and Washing	Washing and steam cleaning	Solvent cleaners, oil/lubricants/additives, antifreeze (ethylene glycol).

(6) Pollutants Found in Storm Water Discharges. Sampling data provided in part 2 of the group application process revealed that storm water discharges from scrap and waste recycling facilities contain pollutants such as heavy metals, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), TSS, nutrients and oil and grease. The following table summarizes the statistical analysis of sampling data provided in part 2 group applications. Table N-6 provides a comparison of a selected subset of these pollutants to benchmark concentrations.

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TABLE N-5.—SUMMARY STATISTICS FOR SCRAP AND WASTE RECYCLING FACILITIES[1] (SIC 5093) (Nonliquid Recyclable Waste Materials.) All units in mg/L unless otherwise noted

Pollutant Sample type	No. of samples		Mean		Minimum		Maximum		Median		99th Percentile	
	Grab	Comp[2]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
pH (std units)	136	N/A	N/A	N/A	4.93	N/A	10.2	N/A	N/A	N/A	9.58	N/A
BOD_5	131	120	23.49	24	0.00	0.00	330.0	360	9.0	9.0	330.0	330.0
COD	131	117	251.33	204	0.00	0.00	1588.0	2400	120.0	110.0	1323	1014
TSS	131	116	437.11	375	0.00	0.00	3894	6042	148.0	84.5	3100	4860
Nitrate + Nitrite N	130	117	1.76	5.9	0.00	0.00	84.0	220.0	0.61	0.80	28	129.0
TKN	132	114	3.44	3.4	0.00	0.00	43.0	39.0	2.05	2.20	25	22.0
Oil and Grease	136	N/A	8.95	N/A	0.00	N/A	85.0	N/A	5.0	N/A	69	N/A
Total P	133	114	0.61	0.77	0.00	0.00	36.0	29.0	0.29	0.28	4.7	10.0
Total Pb	103	100	0.85	0.84	0.00	0.00	8.70	13.00	0.205	0.215	4.9	11.00
Total Cd	75	73	0.02	0.02	0.000	0.000	0.10	0.65	0.0074	0.005	0.069	.65
Total Cu	102	99	0.77	0.60	0.000	0.000	12.0	8.20	0.26	0.22	5.98	8.2
Total Zn	97	94	3.16	3.2	0.028	0.000	22.0	38.0	1.50	1.4	22.0	38.0
Total Cr	103	100	0.08	0.122	0.000	0.000	2.10	2.60	0.03	0.02	0.547	2.3
Total Fe	5	5	25.4	9.80	0.8	0.0	74.0	20.0	10.0	14.0	72.7	19.8
Total Ni	94	93	0.202	0.21	0.001	0.000	5.80	7.30	0.05	0.040	5.8	7.3
Arsenic	9	8	0.038	0.019	0.00	0.00	0.170	0.90	0.005	0.005	0.170	0.090
Total Al	5	3	4.86	3.327	.68	.68	10.0	7.6	4.0	1.70	10.0	7.6
PCB-1016	27	26	0.001	0.051	0.001	0.001	0.010	1.30	0.001	0.001	0.010	1.3
PCB-1221	28	24	0.001	0.001	0.001	0.000	0.010	0.001	0.001	0.001	0.010	0.001
PCB-1232	28	26	0.001	0.001	0.001	0.000	0.010	0.001	0.001	0.001	0.010	0.001
PCB-1242	27	26	0.001	0.047	0.000	0.000	0.010	1.30	0.001	0.001	0.010	1.3
PCB-1248	28	24	0.003	0.005	0.000	0.000	0.025	0.078	0.001	0.001	0.025	0.078
PCB-1254	28	26	0.001	0.001	0.000	0.000	0.010	0.006	0.001	0.001	0.010	0.006
PCB-1260	28	26	0.002	0.049	0.001	0.000	0.011	1.30	0.001	0.001	0.011	1.3

[1] Applicants that did not report the units of measurement for the reported values were not included in these statistics.
[2] Composite samples.

TABLE N-6.—COMPARISON SAMPLING DATA FOR SELECTED PARAMETERS VERSUS BENCHMARK CONCENTRATIONS (MG/L)

Pollutant Sample type	Mean		Maximum		Median		Benchmark
	Grab	Comp	Grab	Comp	Grab	Comp	
COD	251	204	1588	2400	120	110	120
TSS	437	375	3894	6042	148	84.5	100
Total Pb	0.85	0.84	8.70	13.00	0.205	0.215	0.0816
Total Cu	0.77	0.60	12.0	8.20	0.26	0.22	0.0636
Total Fe	25.4	9.60	74.00	20.00	10.00	14.00	1.0
Total Al	4.86	3.327	10.0	7.6	4.0	1.70	0.075
Total Zn	N/A	3.2	22.0	38.0	1.5	1.4	0.117

b. Waste Recycling Facilities (SIC 5093)—(Liquid Recyclable Wastes). **This subsection applies to those facilities engaged in the reclaiming and recycling of liquid wastes such as "spent solvents," "used oil," and "used ethylene glycol" typically identified under SIC 5093. This subsection is particularly applicable to those facilities that participated in EPA group application number 198. EPA received a single group application in this category of waste recycling facilities. The following is a profile of industrial activities and the types of significant materials associated with facilities participating in this group activity.**

Group application number 198 included 220 facilities of which 214 were classified as service centers. Service centers accumulate spent solvent, used oil and antifreeze, filter cartridges and still bottoms **contaminated** with dry cleaning **solvents** (typically perchloroethylene), **and used** lacquer thinner from paint gun **cleaning** machines. The typical service **center has** individual containers with **storage** capacity of up to 10,000 gallons **each, and tanks** with storage capacity of **up** to 20,000 gallons each. Service **centers are** typically limited to a **maximum** of 6 tanks (a total of 120,000 **gallons).** Twenty (20) of the service **centers also** function as accumulation **centers where** they have a maximum **storage** capacity of 70,000 gallons of **liquid materials** in containers. None of **the containers are** opened except under **conditions** where a container begins to **leak or is damaged.**

The group application also included **four (4)** facilities that operated only as **container** transfer stations and do not **operate storage tanks. These facilities are largely enclosed warehouses that provide secondarily contained storage areas. Three (3) facilities were identified as used oil depots where only oily water and/or used oil are accumulated in storage tanks. Storage tanks are limited to a maximum capacity of 20,000 gallons each. Used oil is transported to the facility in tanker trucks (3,500 gallons) and shipped out in tanker trucks (7,500 gallons). The used oil is ultimately transported to a processing or re-refining facility (not covered under this section). The following table summarizes the percentage of facilities with significant materials stored.**

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TABLE N-7. SIGNIFICANT MATERIALS REPORTED IN GROUP APPLICATION NUMBER 195

Significant materials	Percent of facilities
Mineral Spirits	98
Immersion Cleaner	98
Dry Cleaner Solvents	98
Paint Solvents	83
Industrial Solvents	81
Spent Antifreeze	59
Used Oil	57
Allied Products	98

The types of materials identified in Table N-7 are potential sources of storm water runoff contamination. Since these materials are stored and transported in individual drums and bulk storage tanks, the potential exists for spills and/or leaks during all phases of waste transport, waste transfer, container/drum handling and shipping.

There are a number of operations at these facilities that have significant potential to release pollutants to the environment if recyclable waste materials are not managed properly. Potential sources of pollutants are discussed in Part XI.N.3.a.(2) of today's permit. However, in response to other Federal and State environmental regulations, such as RCRA and 40 CFR Part 112 (Oil Pollution Prevention), facilities in this group application currently employ a range of the BMPs and structural controls that also benefit storm water quality. Typical measures and controls for controlling pollutants for facilities in this subsection are presented in Part XI.N.3.a.(3)(b).

(1) Waste Material Handling and Storage. Given the nature and type of materials stored and handled at these facilities, the potential exists for accidental spills and leaks. Consequently, the types of activities that occur at these facilities which could potentially result in contamination of storm water runoff is also of concern to EPA. The following table is a list of activities which may result in a release of pollutants.

TABLE N-8. TYPES OF POTENTIAL POLLUTANT-CAUSING ACTIVITIES AT WASTE RECYCLING FACILITIES THAT HANDLE LIQUID RECYCLABLE WASTES

Activity	Potential sources of pollutants	Pollutants of concern
Drum/Individual Container Storage and Handling.	Leaks or spills due to faulty container/drum integrity, e.g., leaking seals or ports. Container materials incompatible with waste material. Improper stacking and storage of containers.	Mineral spirits, industrial solvents, immersion cleaners, dry cleaner solvents, paint solvents, spent antifreeze.
Return and Fill Stations	Leaks, spills, or overflows from tanker truck transfer of wastes and hose drainage. Leaking pipes, valves, pumps, worn or deteriorated gaskets or seals.	Mineral spirits, industrial solvents, immersion cleaners, dry cleaner solvents, paint solvents, spent antifreeze.
Individual Container/Drum Storage Improper Stacking and Storage of Containers.	Leaks or spills due to faulty container/drum integrity, e.g., leaking seals or ports.	Mineral spirits, industrial solvents, immersion cleaners, dry cleaner solvents, paint solvents, spent antifreeze.
Storage Tank Operations	Overfill of storage tanks, leaking pipes, valves, worn or deteriorated pumps seals. Leaking underground storage tanks.	Mineral spirits, industrial solvents, immersion cleaners, dry cleaner solvents, paint solvents, spent antifreeze.
Material Handling Equipment	Leaking fuel lines, worn gaskets, leaking hydraulic lines and connections.	Fuel, hydraulic fluid, oil and grease.

(2). Other Activities of Concern. The following table highlights other types of activities that are potential sources of storm water contamination.

TABLE N-9. OTHER POTENTIAL SOURCES OF STORM WATER CONTAMINATION

Activity	Potential sources of pollutants	Pollutants of concern
Vehicle and Equipment Maintenance (if applicable).	Replacement of fluids such as transmission and brake fluids, antifreeze, oil and other lubricants, washdown of maintenance areas, dumping fluids down floor drains connected to storm sewer system, outside storage of fluids and oily rags and waste material.	Oil and grease, fuel, accumulated particulate matter, antifreeze.
Vehicle or Equipment Washing (if applicable)	Wash water or steam cleaning	Oil, detergents, chlorinated solvents, suspended solids and accumulated particulate matter.

(3). Pollutants Found in Storm Water Discharges. Based on data provided in group application sampling information, pollutants that were most frequently reported included TSS, BOD, COD, nitrite plus nitrate, oil and grease. The following table provides a statistical summary of data.

TABLE N-10. SUMMARY STATISTICS FOR WASTE RECYCLING FACILITIES[1] (SIC 5093)—(RECYCLABLE LIQUID WASTES). ALL VALUES IN MG/L

Parameter Sample type	# of Samples		Mean		Min		Max		Median		99th percentile	
	Grab	Comp[2]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	22	17	18	9	2	2	94	48	5	5	79	38

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TABLE N–10. SUMMARY STATISTICS FOR WASTE RECYCLING FACILITIES[1] (SIC 5093)—(RECYCLABLE LIQUID WASTES). ALL VALUES IN MG/L—Continued

Parameter Sample type	# of Samples		Mean		Min		Max		Median		99th percentile	
	Grab	Comp[2]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
COD	22	17	133	83	12	5	660	400	45	45	449	320
TSS	21	16	51	28	5	5	500	84	28	20	68	59
Nitrite + Nitrate	22	17	0.90	0.78	0.05	0.05	3.70	3.50	0.61	0.38	3.45	3.29
TKN	22	17	3.1	2.0	1.0	1.0	11.0	6.0	1.5	1.0	9.9	5.7
Oil and Grease	22	N/A	1.8	N/A	1.0	N/A	5.0	N/A	1.5	N/A	4.0	N/A

[1] Applicants that did not report the units of measurement for the reported values were not included in these statistics.
[2] Composite samples.

c. *Recycling Facilities.* This particular group of recycling facilities is distinguished from scrap recycling facilities and waste recycling facilities that accept a mixed wastestream of non-recyclable and recyclable wastes. Facilities included in this sub-sector would include only those facilities that receive source-separated, recyclable materials primarily from non-industrial and residential sources. This includes source-separated material recovery facilities (MRF). EPA Group Applications 274, 647, 828, and 1145 included significant numbers of facilities that would fall within this sub-sector. The recyclable materials in this sub-sector can be characterized as common consumer products such as paper, newspaper, cardboard, plastic containers, glass bottles, aluminum and tin cans. These facilities commonly accept a mix of recyclable materials and reject non-recyclable materials at the source.

(1) *Pollutant-Causing Activities Associated with Recycling Facilities.* There are basically four areas associated with these facilities that are potential sources of pollutants, they include: (1) inbound recyclable materials; (2) outdoor material storage; (3) indoor storage and material processing; and (4) vehicle maintenance. The potential exists that recycling facilities may unknowingly accept nonrecyclable materials and/or small quantities of household hazardous wastes (HHW). If these materials are not handled, stored or disposed of properly, they could become potential pollutant sources. Recycling facilities are already aware of this issue and have commonly instituted practices to minimize accepting such materials. These practices include public education brochures, training of curbside pick-up drivers, and rejecting non-recyclable materials at the source.

Outdoor material storage is another issue of concern given the practice of storing degradable, recyclable products outdoors such as bales of wastepaper and various types of recyclable containers containing residual fluids, e.g., beverage containers. Wastepaper exposed to weather will deteriorate and can be a source of oxygen-demanding substances. For example, biochemical oxygen demand (BOD) concentrations as high as 152 mg/l were measured at facilities that store wastepaper outdoors. Similarly, recycling facilities that stored unprocessed aluminum beverage containers outdoors can be a contaminant source of oxygen-demanding substances. BOD concentrations as high as 460 mg/l were measured at recycling facilities that store unprocessed recyclable containers outdoors.

The third area of concern is indoor processing and storage. EPA is primarily concerned with the potential for illicit connections or improper dumping to floor drains that discharge to a storm sewer system. Another potential source of contamination is the practice of washing down tipping floor areas and allowing the washwater to drain to the storm sewer system. EPA believes that these issues can be readily addressed by disconnecting floor drains to the storm sewer, good housekeeping practices and providing routine employee training. The practice of allowing tipping floor washwaters to discharge to a storm sewer system is prohibited under this permit.

The last area of concern is vehicle maintenance. Onsite vehicle maintenance was infrequently reported in group permit applications. Although vehicle maintenance frequently occurs indoors, the following specific activities could contribute pollutants to storm water: washdown of vehicle maintenance areas, leaks or spills of fuel, hydraulic fluids, lubricants, and other fluids, and exposed oils and oily rags. Fueling areas may lack roof cover, consequently, topping off fuel tanks or overfilling storage tanks (without high-level alarms) could contribute to contamination of surface runoff. Vehicle washing can result in accumulated residue material being discharged to a storm sewer system. The following tables identify significant materials that are exposed to precipitation or runoff based on information from two group applications (274 and 647).

TABLE N–11.—SIGNIFICANT MATERIALS REPORTED IN GROUP APPLICATION NO. 274

Significant materials	Percent of facilities[1]	Pollutant-causing activities
Paper Stock	43	Outdoor exposure could result in deterioration of paper.
Wood Pallets	83	Residual materials on pallets.
Recyclable Waste Paper in Bales	83	Outdoor exposure could result in deterioration of paper.
Recyclables Plastic, Glass, and Aluminum	30	Residual fluids from containers.
Gasoline/Diesel Fuel (outside pumps)	28	Leaks or spills. Overtopping during fueling.

[1] Column totals greater than 100% because many facilities have one or more of these significant materials exposed.

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TABLE N-12.—Significant Materials Reported in Group Application No. 826

Significant materials	Percent of facilities[1]	Pollutant-causing activity
Wood Pallets	64	Residual materials on pallets.
Waste Paper	27	Outdoor exposure could result in deterioration of paper.
Recyclable Waste Paper in Bales	41	Outdoor exposure could result in deterioration of paper.
Gasoline/Diesel Fuel (outside pumps)	55	Leaks or spills. Overtopping during fueling.
Lubricating Fluids	14	Leaks or spills.

[1] Column totals greater than 100% because many facilities have one or more of these significant materials exposed.

EPA has established special pollution prevention plan requirements for recycling facilities that receive only source-separated recyclable materials. Specific requirements are discussed in Part XI.N.3.a.(3)(c) of the permit.

(2) Pollutants Found in Storm Water Discharges.

Based on data provided in group applications 274, 647, 826, and 1145, pollutants that were most frequently reported included TSS, BOD, COD, nitrite plus nitrate, TKN, total phosphorus, oil and grease, and total aluminum (group 1145 only). The table N-13 provides a statistical summary of data.

TABLE N-13.—SUMMARY STATISTICS FOR SELECTED RECYCLING FACILITIES[i] (SIC 5093) (GROUP APPLICATIONS 247, 647, 826, AND 1145) ALL UNITS IN mg/L UNLESS OTHERWISE NOTED

Pollutant, Sample type	# of Samples		Mean		Minimum		Maximum		Median		95th percentile	
	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5			31	22	0	0	460	220	31	22	78	75
COD			179	118	0	0	1200	940	73	43	1005	441
TSS			495	383	0	0	7440	4860	73	40	1731	2754
Nitrate + Nitrite N			0.60	0.78	0	0	13	69	0.41	0.37	1.61	1.33
TKN			1.48	1.78	0	0	6.90	16.85	1.01	0.79	6.12	7.30
Oil and Grease			9.4	0.7	0	0	69.0	13.0	3.0	0.0	32.4	4.9
Total P			0.22	0.19	0	0	7.60	2.20	0.22	0.19	2.17	1.14
Total Al[iii]			5.51	1.55	0	0	44.0	5.40	1.20	0.90	26.00	4.80

[i] Applicants that did not report the units of measurement for the reported values were not included in these statistics.
[ii] Composite samples.
[iii] Values reported for Group Application No. 1145.

3. Options for Controlling Pollutants

a. Scrap and Waste Recycling Facilities (SIC 5093) (Nonliquid recyclable waste materials). This section addresses source control measures, BMPs and structural controls that are specifically applicable to the scrap recycling facilities (SIC 5093) and waste recycling facilities (SIC 5093) and which are engaged in the reclaiming and recycling of solid materials such as ferrous and nonferrous metals, plastics, paper, glass and cardboard and automotive parts.

The BMPs described in this subsection are specifically applicable to scrap recycling and waste recycling facilities. Scrap recycling and waste recycling facilities applying for coverage under Part XI.N. of today's permit shall employ a broad and comprehensive range of BMPs and source control measures to minimize and/or eliminate the diversity of pollutants associated with scrap processing operations. In instances where facilities conduct certain operations indoors or under cover, a determination will be made by the owner/operator of the facility as to the applicability of these BMPs and source control measures to these particular activities.

The following table summarizes alternative source control measures, nonstructural BMPs (BMPs), and structural controls that are associated with and applicable to scrap and waste processing facilities (SIC 5093) (nonliquid recyclable materials).

TABLE N-14.— SUMMARY OF ALTERNATIVE BMP OPTIONS FOR SCRAP AND WASTE RECYCLING PROCESSING FACILITIES

Activity	BMP alternatives
Inbound Recyclable and Waste Material Control.	Establish program to encourage suppliers of scrap, waste and other salvageable materials to drain residual fluids prior to arrival at the facility.
	Establish acceptance program for handling, storage and disposal of lead-acid batteries.
	Establish procedures for rejecting or handling, storing and disposal of hazardous wastes and other nonhazardous residual fluids.
	Establish procedures to properly handle industrial turnings and cuttings and prohibiting cutting oils and metallic fines from coming in contact with runoff.
	Identify inspector training requirements.
Outside Scrap Material Storage: (liquids)	Conduct inspections for fluids, e.g., oils, transmission fluids, antifreeze, brake fluid, and fuels. Establish handling/ storage/disposal procedures for these materials.

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TABLE N-14.— SUMMARY OF ALTERNATIVE BMP OPTIONS FOR SCRAP AND WASTE RECYCLING PROCESSING FACILITIES—Continued

Activity	BMP alternatives
	Drain and collect liquids in a designated area. Provide covered storage or impervious areas with curbing/berms or other appropriate containment. Stored liquid materials in covered areas or impervious areas with curbing/berms or other appropriate measure. Establish spill prevention procedures. Provide adequate supply of materials for dry clean up of spills or leaks. Prevent runoff into liquid storage areas. Store liquid wastes in materially compatible containers. Minimize/eliminate the accumulation of liquid wastes. Establish procedures if hazardous wastes are discovered after material accepted. Conduct periodic inspections of storage areas. Conduct preventative maintenance of BMPs as necessary.
Outside Scrap Material Storage: (bulk solid materials).	Minimize runoff from coming into areas where significant materials are stored, e.g., diversion structures such as curbing, berms, containment trenches, surface grading, and elevated concrete pads or other equivalent measure. Use adsorbents to collect leaking or spills of oil, fuel, transmission and brake fluids, e.g., dry absorbent, drip pans. Install media filters such as catch basin filters and sand filters. Install oil/water separator in storage areas with vehicle transmissions and engines. Locate spill plans under stored vehicles. Provide nonrecyclable waste storage bins and containers. Conduct periodic inspections. Conduct preventative maintenance as necessary. Provide equipment operator training to minimize damage to controls, e.g., curbing and berms.
Storage Other: (lightweight materials)	Identify/provide supplier training or information bulletins on requirements for acceptance of lightweight materials. Encourage supplier participation in program to minimize/eliminate, as practicable, volume of semi-solid and liquid residues in recyclable materials, e.g., residual fluids in aluminum and plastic containers. Provide covered storage, container bins or equivalent for lighter-weight materials such as glass, plastics, aluminum cans, paper, cardboard. Minimize/eliminate residue from bottles, containers, etc. from coming in contact with runoff. Establish dry clean up methods. Establish procedures and employee training for the handling, storage and disposal of residual fluids from small containers. Prohibit washdown of tipping floor areas. Provide good housekeeping to eliminate particulate and residual materials buildup. Establish cleaning schedule for high traffic areas. Provide covered disposal containers or equivalent for residual waste materials. Eliminate floor drains discharging to storm sewer.
Scrap Processing Operations:	Provide training to equipment operators on how to minimize exposure of runoff to scrap processing areas. Schedule frequent cleaning of accumulated fluids and particulate residue around all scrap processing equipment. Schedule frequent inspections of equipment for spills or leakage of fluids, oil, fuel, hydraulic fluids. Conduct routine preventive maintenance of equipment per original manufacturer's equipment (OME) recommendations. Replace worn or malfunctioning parts. Site process equipment on elevated concrete pads or provide runoff diversion structures around process equipment, berms, containment trenches or surface grading or other equivalent measure. Discharge runoff from within bermed areas to a sump, oil/water separator, media filter or discharge to sanitary sewer. Conduct periodic maintenance and clean out of all sumps, oil/water separators, media filters. Dispose of residual waste materials properly, e.g., according to RCRA. Provide curbing, dikes, and berms around scrap processing equipment to prevent contact with runoff. Where practicable, locate process equipment e.g., balers, briquetters, small compactors, under an appropriate cover. Provide cover over hydraulic equipment and combustion engines. Provide dry-clean up materials, e.g.; dry-adsorbents, drip pans, absorbent booms, etc. to prevent contact of hydraulic fluids, oils, fuels, etc., with storm water runoff. Provide alarm, pump shutoff, or sufficient containment for hydraulic reservoirs in the event of a line break. Stabilize high traffic areas, e.g., concrete pads, gravel, pavement, around processing equipment, where practicable. Provide site gages or overfill protection devices for all liquid and fuel storage reservoirs and tanks. Establish spill prevention and response procedures, including employee training. Provide containment bins or equivalent for shredded material, especially lightweight materials such as fluff (preferably at the discharge of these materials from the air classification system).
Supplies for Process Equipment	Locate storage drums containing liquids, including oils and lubricants indoors. Alternatively, site palletized drums and containers on an impervious surface and provide sufficient containment around the materials. Provide sumps, oil/water separators, if necessary.

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TABLE N-14.—SUMMARY OF ALTERNATIVE BMP OPTIONS FOR SCRAP AND WASTE RECYCLING PROCESSING FACILITIES—Continued

Activity	BMP alternatives
	Conduct periodic inspections of containment areas and containers/drums for corrosion. Perform preventive maintenance of BMPs, as necessary. Instruct employees on proper material handling and storage procedures.
Scrap lead acid battery Program	Establish inspection and acceptance procedures for scrap lead-acid batteries. Provide supplier training on acceptance practices for scrap batteries. Provide employee training on the safe handling, storage and disposition of scrap batteries. Separate all scrap batteries from other scrap materials. Store scrap batteries under cover or equivalent. Establish procedures for the storage, handling, disposition of cracked or broken batteries in accordance with applicable Federal regulations, e.g., RCRA. Establish procedures to collect and dispose of leaking battery acid according to Federal regulations, e.g., RCRA. Provide covered storage or equivalent to prevent exposure to either precipitation or runoff.
Vehicle and Equipment Maintenance	Establish an inventory of materials used in the maintenance shop that could become a potential pollutant source with storm water runoff, e.g., fuels, solvents, oils, lubricants. Store and dispose of oily rags, filters (oil and air), batteries, engine coolant, transmission fluid, use oil, brake fluid, and solvents in a manner that minimizes potential contact with runoff and in compliance with State and Federal regulations. Label and track recycling of waste materials, e.g., batteries, solvent, used oil. Drain oil filters before disposal or recycling. Drain all fluids from all parts or components that will become scrap material or secondhand parts. Store liquid waste materials in compatible containers. Store and dispose used batteries in accordance with scrap lead acid battery program. Disconnect all floor drains connected to storm sewer system. Prohibit non-storm water discharges, e.g., dumping of used liquids down floor drains and washdown of maintenance areas. Provide employee training on appropriate storage and disposal of waste materials. Provide good housekeeping measures. Conduct inspections of work areas for compliance with BMPs.
Fueling	Use spill and overflow protection devices. Provide high level alarm on fuel storage tanks. Minimize/eliminate runoff onto fueling areas. Reduce exposure of fueling areas to precipitation by covering the fueling area. Provide dry adsorbents to clean up fuel spills. Conduct periodic inspections of fueling areas. Instruct personnel on proper fueling procedures. Provide curbing or posts around fuel pumps to prevent collisions during vehicle ingress and egress.
Vehicle and Equipment Washing	Avoid washing vehicles and equipment outdoors. Use biodegradable, phosphate free detergents. Recycle wash water. Provide vehicle wash rack with dedicated sediment trap. Use autoshut-off valves on washing equipment.
Outdoor vehicle parking and storage	Use drip pans under all equipment and vehicles waiting maintenance. Cover vehicle and equipment storage areas. Conduct inspections of storage and parking areas for leaks and filled drip pans. Provide employee training.
Vehicle and Equipment Painting (where applicable).	Keep paint and solvents away from traffic areas. Conduct sanding and painting in nonexposed areas, e.g., under cover, in accordance with OSHA standards. Cleanup accumulated particulate matter. Minimize overspraying parts. Dispose or recycle paint, solvents and thinner properly. Provide training to employees. Conduct periodic inspections of paint spraying areas.
Erosion and Sediment Control	Minimize runon from adjacent properties, e.g., diversion dikes, berms, or equivalent. Trap sediment at downgradient locations and outlets serving unstabilized areas. This may include filter fabric fences, gravel outlet protection, sediment traps, vegetated or riprap swales, vegetated strips, diversion structures, catch-basin filters, retention/detention basins or equivalent. Runoff containing oil and grease may include the use of absorbent booms or sand filters in front of outlet structures or other equivalent measures. Stabilize all high traffic areas, including all vehicle entrances and exit points. Conduct periodic sweeping of all traffic areas. Conduct inspections of BMPs. Perform preventative maintenance as needed on BMPs. Provide employee training on the proper installation and maintenance of erosion and sediment controls.

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b. Waste Recycling Facilities (SIC 5093)—(recyclable liquid wastes). This section addresses source control measures, BMPs, and structural controls that are specifically applicable to waste recycling facilities (SIC 5093) which are engaged in such activities as reclaiming and recycling of liquid wastes such as spent solvents, used oil, and used antifreeze (ethylene glycol). Waste recycling facilities applying for coverage under Part XI.N. of today's proposed permit will be required to employ a comprehensive range of BMPs and source control measures to minimize contact of pollutants with storm water runoff and precipitation. In instances where facilities conduct certain operations indoors or under cover, a determination will be made by the owner/operator of the facility as to the applicability of these BMPs and source control measures to their particular facility. The following table summarizes the percent breakdown of BMPs that were reported by applicants participating in group application number 195.

TABLE N-15.—TYPES OF BMPS REPORTED IN EPA GROUP APPLICATION NUMBER 195

BMP	Percent of facilities
Secondary Containment (includes tanks, piping, and return/fill stations)	70
Containment Trench (includes closed loop containment trenches with sumps, sloped floors, and/or berms)	91
Roof (includes canvass tank roofs and enclosed structures)	7
Contingency Plan (serves as Spill Prevention and Countermeasures Control Plan)	100
Prevention and Preparedness Plan (includes inspection information and general housekeeping procedures)	100

The following table summarizes types of BMPs, and structural control options that are applicable to liquid waste recycling facilities.

TABLE N-16.—TYPES OF BMP OPTIONS APPLICABLE TO LIQUID WASTE RECYCLING FACILITIES

Activity	BMP alternatives
Individual Drum/Container Storage	Ensure container/drums are in good condition. Store waste materials in materially compatible drums. Use containers that meet National Fire Protection Association (NFPA) guidelines.
	Put individual containers on pallets. Limit stack height of individual containers/drums. Provide straps, plastic wrap, or equivalent around stacked containers to provided stability.
	Label/mark drums. Segregate hazardous and flammable wastes. Comply with NFPA guidelines for segregation of flammable wastes.
	Provide adequate clearance to allow material movement and access by material handling equipment.
	Provide semipermanent or permanent cover over wastes.
	Provide adequate clearance between stored materials to allow movement and handling.
	Establish clean up procedures, including the use of dry adsorbents, in the event of spills or leaks.
	Prohibit washing down of material storage areas. Disconnect or seal all floor drains from storm sewer system.
	Develop spill prevention, countermeasures and control (SPCC) procedures for all liquid container storage areas. Ensure employees are familiar with SPCC procedures. Schedule/conduct periodic employee training.
	Provide secondary containment, dikes, berms, containment trench, sumps, or other equivalent measure, in all storage areas.
Bulk Liquid Storage	Use welded pipe connections versus flange connections. Inspect all flange gaskets for deterioration.
	Apply corrosion inhibitors to exposed metal surfaces.
	Provide high level alarms for storage tanks.
	Provide redundant piping, valves, pumps, motors, as necessary, at all pumping stations. Provide manually activated shutoff valves in the event of spill. Install visible and/or audible alarms in the event of a spill.
	Install manually activated drainage values, or equivalent, versus flapper-type drain values. Provide adequate security against vandalism and tampering.
	Provide secondary containment around all bulk storage tanks, including berms, dikes, surface impoundments or equivalent. Ensure surfaces of secondary containment areas are adequately sealed to prevent leaks.
	Provide stationary boxes around all return and fill stations to eliminate/minimize hose drainage and minor waste transfer spills.
Waste Transfer Areas	Provide secondary containment or equivalent measures around all liquid waste transfer facilities.
	Provide cover over liquid waste transfer areas.
	Establish clean up procedures for minor spills including the use of dry adsorbents.
Inspections	Conduct inspections of all material storage, handling and transfer areas.
	Document signs of corrosion, worn parts or components on pumps and motors, leaking seals and gaskets.
	Conduct periodic nondestructive testing (NDT) of all bulk storage tanks for signs of deteriorating structural integrity.
Preventive Maintenance	Conduct periodic preventive maintenance of all structural controls, replace worn parts on components on valves, pumps, motors per manufacturer's recommendations.
Vehicle Maintenance (if applicable)	Establish an inventory of materials used in the maintenance shop that could become a potential pollutant source with storm water runoff, e.g., fuels, solvents, oils, lubricants.

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TABLE N-16.—TYPES OF BMP OPTIONS APPLICABLE TO LIQUID WASTE RECYCLING FACILITIES—Continued

Activity	BMP alternatives
	Store and dispose of oily rags, filters (oil and air), batteries, engine coolant, transmission fluid, use oil, brake fluid, and solvents in a manner that minimizes potential contact with runoff and in compliance with State and Federal regulations. Label and track recycling of waste materials, e.g., batteries, solvent, used oil. Drain oil filters before disposal or recycling. Drain all fluids from all parts or components that will become scrap material or secondhand parts. Store liquid waste materials in compatible containers. Store and dispose used batteries in accordance with scrap lead acid battery program. Disconnect all floor drains connected to storm sewer system. Prohibit non-storm water discharges, e.g., dumping of used liquids down floor drains and washdown of maintenance areas. Provide employee training on appropriate storage and disposal of waste materials. Provide good housekeeping measures. Conduct inspections of work areas for compliance with BMPs.
Vehicle Cleaning (if applicable)	Avoid washing vehicles and equipment outdoors. Use biodegradable, phosphate free detergents. Recycle wash water. Provide vehicle wash rack with dedicated sediment trap. Use autoshut-off valves on washing equipment.
Training	Provide employee training on proper material handling and storage procedures. Require familiarization with applicable SPCC measures.

c. Recycling Facilities (SIC 5093). This section addresses best management practices that have been employed by one or more facilities within group applications 274, 647, 826, and 1145. The following table provides examples of BMPs used by the recycling facilities within this sub-section:

TABLE N-17.—Types of BMP Options Applicable to Recycling Facilities

Activity	BMP options and alternatives
Inbound Recyclable Materials Control	Provide public education brochures on acceptable recyclable materials. Educate curbside pick-up drivers on acceptable materials. Reject unacceptable materials at the source. Employee training. Provide totally-enclosed drop-off containers for public.
Indoor Storage	Store equivalent of the average daily volume of recyclable materials indoors. Provide good housekeeping. Disconnect all floor drains from storm sewer system. Prohibit illicit discharges and illegal dumping to floor drains that are connected to the storm sewer. Direct tipping floor washwaters to sanitary sewer system if permitted by local sanitary authority.
Recyclable Material Processing	Conduct processing operations indoors. Clean up residual fluids. Conduct routine preventive maintenance on all processing equipment. Schedule frequent good housekeeping to minimize particulate and residual materials buildup.
Outdoor Storage	Store only processed materials, i.e., baled plastic and aluminum and glass cullet. Provide containment pits with sumps pumps that discharge to sanitary sewer system. Prevent discharge of residual fluids to storm sewer. Provide dikes and curbs around bales of waste paper. Use tarpaulins or covers over bales of wastepaper. Conduct regularly scheduled sweeping of storage areas to minimize particulate buildup.
Residual Non-recyclable Materials	Store residual non-recyclable materials in covered containers for transport to a proper disposal facility. Bale residual non-recyclable materials and cover with tarpaulin or equivalent.
Vehicle Maintenance	Avoid washing equipment and vehicles outdoors. Eliminate outdoor maintenance areas.
Fueling	Establish spill prevention and clean-up procedures. Provide dry-absorbent materials or equivalent. Provide employee training, i.e., avoid topping off fuel tanks. Divert runoff from fueling areas.
Lubricant Storage	Eliminate or minimize outside storage. Provide employee training on proper, handling, storage. Divert runoff from storage areas.

4. Discharges Covered under this Section

The requirements listed under this section are applicable to storm water discharges from facilities typically identified in SIC 5093 (except for battery reclaimers and auto salvage yards). This includes facilities that are engaged in the processing, reclaiming and wholesale distribution of scrap and waste materials such as ferrous and nonferrous metals, paper, plastic,

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cardboard, glass. For purposes of this permit, the term waste recycling facility applies to those facilities within SIC 5093 that receive a mixed wastestream of recyclable and non-recyclable wastes. Facilities that are engaged in reclaiming and recycling liquid wastes such as used oil, antifreeze, mineral spirits and industrial solvents and which are classified SIC 5093 are also covered under this section. The term recycling facility is used in this permit to those facilities that only receive source-separated recyclable materials primarily from non-industrial and residential sources, e.g., common consumer products including paper, newspaper, glass, cardboard, plastic containers, aluminum and tin cans.

5. Special Conditions

The following section identifies special conditions that are applicable to permittees applying for coverage under Part XI.N. of today's permit.

a. Prohibition of Non-storm Water Discharges. This section requires scrap and waste recycling facilities that are typically classified in SIC 5093 to certify that certain non-storm water discharges are not occurring at their facilities. A list of non-storm water discharges that are not authorized by this section has been identified. These discharges are prohibited due to the likelihood these discharges will contain substantial pollutant concentrations. The following non-storm water discharges are not authorized by this section: waste discharges to floor drains or sinks connected to the facilities storm sewer or storm drainage system; water originating from vehicle and equipment washing; steam cleaning wastewater; process wastewaters; washwater originating from cleaning tipping floor areas or material receiving areas that discharge to any portion of a storm sewer system; wastewater from wet scrubbers; boiler blowdown; noncontact and contact cooling water; discharges originating from dust control spray water; discharges from oil/water separators and sumps in the absence of a storm event; discharges originating from the cleaning out of oil/water separators or sumps; and non-storm water discharges from turnings containment areas.

The operators of non-storm water discharges must seek coverage for these discharges under a separate National Pollutant Discharge Elimination System (NPDES) permit if discharging to either a municipal separate storm sewer system or to waters of the United States. If such a permit has been issued, the plan shall identify the NPDES permit number and a copy of the NPDES permit shall be located at the facility and shall be readily accessible. If a permit application has been submitted for a non-storm water discharge, the plan shall be annotated accordingly and a copy of the application shall be located at the facility and shall be readily accessible.

For facilities that have prohibited discharges identified under this section and which discharge to a sanitary sewer system, the facility operator is required to take the appropriate notification actions as may be required by the operator of the sanitary sewer system. Any relevant documentation, i.e., notification letters and approvals, shall be kept with the plan. For facilities that have been issued an industrial user permit under the pretreatment program for discharges prohibited under this section, the plan shall identify the appropriate NPDES permit number and a copy of the permit shall be kept at the facility and shall be readily accessible. EPA strongly recommends that operators keep copies of relevant documentation concerning non-storm water discharges and NPDES permits with the plan.

6. Storm Water Pollution Prevention Plan Requirements

a. Contents of the Plan. In addition to the supplemental information requirements identified in Part VI.C., scrap and waste recycling facilities in SIC 5093 are required to provide the additional information applicable to their industrial sector. The storm water pollution prevention plan is broken out into three subcategories; scrap recycling and waste recycling facilities (nonliquid materials); waste recycling facilities (liquid materials); and recycling facilities.

(1) Description of Potential Pollutant Sources

(a) Scrap Recycling and Waste Recycling Facilities (nonliquid recyclable wastes)—This section establishes that scrap recycling and waste recycling facilities shall provide the following information in their pollution prevention plan.

(i) Inbound Recyclable and Waste Material Control Program—The plan shall include a recyclable and waste material inspection program to minimize the likelihood of receiving non-recyclable materials (e.g., hazardous materials) that may be significant pollutant sources to storm water discharges. At a minimum, the plan shall address the following:

Information/education measures to encourage major suppliers of scrap and recyclable waste materials to drain residual fluids, whenever applicable, prior to its arrival at the facility. This includes vehicles and equipment engines, radiators, and transmissions, oil-filled transformers, white goods (appliances) and individual containers or drums;

Activities which accept scrap and materials that may contain residual fluids, e.g., automotive engines containing used oil, transmission fluids, etc., shall describe procedures to minimize the potential for these fluids from coming in contact with either precipitation or runoff. The description shall also identify measures or procedures to properly store, handle, dispose and/or recycle these residual fluids;

Procedures pertaining to the acceptance of scrap lead-acid batteries. Additional requirements for the handling, storage and disposal or recycling of batteries shall be in conformance with conditions for a scrap lead-acid battery program, see below;

A description of training requirements for those personnel engaged in the inspection and acceptance of inbound recyclable materials; and

Liquid wastes, including used oil, shall be stored in materially compatible and nonleaking containers and disposed or recycled in accordance with all requirements under the Resource Recovery and Conservation Act (RCRA), and other State or local requirements.

(ii) Scrap and Waste Material Stockpiles (outdoors)—The plan shall address areas where significant materials are exposed to either storm water runoff or precipitation. The plan must describe those measures and controls used to minimize contact of storm water runoff with stockpiled materials. The plan should include measures to minimize the extent of storm water contamination from these areas. The operator shall consider (within the plan) the use of the following BMPs (either individually or in combination) or their equivalent to minimize contact with storm water runoff:

Diversion devices or structures such as dikes, berms, containment trenches, culverts and/or surface grading;

Media filtration such as catch basin filters and sand filters;

Silt fencing; and,

Oil/water separators, sumps and dry adsorbents in stockpile areas that are potential sources of residual fluids, e.g., automotive engine storage areas.

The operator may consider the use of permanent or semipermanent covers, or other similar forms of protection over stockpiled materials where the operator determines that such measures are reasonable and appropriate.

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The operator may consider the use of sediment traps, vegetated swales and/or vegetated strips to facilitate settling or filtering out of pollutants and sediment.

(iii) Stockpiling of Turnings Previously Exposed to Cutting Fluids (outdoors)—The plan shall address all areas where stockpiling of industrial turnings (previously exposed to cutting fluids) occurs. The plan shall implement those measures necessary to minimize contact of surface runoff with residual cutting fluids. The operator shall consider implementation of either of the following two alternatives or a combination of both or equivalent measures:

Alternative 1: Storage of all turnings previously exposed to cutting fluids under some form of permanent or semi-permanent cover. Discharges of residual fluids from these areas to the storm sewer system in the absence of a storm event is prohibited. Discharges to the storm sewer system as a consequence of a storm event is permitted provided the discharge is first directed through an oil/water separator or its equivalent. Procedures to collect, handle, and dispose or recycle residual fluids that may be present shall be identified in the plan.

Alternative 2: Establish dedicated containment areas for all turnings that have been exposed to cutting fluids where runoff from these areas is directed to a storm sewer system, providing the following:

Containment areas constructed of either concrete, asphalt or other equivalent type of impermeable material;

A perimeter around containment areas to prevent runoff from moving across these areas. This would include the use of shallow berms, curbing, or constructing an elevated pad or other equivalent measure;

A suitable drainage collection system to collect all runoff generated from within containment areas. At a minimum, the drainage system shall include a plate-type oil/water separator or its equivalent. The oil/water separator or its equivalent shall be installed according to the manufacturer's recommended specifications, whenever available, specifications will be kept with the plan;

A schedule to maintain the oil/water separator (or its equivalent) to prevent the accumulation of appreciable amounts of fluids. In the absence of a storm event, no discharge from containment areas to the storm sewer system are permitted unless the discharge is covered by a separate NPDES permit; and

Identify procedures for the proper disposal or recycling of collected residual fluids.

(iv) Scrap and Waste Material Stockpiles (covered or indoors)—The plan shall address, at a minimum, measures and controls to minimize and, whenever feasible, eliminate residual liquids and particulate matter from materials stored indoors from coming in contact with surface runoff. The operator shall consider including in their plan: good housekeeping measures to collect residual liquids from aluminum, glass and plastic containers and prohibiting the practice of allowing washwater from tipping floors or other indoor processing areas from discharging to a storm sewer system, inspections to ensure that material stockpile areas with existing floor drains are not connected to the storm sewer system or any portion of the storm sewer system, and the disconnection of any floor drains to the storm drainage system.

(v) Scrap and Recyclable Waste Processing Areas—The plan shall address areas where scrap and recyclable waste processing equipment are sited. This includes measures and controls to minimize surface runoff from coming in contact with scrap processing equipment. In the case of processing equipment that generate visible amounts of particulate residue, e.g., shredding facilities, the plan shall describe good housekeeping and preventive maintenance measures to minimize contact of runoff with residual fluids and accumulated particulate matter. At a minimum, the operator shall consider including the following:

A schedule of periodic inspections of equipment for leaks, spills, malfunctioning, worn or corroded parts or equipment; preventive maintenance program to repair and/or maintain processing equipment; measures to minimize shredder fluff from coming in contact with surface runoff; use of dry-absorbents or other cleanup practices to collect and to dispose or recycle spilled or leaking fluids; and installation of low-level alarms or other equivalent protection devices on unattended hydraulic reservoirs over 150 gallons in capacity. Alternatively, provide secondary containment with sufficient volume to contain the entire volume of the reservoir.

The operator shall consider using the following types of BMPs:

(a) Diversion structures such as dikes, berms, culverts, containment trenches, elevated concrete pads, grading to minimize contact of storm water runoff with outdoor processing equipment;

(b) Oil/water separators or sumps in processing areas that are potential sources of residual fluids and grease;

(c) Permanent or semipermanent covers, or other similar measures;

(d) Retention and detention basins or ponds, sediment traps or vegetated swales and strips, to facilitate settling or filtering out of pollutants in runoff from processing areas; or

(e) Media filtration such as catch basin filters and sand filters.

(vi) Scrap Lead-acid Battery Program—The plan shall address measures and controls for the proper receipt, handling, storage and disposition of scrap lead-acid batteries (battery reclaiming is not eligible for coverage under this permit). The operator shall consider including: procedures for accepting scrap batteries and describing how they will be segregated from other scrap materials; procedures for managing battery casings that may be cracked or leaking, including the proper handling and disposal of residual fluids; measures to minimize and, whenever possible, eliminate exposure of scrap batteries to either runoff or precipitation; the schedule for conducting periodic inspections of scrap battery storage areas and applicable source control measures; and measures to provide employee training on the management of scrap batteries.

(vii) Erosion and Sediment Control—The plan shall identify all areas associated with industrial activity that have a high potential for soil erosion and suspended solids loadings, i.e., areas that tend to accumulate significant particulate matter. Appropriate source control, stabilization measures, nonstructural, structural controls, or an equivalent shall be provided in these areas. The plan shall also contain a narrative discussion of the reason(s) for selected erosion and sediment controls. At a minimum, the operator shall consider in the plan, either individually or in combination, the following erosion and sediment control measures:

Filtering or diversion practices, such as filter fabric, sediment filter boom, earthen or gravel berms, curbing or other equivalent measure;

Catch basin filters, filter fabric, or equivalent measure, placed in or around inlets or catch basins that receive runoff from scrap and waste storage areas, and processing equipment; and

Sediment traps, vegetative buffer strips, or equivalent, that effectively trap or remove sediment prior to discharge through an inlet or catch basin.

In instances where significant erosion and suspended solids loadings continue after implementation of source control

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measures and nonstructural controls, the operator shall consider providing in the plan for a detention or retention basin or other equivalent structural control. All structural controls shall be designed using good engineering practice. All structural controls and outlets that are likely to receive discharges containing oil and grease must include appropriate measures to minimize the discharge of oil and grease through the outlet. This may include the use of an absorbent boom or other equivalent measure.

Where space limitations (e.g., obstructions caused by permanent structures such as buildings and permanently-sited processing equipment and limitations caused by a restrictive property boundary) prevent the siting of a structural control, i.e., retention basin, such a determination will be noted in the plan. The operator will identify in the plan what existing practices shall be modified or additional measures shall be undertaken to minimize erosion and suspended sediment loadings in lieu of a structural BMP.

(*viii*) *Spill Prevention and Response Procedures*—To prevent or minimize storm water contamination at loading and unloading areas, and from equipment or container failures, the operator shall consider including in the plan the following practices:

Description of spill prevention and response measures to address areas that are potential sources of leaks or spills of fluids;

All significant leaks and spills should be contained and cleaned up as soon as possible. If malfunctioning equipment is responsible for the spill or leak, repairs should also be conducted as soon as possible;

Cleanup procedures should be identified in the plan, including the use of dry absorbent materials or other cleanup methods. Where dry absorbent cleanup methods are used, an adequate supply of dry absorbent material should be maintained onsite. Used absorbent material should be disposed of properly;

Drums containing liquids, including oil and lubricants, should be stored indoors; or in a bermed area; or in overpack containers or spill pallets; or in similar containment devices;

Overfill prevention devices should be installed on all fuel pumps or tanks;

Drip pans or equivalent measures should be placed under any leaking piece of stationary equipment until the leak is repaired. The drip pans should be inspected for leaks and checked for potential overflow, and be emptied regularly to prevent overflow and all liquids will be disposed of in accordance with all requirements under RCRA; and

An alarm and/or pump shut off system should be installed and maintained on all outside equipment with hydraulic reservoirs exceeding 150 gallons (only those reservoirs not directly visible by the operator of the equipment) in order to prevent draining the tank contents in the event of a line break. Alternatively, the equipment may have a secondary containment system capable of containing the contents of the hydraulic reservoir plus adequate freeboard for precipitation. Leaking hydraulic fluids should be disposed of in accordance with all requirements under RCRA.

(*ix*) *Quarterly Inspections*—A quarterly inspection shall include all designated areas of the facility and equipment identified in the plan. The inspection shall include a means of tracking and conducting follow up actions based on the results of the inspection. The inspections shall be conducted by members of the Storm Water Pollution Prevention team. At a minimum, quarterly inspections shall include the following areas:

All outdoor scrap processing areas;

All material unloading and loading areas (including rail sidings) that are exposed to either precipitation or storm water runoff;

Areas where structural BMPs have been installed;

All erosion and sediment BMPs;

Outdoor vehicle and equipment maintenance areas;

Vehicle and equipment fueling areas; and

All areas where waste is generated, received, stored, treated, or disposed and which are exposed to either precipitation or storm water runoff.

If exposed to precipitation or storm water runoff, the inspection shall attempt to identify any corroded or leaking containers, corroded or leaking pipes, leaking or improperly closed valves and valve fittings, leaking pumps and/or hose connections, and deterioration in diversionary or containment structures. Spills or leaks shall be immediately addressed according to the facilities. A record of inspections shall be maintained with the plan.

The BMPs identified above have been employed by scrap recycling and waste recycling facilities are believed to be appropriate given the types of pollutants found in storm water discharges from these facilities. In addition, the diversity of options allows permittees to select those BMPs that are most applicable to the extent of the risk that exists at a particular facility. In instances where nonstructural measures are not sufficient, the conditions direct the permittee to more stringent requirements such as structural controls.

(*b*) *Waste Recycling Facilities (Recyclable liquid wastes)*—This section establishes that waste recycling facilities (recyclable liquid wastes) shall provide the following information.

(*i*) *Waste Material Storage (Indoors)*—The operator shall consider including in the plan measures and controls to minimize residual liquids from waste materials stored indoors from coming in contact with surface runoff and provisions to maintain a sufficient supply of dry-absorbent materials or a wet vacuum system or other equivalent measure to promptly respond to minor leaks or spills. Measures for secondary containment or its equivalent and procedures for proper material handling (including labeling and marking) and storage of containerized materials should be considered. Drainage from bermed areas should be discharged to an appropriate treatment facility or sanitary sewer system. Discharges from bermed areas should be covered by a separate NPDES permit or industrial user permit under the pretreatment program. The drainage system, where applicable, should include appropriate appurtenances such as pumps or ejectors and manually-operated valves of the open-and-close design.

(*ii*) *Waste Material Storage (outdoors)*—The plan will address areas where waste materials are exposed to either storm water runoff or precipitation. The plan must include measures to provide appropriate containment, drainage control and/or other appropriate diversionary structures. The plan must describe those measures and controls used to minimize contact of storm water runoff with stored materials. The operator shall consider including in the plan the following preventative measures or an equivalent:

An appropriate containment structure such as dikes, berms, curbing or pits, or other equivalent measure. The containment should be sufficient to store the volume of the largest single tank and should include sufficient freeboard for precipitation;

A sufficient supply of dry-absorbent materials or a wet vacuum system to collect liquids from minor spills and leaks in contained areas; and

Discharges of precipitation from containment areas containing used oil shall be in accordance with applicable sections of 40 CFR Part 112.

(*iii*) *Truck and Rail Car Waste Transfer Areas*—The plan will describe

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measures and controls for truck and rail car loading and unloading areas. This includes appropriate containment and diversionary structures to minimize contact with precipitation and/or storm water runoff. The plan will also address measures to clean up minor spills and/or leaks originating from the transfer of liquid wastes. This may include dry-clean up methods, roof coverings, and other runoff controls.

(iv) Erosion and Sediment Control—The plan shall identify all areas associated with industrial activity that have a high potential for soil erosion. Appropriate stabilization measures, nonstructural and structural controls shall be provided in these areas. The plan shall contain a narrative consideration of the appropriateness for selected erosion and sediment controls. Where applicable, the facility shall consider the use of the following types of preventive measures: sediment traps; vegetative buffer strips; filter fabric fence; sediment filtering boom; gravel outlet protection; or other equivalent measures that effectively trap or remove sediment prior to discharge through an inlet or catch basin.

(v) Spill Prevention and Response Procedures—The plan will address measures and procedures to address potential spill scenarios that could occur at the facility. This includes all applicable handling and storage procedures, containment, diversion controls and clean-up procedures. The plan will specifically address all outdoor and indoor storage areas, waste transfer areas, material receiving areas (loading and unloading), and waste disposal areas.

(vi) Quarterly Inspections—Quarterly visual inspections shall be conducted by a member, or members, of the storm water pollution prevention team. The quarterly inspection shall include all designated areas of the facility and equipment identified in the plan. The inspection shall include a means of tracking and conducting follow up actions based on the results of the inspection. At a minimum, the inspections shall include the following areas:

Material storage areas;

Material unloading and loading areas (including rail sidings) that are exposed to either precipitation or storm water runoff;

Areas where structural BMPs have been installed;

All erosion and sediment BMPs;

Outdoor vehicle and equipment maintenance areas (if applicable);

Vehicle and equipment fueling areas (if applicable); and

All areas where waste is generated, received, stored, treated, or disposed and which are exposed to either precipitation or storm water runoff.

If exposed to precipitation or storm water runoff, the inspection shall identify the presence of any corroded or leaking containers, corroded or leaking pipes, leaking or improperly closed valves and valve fittings, leaking pumps and/or hose connections, and deterioration in diversionary or containment structures. Spills or leaks shall be immediately addressed according to the facility's spill prevention and response procedures.

(c) Recycling Facilities.—This section establishes that recycling facilities (including MRFs) that receive only source-separated recyclable materials primarily from non-industrial and residential sources shall provide the following information in their pollution prevention plan.

(i) Inbound Recyclable Material Control Program. The plan shall include a recyclable material inspection program to minimize the likelihood of receiving non-recyclable materials (e.g., hazardous materials) that may be significant source of pollutants in surface runoff. At a minimum, the operator shall consider addressing in the plan the following:

A description of information and education measures to educate the appropriate suppliers of recyclable materials on the types of recyclable materials that are acceptable and those that are not acceptable, e.g., household hazardous wastes;

A description of training requirements for drivers responsible for pickup of recyclable materials;

Clearly mark public drop-off containers as to what materials can be accepted;

Rejecting non-recyclable wastes or household hazardous wastes at the source; and

A description of procedures for the handling and disposal of nonrecyclable materials.

(ii) Outdoor Storage. The plan shall include BMPs to minimize or reduce the exposure of recyclable materials to surface runoff and precipitation. The plan, at a minimum, shall include good housekeeping measures to prevent the accumulation of visible quantities of residual particulate matter and fluids, particularly in high traffic areas. The plan shall consider tarpaulins or their equivalent to be used to cover exposed bales of recyclable waste paper. The operator shall consider within the plan the use of the following types of BMPs (individually or in combination) or their equivalent:

Provide totally-enclosed drop-off containers for public.

Provide a sump and sump pump with each containment pit. Prevent the discharge of residual fluids to storm sewer system. Prevent discharging to the storm sewer system;

Provide dikes and curbs around bales of recyclable waste paper;

Divert surface runoff away from outside material storage areas;

Provide covers over containment bins, dumpsters, roll-off boxes; and,

Store the equivalent one day's volume of recyclable materials indoors.

(iii) Indoor Storage and Material Processing. The plan shall address BMPs to minimize the release of pollutants from indoor storage and processing areas to the storm sewer system. The plan shall establish specific measures to ensure that all floor drains do not discharge to the storm sewer system. The following BMPs shall be considered for inclusion in the plan:

Schedule routine good housekeeping measures for all storage and processing areas;

Prohibit the practice of allowing tipping floor washwaters from draining to any portion of a storm sewer system;

Provide employee training on pollution prevention practices;

(iv) Vehicle and Equipment Maintenance. The plan shall also provide for BMPs in those areas where vehicle and equipment maintenance is occurring outdoors. At a minimum, the following BMPs shall be considered for inclusion in the plan:

Prohibit vehicle and equipment washwater from discharging to the storm sewer system;

Minimize or eliminate outdoor maintenance areas, wherever possible;

Establish spill prevention and clean-up procedures in fueling areas;

Provide employee training on avoiding topping off fuel tanks;

Divert runoff from fueling areas;

Store lubricants and hydraulic fluids indoors;

Provide employee training on proper, handling, storage of hydraulic fluids and lubricants.

Monitoring and Reporting Requirements

Analytical Monitoring Requirements. EPA believes that scrap recycling and waste recycling facilities (nonsource-separated facilities only) may reduce the level of pollutants in storm water runoff from their sites through the development and proper implementation of the storm water pollution prevention plan requirements discussed in today's permit. In order to provide a tool for evaluating the effectiveness of the pollution prevention

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plan and to characterize the discharge for potential environmental impacts, the permit requires scrap recycling and waste recycling facilities to collect and analyze samples of their storm water discharges for the pollutants listed in Table N–18. The pollutants listed in Table N–18 were found to be above benchmark levels for a significant portion of scrap and waste recycling facilities that submitted quantitative data in the group application process, or are believed to be present based upon the description of industrial activities and significant materials exposed. Because these pollutants have been reported above benchmark levels, EPA is requiring monitoring after the pollution prevention plan has been implemented to assess the effectiveness of the pollution prevention plan and to help ensure that a reduction of pollutants is realized.

At a minimum, storm water discharges from scrap recycling and waste recycling facilities must be monitored quarterly during the second year of permit coverage. Samples must be collected at least once in each of the following periods: January through March; April through June; July through September; and October through December. At the end of the second year of permit coverage, a facility must calculate the average concentration for each parameter listed in Table N–18. If the permittee collects more than four samples in this period, then they must calculate an average concentration for each pollutant of concern for all samples analyzed.

TABLE N–18.—INDUSTRY MONITORING REQUIREMENTS

Pollutants of concern [1]	Cut-off concentration
Chemical Oxygen Demand (COD).	120 mg/L
Total Suspended Solids (TSS).	100 mg/L
Total Recoverable Aluminum.	0.75 mg/L
Total Recoverable Copper.	0.0636 mg/L
Total Recoverable Iron ...	1.0 mg/L
Total Recoverable Lead .	0.0816 mg/L
Total Recoverable Zinc ...	0.117 mg/L

[1] Several congeners of PCBs (PCB–1016, –1221, –1242, –1248, –1260) were above established benchmarks, however, EPA believes that these constituents will readily bound up with sediment and particulate matter. Therefore, EPA feels that monitoring for TSS will serve as an adequate indicator for the control of PCBs.

If the average concentration for a parameter is less than or equal to the value listed in Table N–18, then the permittee is not required to conduct quantitative analysis for that parameter during the fourth year of the permit. If, however, the average concentration for a parameter is greater than the cut-off concentration listed in Table N–18, then the permittee is required to conduct quarterly monitoring for that parameter during the fourth year of permit coverage. Monitoring is not required during the first, third, and fifth year of the permit. The exclusion from monitoring in the fourth year of the permit is conditional on the facility maintaining industrial operations and BMPs that will ensure a quality of storm water discharges consistent with the average concentrations recorded during the second year of the permit.

TABLE N–19.—SCHEDULE OF MONITORING

2nd Year of Permit Coverage	• Conduct quarterly monitoring. • Calculate the average concentration for all parameters analyzed during this period. • If average concentration is greater than the value listed in Table N–18, then quarterly sampling is required during the fourth year of the permit. • If average concentration is less than or equal to the value listed in Table N–18, then no further sampling is required for that parameter.
4th Year of Permit Coverage	• Conduct quarterly monitoring for any parameter where the average concentration in year 2 of the permit is greater than the value listed in Table N–18. • If industrial activities or the pollution prevention plan have been altered such that storm water discharges may be adversely affected, quarterly monitoring is required for all parameters of concern.

In cases where the average concentration of a parameter exceeds the cut-off concentration, EPA expects permittees to place special emphasis on methods for reducing the presence of those parameters in storm water discharges. Quarterly monitoring in the fourth year of the permit will reassess the effectiveness of the adjusted pollution prevention plan.

EPA realizes that if a facility is inactive and unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly chemical sampling.

b. Alternative Certification. Throughout today's permit, EPA has proposed monitoring requirements for facilities which the Agency believes have the potential for contributing significant levels of pollutants to storm water discharges. The alternative described below is necessary to ensure that monitoring requirements are only imposed on those facilities that do, in fact, have storm water discharges containing pollutants at concentrations of concern. EPA has determined that if materials and activities are not exposed to storm water at the site, then the potential for pollutants to contaminate storm water discharges does not warrant monitoring.

Therefore, a discharger is not subject to the monitoring requirements of this Part provided the discharger makes a certification for a given outfall, or on a pollutant-by-pollutant basis in lieu of monitoring reports required, under penalty of law, signed in accordance with Part VII.G. (Signatory Requirements), that material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, industrial machinery or operations, significant materials from past industrial activity that are located in areas of the facility that are within the drainage area of the outfall are not presently exposed to storm water and will not be exposed to storm water for the certification period. Such certification must be retained in the storm water pollution prevention plan and submitted to EPA in the case of certifying that a pollutant is not present, the permittee must submit the certification along with the monitoring

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reports required under paragraph (c) below. If the permittee cannot certify for an entire period, they must submit the date exposure was eliminated and any monitoring required up until that date. This certification option is not applicable to compliance monitoring requirements associated with effluent limitations. EPA does not expect facilities to be able to exercise this certification for indicator parameters, such as TSS and BOD.

c. Reporting Requirements. Permittees are required to submit all monitoring results obtained during the second and fourth year of permit coverage within 3 months of the conclusion of each year. For each outfall, one signed Discharge Monitoring Report form must be submitted to the Director per storm event sampled. For facilities conducting monitoring beyond the minimum quarterly requirements an additional Discharge Monitoring Report Form must be filed for each analysis.

d. Sample Type. All discharge data shall be reported for grab samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The required 72-hour storm event interval is waived where the preceding measurable storm event did not result in a measurable discharge from the facility. The required 72-hour storm event interval may also be waived where the permittee documents that less than a 72-hour interval is representative for local storm events during the season when sampling is being conducted. The grab sample shall be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable. If storm water discharges associated with industrial activity commingle with process or nonprocess water, then where practicable permittees must attempt to sample the storm water discharge before it mixes with the non-storm water discharge.

e. Representative Discharge. When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may test the effluent of one of such outfalls and report that the quantitative data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluent. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

f. Quarterly Visual Examination of Storm Water Quality. Quarterly visual examinations of storm water discharges from each outfall are required. The examination must be of a grab sample collected from each storm water outfall. The examination of storm water grab samples shall include any observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, or other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on these samples. The examination must be conducted at least once in each of the following periods: January through March; April through June; July through September; and October through December.

The examination must be made at least once in each quarter of the permit during daylight unless there is insufficient rainfall or snow-melt to generate runoff. Where practicable, the same individual should carry out the collection and examination of discharges throughout the life of the permit to ensure the greatest degree of consistency possible. Grab samples shall be collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 60 minutes) of when the runoff begins discharging. Reports of the visual examination include: the examination date and time, examination personnel, visual quality of the storm water discharge, and probable sources of any observed storm water contamination. The visual examination reports must be maintained onsite with the pollution prevention plan.

EPA realizes that if a facility is inactive and unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly visual examination.

EPA believes that this quick and simple assessment will allow the permittee to approximate the effectiveness of his/her plan on a regular basis at very little cost. Although the visual examination cannot assess the chemical properties of the storm water discharged from the site, the examination will provide meaningful results upon which the facility may act quickly. The frequency of this visual examination will also allow for timely adjustments to be made to the plan. If BMPs are performing ineffectively, corrective action must be implemented. A set of tracking or follow-up procedures must be used to ensure that appropriate actions are taken in response to the inspections. The visual examination is intended to be performed by members of the pollution prevention team. This hands-on examination will enhance the staff's understanding of the storm water problems on that site and effects on the management practices that are included in the plan.

When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation on-site with the records of the visual examination. Adverse weather conditions which may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

g. Retention of Records

(1) The permittee shall retain records of all inspections and monitoring information, including certification reports, noncompliance reports, calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports, and supporting data, requested by the permitting authority for at least 3 years after the date of the sampling event or inspection.

O. Storm Water Discharges Associated With Industrial Activity From Steam Electric Power Generating Facilities, Including Coal Handling Areas

1. Industrial Profile

The conditions in this section apply to storm water discharges from steam electric power generating facilities. The steam electric power generating category includes facilities which are coal, oil, gas, or nuclear fired. Heat captured co-generation facilities are not covered under the definition of storm water discharge associated with industrial activity, however, dual fuel co-generation facilities are included in the definition. When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

Storm water discharges from coal piles are eligible for coverage under this permit, where these discharges are not already subject to an existing NPDES permit.

The production of electrical energy always involves the conversion of some other form of energy. The two most important sources of energy which are converted to steam electric energy are the chemical energy of fossil fuels and the atomic energy of nuclear fuels. Current uses of fossil fuels are based on a combustion process, followed by steam generation to convert the heat first into mechanical energy and then to convert the mechanical energy into electrical energy. Nuclear power plants utilize a cycle similar to that used in fossil fueled power plants except that the source of heat is atomic interactions rather than the combustion of fossil fuel.

The steam electric power generating process for fossil fuel systems are typically enclosed and subject to effluent limitations guidelines [40 Code of Federal Regulations (CFR) Part 423], as is coal pile runoff. However, the unloading and transport of coal within the facility is subject to the conditions set forth in this section of today's permit. Likewise, the unloading and storage areas for liquid fuels and chemicals are subject to the conditions in this section of today's permit.

Industrial activities occurring at steam electric power generating facilities that pertain to the storm water rule include, "* * * but [are] not limited to, storm water discharges from industrial plant yards; material handling sites; refuse sites; sites used for the application or disposal of process wastewaters (as defined at 40 CFR Part 401); sites used for the storage and maintenance of material handling equipment; sites used for residual treatment, storage, or disposal; shipping and receiving areas; manufacturing buildings; storage areas (including tank farms) for raw materials and intermediate and finished materials; and areas where industrial activity has taken place in the past and significant materials remain and are exposed to storm water" (40 CFR 122.26(b)(14)). Common industrial activities at steam electric power generating facilities include the unloading, transport, and storage of raw materials, and the disposal of waste materials.

Significant materials include, "* * * but [are] not limited to: raw materials; fuels; materials such as solvents, detergents, and plastic pellets; finished materials such as metallic products; * * * hazardous substances designated under Section 101(14) of CERCLA; any chemical facilities required to report pursuant to Section 313 of Title III of SARA; fertilizers; pesticides; and waste products such as ashes, slag, and sludge that have the potential to be released with storm water discharges" (40 CFR 122.26(b)(12)). Significant materials commonly found at steam electric power generating facilities include: coal; diesel fuel; and waste materials.

Historically, steam electric power generating facilities were categorized in accordance with the type of fuel they burned. Recently, however, steam electric power generating facilities have modified their equipment to enable them to use more than one fuel. Presented below are brief descriptions of the industrial activities and significant materials associated with the production of steam electric power. Due to the increase in facilities burning multiple fuels the industrial activities and significant materials are discussed together. However, the industrial activities and significant materials for nuclear powered facilities are discussed separately. Unique practices are noted.

a. Industrial Activities: Fossil Fuel Powered Plants. Steam electric power generation can be divided into four stages. In the first operation, fossil fuel (coal, oil, or natural gas) is burned in a boiler furnace. The evolving heat is used to produce pressurized and superheated steam. This steam is conveyed to the second stage, the turbine, where it gives energy to the rotating blades and, in the process, loses pressure and increases in volume. The rotating blades of the turbine act to drive an electric generator or alternator to convert the imparted mechanical energy into electrical energy. The steam leaving the turbine enters the third state, the condenser, where it is condensed to water. The liberated heat is transferred to a cooling medium which is normally water. Finally, the condensed steam is reintroduced into the boiler by a pump to complete the cycle.

Features unique to coal-fired plants include coal storage and preparation (transport, beneficiation, pulverization, drying), coal-fired boiler, ash handling and disposal systems, and flue gas cleaning, and desulfurization.

b. Significant Materials: Fossil Fuel Powered Plants. The type of fuel (coal, oil, gas, nuclear) used to fire power plant boilers most directly influences the number of waste streams. The influence comes principally from the effect of fuel on the volume of ash generated. Stations using heavy or residual oils generate fly ash in large quantities and may generate some bottom ash. Stations which burn coal create both fly ash and bottom ash. Bottom ash is the residue which accumulates on the furnace bottom, and fly ash is the lighter material which is carried over in the flue gas stream.

c. Industrial Activities: Nuclear Powered Plants. Nuclear power plants utilize a cycle similar to that used in fossil fueled power plants except that the source of heat is atomic interactions rather than the combustion of fossil fuel. Water serves as both moderator and coolant as it passes through the nuclear reactor core. In a pressurized water reactor, the heated water then passes through a separate heat exchanger where steam is produced on the secondary side. This steam, which contains radioactive materials, drives the turbines. In a boiling water reactor, steam is generated directly in the reactor core and is then piped directly to the turbine. This arrangement produces some radioactivity in the steam and therefore requires some shielding of the turbine and condenser.

d. Significant Materials: Nuclear Powered Plants. Few if any significant materials are exposed to storm water at nuclear powered steam electric facilities. Materials that are potentially exposed do not involve steam electric generating equipment, raw materials, or waste products. The materials that are exposed to storm water are office wastes and ground maintenance equipment and tools.

2. Pollutants in Storm Water Discharges Associated With Steam Electric Power Generating Facilities

Steam electric generating facilities are subject to effluent limitations guidelines that limit the number and variety of industrial activities that are included in the storm water program. Pollutants may be present in storm water as a result of outdoor activities associated with steam electric power generating facilities such as: material handling and transport operations; waste disposal; and deposition of airborne particulate matter. In addition, sources of pollutants other than storm water, such as illicit connections,[92] spills, and other improperly dumped materials, may increase the pollutant loadings discharged into waters of the United States.

Many of the part 2 group application data submittals did not identify individual site characteristics or sources of storm water pollutants which may be responsible for pollutant loadings. In addition, because the industry has been moving toward combined fuel generating facilities, the part 2 sampling data was reviewed in the aggregate.

Table O–1 lists potential pollutant source activities and related pollutants associated with steam electric power generating facilities. The primary and largest potential source of storm water pollutants from fossil-fueled steam electric generating facilities is ash refuse piles.

TABLE O–1.—INDUSTRIAL ACTIVITIES, POLLUTANT SOURCES, AND POLLUTANTS FOR STEAM ELECTRIC POWER GENERATING FACILITIES

Activity	Pollutant source	Pollutant
Above Ground Liquid Storage Tank.	External corrosion and structural failure	Fuel, oil, heavy metals, ammonia, chlorine, sulfuric acid, sodium hydroxide, and other materials being stored.
	Installation problems	Fuel, oil, heavy metals, ammonia, chlorine, sulfuric acid, sodium hydroxide, and other materials being stored.
	Spills due to operator error	Fuel, oil, heavy metals, ammonia, chlorine, sulfuric acid, sodium hydroxide, and other materials being stored.
	Failure of piping systems	Fuel, oil, heavy metals, ammonia, chlorine, sulfuric acid, sodium hydroxide, and other materials being stored.
	Leaks or spills during pumping of liquids from barges, trucks, rail cars to a storage facility.	Fuel, oil, heavy metals, ammonia, chlorine, sulfuric acid, sodium hydroxide, and other materials being stored.
Vehicle and Equipment Maintenance.	Parts cleaning	Oil, heavy metals, chlorinated solvents, acid/alkaline wastes, ethylene glycol.
	Spills of oil, degreasers, hydraulic fluids, transmission fluid, radiator fluids.	Oil, arsenic, heavy metals, organics, chlorinated solvents, ethylene glycol.
	Fluids replacement	Oil, arsenic, heavy metals, organics, fuel.
Fueling Operations	Spills & leaks during fuel delivery	Fuel, oil, heavy metals.
	Spills caused by "topping off" fuel tanks	Fuel, oil, heavy metals.
	Leaking storage tanks	Fuel, oil, heavy metals.
	Allowing rainfall on the fuel area or storm water to run onto the fuel area.	Fuel, oil, heavy metals.
Coal Handling Areas	Fugitive dust emissions from coal handling	Suspended solids, copper, iron, aluminum, nickel, and trace metals.
	Spills during delivery	Suspended solids, copper, iron, aluminum, nickel, and trace metals.
	Offsite tracking of coal dust	Suspended solids, copper, iron, aluminum, nickel, and trace metals.
Ash Handling Areas, Ash Landfills.	Spills during transfer of ash to landfills	Suspended solids, chromium, copper, iron, zinc, oil and grease, aluminum.
	Offsite tracking of ash	Suspended solids, chromium, copper, iron, zinc, oil and grease, aluminum.
Scrapyards, Refuse Sites	Discarded material	Fuel, oils, heavy metals.

The ash composition from oil, on a weight percent basis, is much lower than that of coal. Oil ash rarely exceeds 0.3 percent of the input oil whereas coal ash comprises from 3 to 30 percent of the coal. In general, the ash content increases with increasing asphaltic constituents in which the sulfur acts largely as a bridge between aromatic rings.

The many elements which may appear in oil ash deposits include vanadium, sodium, and sulfur. Compounds containing these elements are found in almost every deposit in boilers fired by residual fuel oil and often constitute the major portion of these deposits. Oil ash, especially from plants using Venezuelan and certain Middle Eastern oil can contain significant amounts of nickel.

Some of the ash-forming constituents in the crude oil had their origin in animal and vegetable matter from which the oil was derived. The remainder is extraneous material resulting from contact of the crude oil with rock structures and salt brines or picked up during refining processes, storage, and transportation. Vanadium, iron, sodium, nickel, and calcium in fuel oil are common in rock strata, but elements including vanadium, nickel, zinc, and copper are believed to come from organic matter from which the petroleum was created.

[92] Illicit connections are contributions of unpermitted non-storm water discharges to storm sewers from any of a number of sources including sanitary sewers, industrial facilities, commercial establishments, or residential dwellings. The probability of illicit connections at steam electric facilities is low yet it still may be applicable at some operations.

The ash residue resulting from the combustion of coal is primarily derived from the inorganic matter in the coal. The chemical composition of dry bottom ash and fly ash are quite similar. The major constituents present in coal ash are silica, alumina, ferric oxide, calcium oxide, magnesium oxide, and minor amounts of sodium and potassium oxides. Other parameters which may be present include sulfur trioxide, carbon, boron, phosphorus, uranium, and thorium. The concentration differences can vary considerably from one site to another.[93]

When conducting their data analysis for their 1980 Development Document, the U.S. Environmental Protection Agency (EPA) found that there was no correlation between arsenic, nickel, zinc, copper, and selenium and total suspended solids, whenever their value was 30 mg/L or less.[94]

The quality of storm water runoff from coal handling areas is dependent on pH, as pH influences the release of toxic and heavy metals. Suspended solids levels result when storm water suspends coal particulates. Most of the total dissolved solids concentrations are a consequence of enhanced pyritic oxidation.

Storm water runoff from exposed sources of coal tends to be of an acid nature, primarily as a result of the oxidation of iron sulfide in the presence of oxygen and water.[95] The presence of certain acidophilic, chemoautotrophic bacteria, and a pH of 2.0 to 4.5 generally indicates storm water runoff high in iron, manganese, and total dissolved solids.[96]

Based on the similarities of the facilities included in this sector in terms of industrial activities and significant materials, EPA believes it is appropriate to discuss the potential pollutants at steam electric power generating facilities as a whole and not subdivide this sector. Therefore, Table O–2 lists data for selected parameters from facilities in the steam electric power generating sector. These data include the eight pollutants that all facilities were required to monitor for under Form 2F, as well as the pollutants that EPA has determined may merit further monitoring.

TABLE O–2.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY STEAM ELECTRIC GENERATING FACILITIES SUBMITTING PART II SAMPLING DATA[i] (mg/L)

Pollutant, Sample type	# of Facilities		# of Samples		Mean		Minimum		Maximum		Median		95th Percentile		99th Percentile	
	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	29	33	78	80	5.8	5.7	0.0	0.0	45.0	37.0	4.3	4.0	20.3	16.8	38.4	29.5
COD	30	33	78	79	102.5	68.7	0.0	0.0	1410.0	540.0	32.5	39.0	332.8	188.3	739.8	333.6
Nitrate + Nitrite Nitrogen	30	33	78	79	5.47	0.73	0.00	0.00	350.00	3.90	0.36	0.41	4.34	2.41	11.17	4.66
Total Kjeldahl Nitrogen	30	33	78	80	2.36	1.90	0.00	0.00	22.30	19.1	1.20	0.99	7.35	5.37	14.95	10.26
Oil & Grease	34	N/A	90	N/A	1.4	N/A	0.0	N/A	20.0	N/A	0.0	N/A	7.3	N/A	19.5	N/A
pH	30	N/A	72	N/A	N/A	N/A	3.8	N/A	9.0	N/A	7.4	N/A	8.9	N/A	9.7	N/A
Total Phosphorus	30	33	77	80	0.81	0.65	0.00	0.00	6.00	7.20	0.30	0.28	3.56	2.62	9.27	6.45
Total Suspended Solids	30	33	78	79	504	208	0	0	22790	5554	44	40	1561	967	6077	3292
Iron, Total	29	32	67	73	7.0	6.3	0.0	0.0	67.0	191.0	1.8	1.4	34.7	19.9	117.0	58.1
Zinc, Total	14	17	33	38	0.300	0.250	0.000	0.000	5.500	4.200	0.07	0.08	1.164	0.725	3.389	1.607

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.

[ii] Composite samples.

3. Pollutant Control Measures Required Under Other EPA Programs.

The Agency recognizes that other EPA programs address pollution prevention at steam electric power generating facilities. The Oil Pollution Prevention Program (40 CFR Part 112) has established procedures to prevent the discharge of oil from nontransportation related onshore and offshore facilities. This program requires owners or operators of onshore and offshore facilities to prepare a Spill Prevention Control and Countermeasure Plan (SPCC Plan) for their facility if they could reasonably be expected to discharge oil, into or upon the navigable waters of the United States or adjoining shorelines, in quantities that violate applicable water quality standards, or cause a film or sheen upon or discoloration of the surface of the water or adjoining shorelines or cause a sludge or emulsion to be deposited beneath the surface of the water or upon adjoining shorelines. Guidelines for the preparation and implementation of a Spill Prevention Control and Countermeasure Plan can be found at 40 CFR 112.7.

Under the Resource Conservation and Recovery Act (RCRA) specific requirements have been established which address generators of hazardous wastes. Regulations have been developed which address the accumulation of hazardous waste onsite prior to transport to a hazardous waste disposal facility. These regulations address proper storage of hazardous wastes, emergency planning, and training personnel in proper handling procedures for hazardous wastes.

4. Storm Water Pollution Prevention Plan Requirements

The conditions that apply to steam electric power generating facilities are based on the requirements set forth in the common permit conditions for storm water discharges from industrial activities discussed in today's fact sheet. The discussion that follows only addresses conditions that differ from those common conditions. There are no additional pollution prevention requirements beyond the common conditions for nuclear powered steam electric generating facilities.

a. Description of Pollutant Sources. Under the description of pollutant sources in the storm water pollution prevention plan requirements, permittees are required to include a site map of the facility. The areas required to be identified on the site map now also include the following: landfills,

[93] EPA. Effluent Guidelines Division. "Development Document for Effluent Limitations Guidelines and Standards for the Steam Electric Point Source Category." September 1980. (EPA 440/1–80/029–b). Page 131.

[94] EPA. Effluent Guidelines Division. "Development Document for Effluent Limitations Guidelines and Standards for the Steam Electric Point Source Category." September 1980. (EPA 440/1–80/029–b). Page 138.

[95] EPA. Effluent Guidelines Division. "Development Document for Effluent Limitations Guidelines and Standards for the Steam Electric Point Source Category." September 1980. (EPA 440/1–80/029–b). Page 138.

[96] EPA. Effluent Guidelines Division. "Development Document for Effluent Limitations Guidelines and Standards for the Steam Electric Point Source Category." September 1980. (EPA 440/1–80/029–b). Page 138.

treatment ponds, scrap yards, general refuse areas, locations of short and long term storage of general materials, and the location of stock pile areas. EPA believes this is appropriate since these areas may potentially be significant sources of pollutants to storm water. In addition, the site map must also indicate the outfall locations and the types of discharges contained in the drainage areas of the outfalls (e.g., storm water and air conditioner condensate). In order to increase the readability of the map, the inventory of the types of discharges contained in each outfall may be kept as an attachment to the site map.

b. Measures and Controls. Under the description of measures and controls in the storm water pollution prevention plan requirements, this section requires that all areas that may contribute pollutants to storm water discharges shall be maintained in a clean, orderly manner. This section also requires that the following 15 areas must be specifically addressed:

(1) Fugitive Dust Emissions. The plan must describe measures that prevent or minimize fugitive dust emissions from coal handling areas. The permittee shall consider establishing procedures to minimize offsite tracking of coal dust. To prevent offsite tracking the facility may consider specially designed tires, or washing vehicles in a designated area before they leave the site, and controlling the wash water.

(2) Delivery Vehicles. The plan must describe measures that prevent or minimize contamination of storm water runoff from delivery vehicles arriving on the plant site. At a minimum the permittee should consider the following:

(a) Develop procedures for the inspection of delivery vehicles arriving on the plant site, and ensure overall integrity of the body or container.

(b) Develop procedures to control leakage or spillage from vehicles or containers, and ensure that proper protective measures are available for personnel and environment.

(3) Fuel Oil Unloading Areas. The plan must describe measures that prevent or minimize contamination of storm water runoff from fuel oil unloading areas. At a minimum the facility operator must consider using the following measures or an equivalent:

(a) Use containment curbs in unloading areas.

(b) During deliveries station personnel familiar with spill prevention and response procedures must be present to ensure that any leaks or spills are immediately contained and cleaned up.

(c) Use spill and overflow protection (drip pans, drip diapers, and/or other containment devices shall be placed beneath fuel oil connectors to contain any spillage that may occur during deliveries or due to leaks at such connectors).

(4) Chemical Loading/Unloading Areas. The plan must describe measures that prevent or minimize the contamination of storm water runoff from chemical loading/unloading areas. At a minimum the permittee must consider using the following measures or an equivalent:

(a) Use containment curbs at chemical loading/unloading areas to contain spills.

(b) During deliveries station personnel familiar with spill prevention and response procedures must be present to ensure that any leaks or spills are immediately contained and cleaned up.

Where practicable chemical loading/unloading areas should be covered, and chemicals should be stored indoors.

(5) Miscellaneous Loading/Unloading Areas. The plan must describe measures that prevent or minimize the contamination of storm water runoff from loading and unloading areas. The facility may consider covering the loading area, minimizing storm water runon to the loading area by grading, berming, or curbing the area around the loading area to direct storm water away from the area, or locate the loading/unloading equipment and vehicles so that leaks can be controlled in existing containment and flow diversion systems.

(6) Liquid Storage Tanks. The plan must describe measures that prevent or minimize contamination of storm water runoff from above ground liquid storage tanks. At a minimum the facility operator must consider employing the following measures or an equivalent:

(a) Use protective guards around tanks.

(b) Use containment curbs.

(c) Use spill and overflow protection (drip pans, drip diapers, and/or other containment devices shall be placed beneath chemical connectors to contain any spillage that may occur during deliveries or due to leaks at such connectors).

(d) Use dry cleanup methods.

(7) Large Bulk Fuel Storage Tanks. The plan must describe measures that prevent or minimize contamination of storm water runoff from liquid storage tanks. At a minimum the facility operator must consider employing the following measures or an equivalent:

(a) Comply with applicable State and Federal laws, including Spill Prevention Control and Countermeasures (SPCC)

(b) Containment berms.

(8) The plan must describe measures to reduce the potential for an oil or chemical spill, or reference the appropriate section of their SPCC plan. At a minimum the structural integrity of all above ground tanks, pipelines, pumps and other related equipment shall be visually inspected on a weekly basis. All repairs deemed necessary based on the findings of the inspections shall be completed immediately to reduce the incidence of spills and leaks occurring from such faulty equipment.

(9) Oil Bearing Equipment in Switchyards. The plan must describe measures to reduce the potential for storm water contamination from oil bearing equipment in switchyard areas. The facility may consider level grades and gravel surfaces to retard flows and limit the spread of spills; collection of storm water runoff in perimeter ditches.

(10) Residue Hauling Vehicles. All residue hauling vehicles shall be inspected for proper covering over the load, adequate gate sealing and overall integrity of the body or container. Vehicles without load covers or adequate gate sealing, or with poor body or container conditions must be repaired as soon as practicable.

(11) Ash Loading Areas. Plant procedures shall be established to reduce and/or control the tracking of ash or residue from ash loading areas including, where practicable, requirements to clear the ash building floor and immediately adjacent roadways of spillage, debris and excess water before each loaded vehicle departs.

(12) Areas Adjacent to Disposal Ponds or Landfills. The plan must describe measures that prevent or minimize contamination of storm water runoff from areas adjacent to disposal ponds or landfills. The facility must develop procedures to:

(a) Reduce ash residue which may be tracked on to access roads traveled by residue trucks or residue handling vehicles.

(b) Reduce ash residue on exit roads leading into and out of residue handling areas.

(13) Landfills, Scrapyards, and General Refuse Sites. The plan must address landfills, scrapyards, and general refuse sites. The permittee is referred to Parts XI.L. and XI.N. of today's permit (Storm Water Discharges From Landfills and Land Application Sites and Scrap and Waste Material Processing and Recycling Facilities, respectively) for applicable Best Management Practices.

(14) Maintenance Activities. For vehicle maintenance activities

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performed on the plant site, the permittee shall consider the applicable Best Management Practices outlined in Part XI.P. of today's permit (Storm Water Discharges From Vehicle Maintenance or Equipment Cleaning Operations at Motor Freight Transportation Facilities, Passenger Transportation Facilities, Petroleum Bulk Oil Stations and Terminals, or the United States Postal Service).

(15) Material Storage Areas. The plan must describe measures that prevent or minimize contamination of storm water from material storage areas (including areas used for temporary storage of miscellaneous products and construction materials stored in lay down areas). The facility operator may consider flat yard grades, runoff collection in graded swales or ditches, erosion protection measures at steep outfall sites (e.g., concrete chutes, riprap, stilling basins), covering lay down areas, storing the materials indoors, covering the material with a temporary covering made of polyethylene, polyurethane, polypropylene, or hypalon. Storm water runon may be minimized by constructing an enclosure or building a berm around the area.

Based on information provided in part 1 of the group application process, the management practices applicable to the 15 areas listed above are commonly used at many steam electric power generating facilities. EPA believes that the incorporation of management practices to accomplish the objectives described above, in conjunction with the baseline requirements, will substantially reduce the potential for these activities and areas to significantly contribute to the pollution of storm water discharges. EPA believes that these requirements provide the necessary flexibility to address the variable risk for pollutants in storm water discharges associated with different facilities.

(c) Inspections. Under the inspection requirements of the storm water pollution prevention plan elements, this section requires that in addition to the comprehensive site evaluation required under Part VIII.C.4. of today's permit, qualified facility personnel shall be identified to inspect designated equipment and areas of the facility on a monthly basis. The following areas shall be included in the inspection: coal handling areas, fueling areas, loading/unloading areas, switchyards, bulk storage areas, ash handling areas, areas adjacent to disposal ponds and landfills, maintenance areas, liquid storage tanks and long term and short term material storage areas. A set of tracking or follow-up procedures shall be used to ensure that appropriate actions are taken in response to the inspections. Records of inspections shall be maintained onsite.

The purpose of the inspections is to check on the implementation of the storm water pollution prevention plan. The inspections allow facility personnel to monitor the success or failure of elements of the plan on a regular basis.

d. Employee Training. Steam electric power generating facilities are required to identify periodic training dates in the pollution prevention plan, but in all cases training must be held at least annually. EPA believes that such a frequency is necessary due to the many areas with a high potential for contamination of storm water.

5. Numeric Effluent Limitations

Coal pile runoff is subject to the effluent guidelines described in Part V.B of today's permit. However, steam electric generating facilities must comply with the requirement of Part V.B immediately upon permit issuance. Steam electric generating facilities are not permitted to take 3 years to meet this requirement.

6. Monitoring and Reporting Requirements

a. Analytical Monitoring Requirements. EPA believes that steam electric power generating facilities may reduce the level of pollutants in storm water runoff from their sites through the development and proper implementation of the storm water pollution prevention plan requirements discussed in today's permit. In order to provide a tool for evaluating the effectiveness of the pollution prevention plan and to characterize the discharge for potential environmental impacts, the permit requires steam electric power generating facilities to collect and analyze samples of their storm water discharges for the pollutant listed in Table O–3. The pollutant listed in Table O–3 was found to be above levels of concern for a significant portion of steam electric power generating facilities that submitted quantitative data in the group application process. Because this pollutant has been reported at or above levels of concern from steam electric power generating facilities, EPA is requiring monitoring after the pollution prevention plan has been implemented to assess the effectiveness of the pollution prevention plan and to help ensure that a reduction of pollutants is realized.

Under the Storm Water Regulations at 40 CFR 122.26(b)(14), EPA defined "storm water discharge associated with industrial activity". The focus of today's permit is to address the presence of pollutants that are associated with the industrial activities identified in this definition and that might be found in storm water discharges. Under the methodology for determining analytical monitoring requirements, described in section VI.E.1 of this fact sheet, zinc is above the bench mark concentrations for the steam electric generating facilities sector. After a review of the nature of industrial activities and the significant materials exposed to storm water described by facilities in this sector, EPA has determined that the higher concentrations of zinc are not likely to be caused by the industrial activity, but may be primarily due to non-industrial activities on-site. Today's permit does not require steam electric generating facilities to conduct analytical monitoring for this parameter.

At a minimum, storm water discharges from steam electric power generating facilities must be monitored quarterly during the second year of permit coverage. Samples must be collected at least once in each of the following periods: January through March; April through June; July through September; and October through December. At the end of the second year of permit coverage, a facility must calculate the average concentration for each parameter listed in Table O–3. If the permittee collects more than four samples in this period, then they must calculate an average concentration for each pollutant of concern for all samples analyzed.

TABLE O–3.—MONITORING REQUIREMENTS FOR STEAM ELECTRIC POWER GENERATING FACILITIES

Pollutant of concern	Cut-Off concentration
Total Recoverable Iron ...	1.0 mg/L

If the average concentration for a parameter is less than or equal to the value listed in Table O–3, then the permittee is not required to conduct quantitative analysis for that parameter during the fourth year of the permit. If, however, the average concentration for a parameter is greater than the cut-off concentration listed in Table O–3, then the permittee is required to conduct quarterly monitoring for that parameter during the fourth year of permit coverage. Monitoring is not required during the first, third, and fifth year of the permit. The exclusion from monitoring in the fourth year of the permit is conditional on the facility maintaining industrial operations and BMPs that will ensure a quality of storm water discharges consistent with the average concentrations recorded during the second year of the permit.

TABLE O–5.—Schedule of Monitoring

2nd Year of Permit Coverage	• conduct quarterly monitoring. • calculate the average concentration for all parameters analyzed during this period. • if average concentration is greater than the value listed in Table O–3, then quarterly sampling is required during the fourth year of the permit. • if average concentration is less than or equal to the value listed in Table O–3, then no further sampling is required for that parameter.
4th Year of Permit Coverage	• conduct quarterly monitoring for any parameter where the average concentration in year two of the permit is greater than the value listed in Table O–3. • if industrial activities or the pollution prevention plan have been altered such that storm water discharges may be adversely affected, quarterly monitoring is required for all parameters of concern.

In cases where the average concentration of a parameter exceeds the cut-off concentration, EPA expects permittees to place special emphasis on methods for reducing the presence of those parameters in storm water discharges. Quarterly monitoring in the fourth year of the permit will reassess the effectiveness of the adjusted pollution prevention plan.

The monitoring cut off concentrations listed in Table O–3 are not numerical effluent limitations. These values represent a level of pollutant discharge which facilities may achieve through the implementation of pollution prevention plans. At least half of the facilities which submitted Part 2 data, reported concentrations greater than or equal to the values listed in Table O–3. Facilities which achieve average discharge concentrations which are less than or equal to the values in Table O–3 are not relieved from the pollution prevention plan requirements or any other requirements of the permit.

EPA realizes that if a facility is inactive and unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly chemical sampling.

b. Alternative Certification. Throughout today's permit, EPA has included monitoring requirements for facilities which the Agency believes have the potential for contributing significant levels of pollutants to storm water discharges. The alternative described below is necessary to ensure that monitoring requirements are only imposed on those facilities which do, in fact, have storm water discharges containing pollutants at concentrations of concern. EPA has determined that if materials and activities are not exposed to storm water at the site then the potential for pollutants to contaminate storm water discharges does not warrant monitoring.

Therefore, a discharger is not subject to the monitoring requirements of this Part provided the discharger makes a certification for a given outfall, or on a pollutant-by-pollutant basis in lieu of the monitoring reports required under paragraph c. below, under penalty of law, signed in accordance with Part VII.G. (Signatory Requirements), that material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, industrial machinery or operations, significant materials from past industrial activity that are located in areas of the facility that are within the drainage area of the outfall are not presently exposed to storm water and will not be exposed to storm water for the certification period. Such certification must be retained in the storm water pollution prevention plan, and submitted to EPA in accordance with Part VI.C. of this permit. In the case of certifying that a pollutant is not present, the permittee must submit the certification along with the monitoring reports required under paragraph c. below. If the permittee cannot certify for an entire period, they must submit the date exposure was eliminated and any monitoring required up until that date. This certification option is not applicable to compliance monitoring requirements associated with effluent limitations. EPA does not expect facilities to be able to exercise this certification for indicator parameters, such as TSS and BOD.

c. Reporting Requirements. Permittees are required to submit all monitoring results obtained during the second and fourth year of permit coverage within three months of the conclusion of each year. For each outfall, one signed Discharge Monitoring Report form must be submitted to the Director per storm event sampled. For facilities conducting monitoring beyond the minimum requirements an additional Discharge Monitoring Report Form must be filed for each analysis.

d. Sample Type. All discharge data shall be reported for grab samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The required 72-hour storm event interval is waived where the preceding measurable storm event did not result in a measurable discharge from the facility. The required 72-hour storm event interval may also be waived where the permittee documents that less than a 72-hour interval is representative for local storm events during the season when sampling is being conducted. The grab sample shall be taken during the first thirty minutes of the discharge. If the collection of a grab sample during the first thirty minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first thirty minutes was impracticable.

If storm water discharges associated with industrial activity commingle with process or non-process water, then where practicable permittees must attempt to sample the storm water discharge before it mixes with the non-storm water discharge.

e. Representative Discharge. When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may test the effluent of one of such outfalls and report that the quantitative data also applies to the substantially identical outfalls provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explaining in detail why the outfalls are expected to discharge substantially identical effluent. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area (e.g., low (under 40 percent), medium (40 to 65 percent) or high (above 65 percent)) shall be provided in the plan.

f. Compliance Monitoring Requirements. Today's permit requires permittees with coal pile runoff associated with steam electric power generation to monitor for the presence of total suspended solids and pH at least annually. These monitoring requirements are necessary to evaluate compliance with the numeric effluent limitation imposed on these discharges. Monitoring shall be performed upon a minimum of one grab sample. All samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The grab sample shall be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable. Monitoring results shall be submitted on Discharge Monitoring Report Form(s) postmarked no later than the last day of the month following collection of the sample. For each outfall, one Discharge Monitoring Report from must be submitted per storm event sampled. Facilities which discharge through a large or medium municipal separate storm sewer system (systems serving a population of 100,000 or more) must also submit signed copies of discharge monitoring reports to the operator of the municipal separate storm sewer system. Alternative Certification provisions described in Section XI.O.5 do not apply to facilities subject to compliance monitoring requirements in this section. Compliance monitoring is required at least annually for discharges subject to effluent limitations. Therefore, EPA cannot permit a facility to waive compliance monitoring.

g. Quarterly Visual Examination of Storm Water Quality. Quarterly visual examinations of storm water discharges from each outfall are required at steam electric generating facilities. The examination must be of a grab sample collected from each storm water outfall. The examination of storm water grab samples shall include any observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, or other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on these samples.

The examination must be made at least once in each quarter of the permit during daylight unless there is insufficient rainfall or snow-melt to runoff. Where practicable, the same individual should carry out the collection and examination of discharges throughout the life of the permit to ensure the greatest degree of consistency possible. Grab samples shall be collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 60 minutes) of when the runoff begins discharging. Reports of the visual examination include: the examination date and time, examination personnel, visual quality of the storm water discharge, and probable sources of any observed storm water contamination. The visual examination reports must be maintained onsite with the pollution prevention plan.

EPA believes that this quick and simple assessment will allow the permittee to approximate the effectiveness of his/her plan on a regular basis at very little cost. Although the visual examination cannot assess the chemical properties of the storm water discharged from the site, the examination will provide meaningful results upon which the facility may act quickly. The frequency of this visual examination will also allow for timely adjustments to be made to the plan. If BMPs are performing ineffectively, corrective action must be implemented. A set of tracking or follow-up procedures must be used to ensure that appropriate actions are taken in response to the examinations. The visual examination is intended to be performed by members of the pollution prevention team. This hands on examination will enhance the staff's understanding of the storm water problems on that site and effects on the management practices that are included in the plan.

When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the records of the visual examinations. Adverse weather conditions which may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

EPA realizes that if a facility is inactive and unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly visual examination.

P. Storm Water Discharges Associated With Industrial Activity From Motor Freight Transportation Facilities, Passenger Transportation Facilities, Petroleum Bulk Oil Stations and Terminals, Rail Transportation Facilities, and United States Postal Service Transportation Facilities

1. Discharges Covered Under This Section

Special conditions have been developed for ground transportation facilities and rail transportation facilities that have vehicle and equipment maintenance shops (vehicle and equipment rehabilitation, mechanical repairs, painting, fueling and lubrication) and equipment cleaning operations. Vehicle and equipment maintenance is a broad term used to include the following activities: vehicle and equipment fluid changes, mechanical repairs, parts cleaning, sanding, refinishing, painting, fueling, locomotive sanding (loading sand for traction), storage of vehicles and equipment waiting for repair or maintenance, and storage of the related materials and waste materials, such as oil, fuel, batteries, tires, or oil filters. Equipment cleaning operations include areas where the following types of activities take place: vehicle exterior wash down, interior trailer washouts, tank washouts, and rinsing of transfer equipment. Any storm water discharges from facilities where such activities take place are subject to the special conditions described in Part XI.P. of today's permit.

The conditions in this section apply to storm water discharges from vehicle and equipment maintenance shops or cleaning operations located on any of the industrial facilities covered under the storm water application regulations (40 CFR 122.26) and applying for coverage under this permit.

As background, the storm water application regulations define storm water discharge associated with industrial activity at 40 CFR 122.26(b)(14). Category (viii) of this definition includes transportation facilities classified as Standard Industrial Classification (SIC) codes 40, 41, 42 (except 4221–25), 43, 44, 45, and 5171 that have vehicle and equipment maintenance shops, equipment cleaning operations, or airport deicing operations. The category further states that only those portions of the facility that are either involved in vehicle and equipment maintenance (including vehicle and equipment rehabilitation, mechanical repairs, painting, fueling, and lubrication), equipment cleaning operations, or airport deicing operations are associated with industrial activity. The facilities that would potentially be covered by this section of today's permit are transportation facilities (commonly assigned SIC codes 40, 41, 42, 43, and 5171).

This sector includes facilities primarily engaged in furnishing transportation by line-haul railroad, and switching and terminal establishments (SIC code 40). The following are examples of these types of facilities: electric railroad line-haul operation, railroad line-haul operation, interurban railways, beltline railroads, logging railroads, railroad terminals, and stations operated by railroad terminal companies.

Facilities primarily engaged in furnishing local and suburban transportation (SIC code 41), such as those providing transportation in and around a municipality by bus, rail, or subway are also covered under this section. Examples include: bus line operation, airport transportation service (road or rail), cable car operation, subway operation, ambulance service, sightseeing buses, van pool operation, limousine rental with drivers, taxicab operation, and school buses not operated by the educational institution.

In addition, facilities providing local or long-distance trucking, transfer, and/or storage services (SIC code 42) are included in this sector. The following are examples of such facilities: hauling by dump truck, trucking timber, contract mail carriers, furniture moving, garbage collection without disposal, over-the-road trucking, long distance trucking, and freight trucking terminal.

All establishments of the United States Postal Service (SIC code 43) and establishments engaged in the wholesale distribution of crude petroleum and petroleum products from bulk liquid storage facilities (SIC code 5171) are also covered under this sector.

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

2. Pollutants Found in Storm Water Discharges From Vehicle and Equipment Maintenance and Cleaning Operations

The following table lists potential pollutant source activities that commonly take place at vehicle and equipment maintenance and equipment cleaning operations.

TABLE P–1.—POTENTIAL POLLUTANT SOURCE ACTIVITIES AT VEHICLE AND EQUIPMENT MAINTENANCE AND EQUIPMENT CLEANING OPERATIONS

Activity	Pollutant source	Pollutant
Fueling	Spills and leaks during fuel delivery	Fuel, oil, heavy metals.
	Spills caused by "topping off" fuel tanks	Fuel, oil, heavy metals.
	Rainfall falling on the fuel area or storm water running onto the fuel area.	Fuel, oil, heavy metals.
	Hosing or washing down fuel area	Fuel, oil, heavy metals.
	Leaking storage tanks	Fuel, oil, heavy metals.
Vehicle and equipment maintenance.	Parts cleaning	Chlorinated solvents, oil, heavy metals, acid/alkaline wastes.
	Waste disposal of greasy rags, oil filters, air filters, batteries, hydraulic fluids, transmission fluid, radiator fluids, degreasers.	Oil, heavy metals, chlorinated solvents, acid/alkaline wastes, ethylene glycol.
	Spills of oil, degreasers, hydraulic fluids, transmission fluid, radiator fluids.	Oil, arsenic, heavy metals, organics, chlorinated solvents, ethylene glycol.
	Fluids replacement, including oil, hydraulic fluids, transmission fluid, radiator fluids.	Oil, arsenic, heavy metals, organics, chlorinated solvents, ethylene glycol.
Outdoor vehicle and equipment storage and parking.	Leaking vehicle fluids including hydraulic lines and radiators, leaking or improperly maintained locomotive on-board drip collection systems, brake dust..	Oil, hydraulic fluids, arsenic, heavy metals, organics, fuel.
Painting areas	Paint and paint thinner spills	Paint, spent chlorinated solvents, heavy metals.
	Spray painting	Paint solids, heavy metals.
	Sanding or paint stripping	Dust, paint solids, heavy metals.
	Paint clean-up	Paint, spent chlorinated solvents, heavy metals.
Railroad locomotive sanding	Loading traction sand on locomotives	Sediment.
Vehicle or equipment washing areas.	Washing or steam cleaning	Oil, detergents, heavy metals, chlorinated solvents, phosphorus, salts, suspended solids.
Liquid storage in above ground storage.	External corrosion and structural failure	Fuel, oil, heavy metals, materials being stored.
	Installation problems	Fuel, oil, heavy metals, materials being stored.
	Spills and overfills due to operator error	Fuel, oil, heavy metals, materials being stored.
	Failure of piping systems (pipes, pumps, flanges, couplings, hoses, and valves).	Fuel, oil, heavy metals, materials being stored

TABLE P–1.—POTENTIAL POLLUTANT SOURCE ACTIVITIES AT VEHICLE AND EQUIPMENT MAINTENANCE AND EQUIPMENT CLEANING OPERATIONS—Continued

Activity	Pollutant source	Pollutant
	Leaks or spills during pumping of liquids from barges, trucks, or rail cars to a storage facility.	Fuel, oil, heavy metals, materials being stored.
Cold weather activities	Salt application	Sodium chloride.
	Dirt/ash application	Suspended solids, heavy metals
Improper connections to storm sewer.	Process wastewater	Dependent on operations.
	Sanitary water	Bacteria, biochemical oxygen demand (BOD), suspended solids.
	Floor drains	Oil, heavy metals, chlorinated solvents, fuel, ethylene glycol.
	Vehicle washwaters	Oil, detergents, metals, chlorinated solvents, phosphorus, suspended solids.
	Radiator flushing wastewater	Ethylene glycol.
	Leaky underground storage tanks	Materials stored or previously stored.

Sources: EPA, Office of Research and Development. October 1991. "Guides to Pollution Prevention—The Automotive Refinishing Industry." EPA/625/7–91/016.
EPA, Office of Research and Development. October 1991. "Guides to Pollution Prevention—The Automotive Repair Industry." EPA/625/7–91/013.
EPA, Office of Research and Development. May 1992. "Facility Pollution Prevention Guide." EPA/600/R–92/088.
EPA, Office of Water. September 1992. "Storm Water Management for Industrial Activities—Developing Pollution Prevention Plans and Best Management Practices." EPA 832–R–92–006.
U.S. Postal Service. May 1992. "NPDES/Storm Water Guide." AS–554.

Based on the wide variety of industrial activities and significant materials at the facilities included in this sector, EPA believes it is appropriate to divide the land transportation industry into subsectors to properly analyze sampling data and determine monitoring requirements. As a result, this sector has been divided into the following subsectors: railroad transportation; local and highway passenger transportation; motor freight transportation and warehousing; United States Postal Service; and petroleum bulk stations and terminals. The tables below include data for the eight pollutants that all facilities were required to monitor for under Form 2F. The tables also list those parameters that EPA has determined may merit further monitoring.

TABLE P–2.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY RAILROAD TRANSPORTATION FACILITIES SUBMITTING PART II SAMPLING DATA[i] (mg/L)

Pollutant, Sample	# of Facilities		# of Samples		Mean		Minimum		Maximum		Median		95th Percentile		99th Percentile	
	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	100	89	141	126	17.3	9.6	0.0	0.0	310.0	155.0	7.0	6.0	51.8	26.8	102.8	44.8
COD	102	89	143	124	320.0	179.8	0.0	0.0	11800	5470.0	145.0	89.0	879.3	475.3	1848.1	927.8
Nitrate + Nitrite Nitrogen	103	89	144	124	1.57	1.32	0.00	0.00	19.50	19.00	0.92	0.78	5.66	3.68	12.01	6.76
Total Kjeldahl Nitrogen	103	89	144	124	4.35	3.00	0.00	0.00	72.00	58.00	1.90	1.50	13.63	8.79	29.13	17.39
Oil & Grease	104	N/A	144	N/A	33.7	N/A	0.0	N/A	3340.0	N/A	0.0	N/A	46.92	N/A	140.26	N/A
pH	95	N/A	133	N/A	N/A	N/A	3.6	N/A	10.2	N/A	7.3	N/A	9.2	N/A	10.2	N/A
Total Phosphorus	103	89	144	124	2.85	1.02	0.00	0.00	180.00	23.00	0.55	0.44	7.05	3.51	19.63	8.19
Total Suspended Solids	103	89	144	124	474	221	0	0	4680	2620	176	77	2717	1000	9367	2853
Lead, Total	3	4	4	6	0.088	0.048	0.042	0.012	0.130	0.070	0.09	0.06	0.208	0.151	0.313	0.268
Zinc, Total	3	4	3	5	0.487	0.337	0.140	0.160	0.920	0.510	0.40	0.28	1.756	0.704	3.341	0.995

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.
[ii] Composite samples.

TABLE P–3.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY LOCAL AND HIGHWAY PASSENGER TRANSPORTATION FACILITIES SUBMITTING PART II SAMPLING DATA[i] (mg/L)

Pollutant, Sample	# of Facilities		# of Samples		Mean		Minimum		Maximum		Median		95th Percentile		99th Percentile	
	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	46	45	50	50	15.9	12.3	0.0	0.0	235.3	104.8	8.5	6.3	46.4	41.3	91.6	85.4
COD	47	45	51	50	51.4	39.2	0.0	0.0	376.0	216.0	18.5	18.4	186.2	123.8	411.4	228.8
Nitrate + Nitrite Nitrogen	46	43	50	48	14.39	7.66	0.00	0.10	181.40	104.00	1.79	1.30	66.44	28.71	265.35	96.75
Total Kjeldahl Nitrogen	45	44	49	49	4.22	2.37	0.00	0.00	81.26	15.74	1.82	1.20	11.84	8.23	24.12	16.53
Oil & Grease	53	N/A	59	N/A	47.1	N/A	0.0	N/A	771.0	N/A	6.0	N/A	183.0	N/A	621.6	N/A
pH	52	N/A	58	N/A	N/A	N/A	4.7	N/A	9.4	N/A	7.0	N/A	8.8	N/A	9.7	N/A
Total Phosphorus	47	45	52	50	0.92	0.65	0.00	0.00	7.50	7.00	0.33	0.33	3.40	2.32	8.20	5.12
Total Suspended Solids	46	46	50	51	246	134	0	0	2320	802	70	41	1319	725	4590	2397

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.
[ii] Composite samples.

TABLE P–4.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY MOTOR FREIGHT TRANSPORTATION AND WAREHOUSING FACILITIES SUBMITTING PART II SAMPLING DATA[i] (mg/L)

Pollutant, Sample	# of Facilities		# of Samples		Mean		Minimum		Maximum		Median		95th Percentile		99th Percentile	
	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	183	159	237	212	16.5	9.1	0.0	0.0	510.0	66.0	7.0	5.5	48.9	27.4	100.2	49.6
COD	185	158	242	210	146.1	82.0	0.0	0.0	1800.0	600.0	79.0	50.5	475.6	253.8	968.6	479.8
Nitrate + Nitrite Nitrogen	179	159	234	210	1.47	1.30	0.00	0.00	90.80	60.50	0.61	0.49	3.86	3.63	8.21	8.16
Total Kjeldahl Nitrogen	185	159	242	211	2.25	1.46	0.00	0.00	24.00	15.00	1.40	1.10	6.73	4.23	12.70	7.39
Oil & Grease	188	N/A	245	N/A	14.0	N/A	0.0	N/A	1340.0	N/A	2.8	N/A	37.8	N/A	95.1	N/A
pH	161	N/A	215	N/A	N/A	N/A	2.6	N/A	9.5	N/A	7.3	N/A	9.6	N/A	11	N/A
Total Phosphorus	184	157	238	208	1.09	0.61	0.00	0.00	37.40	6.80	0.32	0.29	3.64	2.16	9.30	4.72
Total Suspended Solids	185	158	242	210	466	360	0	0	4700	20900	159	90	2638	1448	9012	4815
Zinc, Total	7	5	7	5	0.294	0.159	0.031	0.020	1.100	0.370	0.17	0.08	1.111	0.680	2.434	1.496

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.
[ii] Composite samples.

TABLE P–5.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY UNITED STATES POSTAL SERVICE FACILITIES SUBMITTING PART II SAMPLING DATA[i] (mg/L)

Pollutant, Sample	# of Facilities		# of Samples		Mean		Minimum		Maximum		Median		95th Percentile		99th Percentile	
	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	16	16	22	22	8.1	9.2	0.0	0.0	25.0	62.0	5.5	4.8	22.6	25.2	38.0	44.5
COD	16	16	22	22	51.4	33.8	5.6	0.0	350.0	190.0	26.5	19.5	148.2	95.5	291.5	167.6
Nitrate + Nitrite Nitrogen	16	16	22	22	0.52	0.75	0.11	0.07	1.30	1.80	0.40	0.61	1.47	2.51	2.57	4.81
Total Kjeldahl Nitrogen	16	16	22	22	1.80	1.91	0.00	0.00	11.00	11.00	1.05	0.97	5.01	6.08	8.98	12.22
Oil & Grease	16	N/A	22	N/A	5.4	N/A	0.0	N/A	21.0	N/A	4.4	N/A	16.0	N/A	27.3	N/A
pH	16	N/A	22	N/A	N/A	N/A	0.1	N/A	8.4	N/A	6.7	N/A		N/A		N/A
Total Phosphorus	16	16	22	22	0.46	0.47	0.00	0.00	2.50	3.40	0.28	0.20	1.41	1.79	2.77	4.48
Total Suspended Solids	15	16	21	22	16	13	0	0	77	86	4	1	88	77	210	254
Zinc, Total	14	15	18	18	0.228	0.175	0.000	0.000	1.400	0.660	0.11	0.11	1.870	1.069	6.335	2.896

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.
[ii] Composite samples.

TABLE P–6.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY PETROLEUM BULK STATIONS AND TERMINALS SUBMITTING PART II SAMPLING DATA[i] (mg/L)

Pollutant, Sample	# of Facilities		# of Samples		Mean		Minimum		Maximum		Median		95th Percentile		99th Percentile	
	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	11	10	11	10	27.7	10.2	1.3	0.0	120.0	31.0	8.0	9.0	111.5	26.0	303.4	40.6
COD	11	10	11	10	118.3	75.9	15.0	9.3	390.0	200.0	94.0	60.5	432.7	232.4	900.6	412.4
Nitrate + Nitrite Nitrogen	11	10	11	10	1.07	0.74	0.00	0.00	5.10	2.90	0.35	0.39	4.83	3.20	13.44	7.51
Total Kjeldahl Nitrogen	10	9	10	9	2.80	2.02	0.00	0.00	5.80	4.60	2.80	2.00	7.14	4.39	11.47	6.11
Oil & Grease	11	N/A	11	N/A	8.8	N/A	0.0	N/A	28.0	N/A	5.4	N/A	38.7	N/A	78.5	N/A
pH	10	N/A	10	N/A	N/A	N/A	6.0	N/A	9.3	N/A	7.8	N/A	9.6	N/A	10.5	N/A
Total Phosphorus	11	10	11	10	0.81	0.45	0.00	0.04	4.60	2.0	0.12	0.27	1.90	1.71	4.82	3.92
Total Suspended Solids	11	10	11	10	253	151	6	0	1090	560	106	93	1612	633	5567	1387

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.
[ii] Composite samples.

3. Options for Controlling Pollutants

The measures commonly implemented to reduce pollutants in storm water associated with vehicle and equipment maintenance and equipment cleaning operations are generally uncomplicated practices. The following table identifies best management practices (BMPs) associated with different activities that routinely take place at vehicle and equipment maintenance and equipment cleaning operations.

TABLE P–7.—COMMON STORM WATER MANAGEMENT CONTROLS FOR ACTIVITIES AT VEHICLE AND EQUIPMENT MAINTENANCE SHOPS

Activity	BMPs
Fueling	Use spill and overflow protection. Minimize runon of storm water into the fueling area by grading the area such that storm water only runs off. Reduce exposure of the fuel area to storm water by covering the area. Use dry cleanup methods for fuel area rather than hosing the fuel area down. Use proper petroleum spill control. Perform preventive maintenance on storage tanks to detect potential leaks before they occur. Inspect the fueling area to detect problems before they occur. Train employees on proper fueling techniques.
Vehicle and equipment maintenance	Maintain an organized inventory of materials used in the maintenance shop. Dispose of greasy rags, oil filters, air filters, batteries, spent coolant, and degreasers properly. Label and track the recycling of waste material (e.g., used oil, spent solvents, batteries).

TABLE P–7.—COMMON STORM WATER MANAGEMENT CONTROLS FOR ACTIVITIES AT VEHICLE AND EQUIPMENT MAINTENANCE SHOPS—Continued

Activity	BMPs
	Drain oil filters before disposal or recycling. Drain and contain all fluids from wrecked vehicles and "parts" cars. Store cracked batteries in a nonleaking secondary container. Promptly transfer used fluids to the proper container; do not leave full drip pans or other open containers around the shop. Empty and clean drip pans and containers. Do not pour liquid waste down floor drains, sinks, or outdoor storm drain inlets. Plug floor drains that are connected to the storm or sanitary sewer; if necessary, install a sump that is pumped regularly. Inspect the maintenance area regularly for proper implementation of control measures. Train employees on proper waste control and disposal procedures.
Outdoor vehicle and equipment storage and parking.	Use drip pans under all vehicles and equipment waiting for maintenance. Cover the storage area with a roof. Inspect the storage yard for filling drip pans and other problems regularly. Train employees on procedures for storage and inspection items.
Locomotive sanding areas	Cover sand storage piles. Install sediment traps. Install curbs or dikes around storage piles to minimize storm water runon.
Painting areas	Keep paint and paint thinner away from traffic areas to avoid spills. Spray paint in an Occupational Safety and Health Act (OSHA) approved hood. Use effective spray equipment that delivers more paint to the target and less over-spray. Avoid sanding in windy weather and collect and dispose of waste properly. Recycle paint, paint thinner, and solvents. Inspect painting procedures to ensure that they are conducted properly. Train employees on proper sanding, painting, and spraying techniques.
Vehicle or equipment washing areas	Avoid washing parts or equipment outside. Use phosphate-free biodegradable detergents. Designate an area for cleaning activities. Contain and recycle washwaters. Ensure that washwaters drain well. Inspect cleaning area regularly. Train employees on proper washing procedures.
Liquid storage in above ground storage	Maintain good integrity of all storage containers. Install safeguards (such as diking or berming) against accidental releases at the storage area. Inspect storage tanks to detect potential leaks and perform preventive maintenance. Inspect piping systems (pipes, pumps, flanges, couplings, hoses, and valves) for failures or leaks. Train employees on proper filling and transfer procedures.
Cold weather activities	Minimize salt application. Use uncontaminated dirt or ash, if use is necessary. Train employees on proper salt, dirt, sand, or ash application
Improper connections to storm sewer	Plug all floor drains connected to sanitary or storm sewer or if connection is unknown. Alternatively, install a sump that is pumped regularly. Perform smoke or dye testing to determine if interconnections exist between sanitary water system and storm sewer system. Update facility schematics to accurately reflect all plumbing connections. Install a safeguard against vehicle washwaters entering the storm sewer unless permitted. Maintain and inspect the integrity of all underground storage tanks; replace when necessary. Train employees on proper disposal practices for all materials.

Sources: NPDES Storm Water Group Applications—Part 1. Received by EPA March 18, 1991, through December 31, 1992.
EPA, Office of Research and Development. October 1991. "Guides to Pollution Prevention—The Automotive Refinishing Industry." EPA/625/7–91/016.
EPA, Office of Research and Development. October 1991. "Guides to Pollution Prevention—The Automotive Repair Industry." EPA/625/7–91/013.
EPA, Office of Research and Development. May 1992. "Facility Pollution Prevention Guide." EPA/600/R–92/088.
EPA, Office of Water. September 1992. "Storm Water Management for Industrial Activities—Developing Pollution Prevention Plans and Best Management Practices." EPA 832–R–92–006.
U.S. Postal Service. May 1992. "NPDES/Storm Water Guide." AS–554.

4. Pollutant Control Measures Required Through Other EPA Programs

EPA recognizes that other programs address the operation of vehicle and equipment maintenance and equipment cleaning operations. In particular, as described below, the Resource Conservation and Recovery Act (RCRA) and the Underground Storage Tank (UST) programs require careful management of materials used onsite which decreases the probability that storm water from such areas will be contaminated by these materials.

Under the RCRA program, on September 10, 1992, EPA promulgated standards in 40 CFR Part 279 for the management of used oils that are recycled (57 FR 41566). These standards include requirements for used oil generators, transporters, processors/re-refiners, and burners. The standards for used oil generators apply to all generators, regardless of the amount of used oil they generate. Do-it-yourself (DIY) generators which generate used oil from the maintenance of their personal vehicles, however, are not subject to the management standards (Section 279.20(a)(1)).

The requirements for used oil generators were designed to impose a minimal burden on generators while protecting human health and the environment from the risks associated with managing used oil. Under Subpart C of 40 CFR Part 279, used oil generators must not store used oil in units other than tanks, containers, or units subject to regulation under Part 264 or 265 of 40 CFR (Section 279.22(a)). In other words, generators may store used oil in tanks or containers that are not subject to Subpart J (Hazardous Waste Tanks) or Subpart I (Containers) of Parts 264/265, as long as such tanks or containers are maintained in compliance with the used oil management standards. This does not preclude generators from storing used oil in Subpart J tanks or Subpart I containers or other units, such as surface impoundments (Subpart K), that are subject to regulation under Part 264 or 265.

Storage units at generator facilities must be maintained in good condition and labeled with the words "used oil." Upon detection of a release of used oil to the environment, a generator must take steps to stop the release, contain the released used oil, and properly manage the released used oil and other materials (Sections 279.22(b) to (d)). Generators storing used oil in underground storage tanks are subject to the UST regulations in 40 CFR Part 280.

If used oil generators ship used oil offsite for recycling, they must use a transporter who has notified EPA and obtained an EPA identification number (Section 279.24).

The technical standards for USTs at 40 CFR Part 280 require that new UST systems (defined as systems for which installation commenced after December 12, 1988) use overfill prevention equipment that will: 1) automatically shut off flow into the tank when the tank is no more than 95 percent full; or 2) alert the transfer operator when the tank is no more than 90 percent full by restricting the flow into the tank or triggering a high level alarm. The preceding requirements do not apply to systems that are filled by transfers of no more than 25 gallons at one time. Existing UST systems (defined as systems for which installation has commenced on or before December 12, 1988) are required to have installed the described overfill prevention equipment by December 12, 1998.

5. Special Conditions

The permit conditions that apply to ground transportation facilities build upon the requirements set forth in the common permit conditions for storm water discharges from industrial activities described in the front of this fact sheet. The discussion that follows, therefore, only addresses conditions that differ from those required in that section.

Due to concern that many non-storm water discharges may be present at vehicle and equipment cleaning and maintenance facilities, EPA is requiring that all facilities provide proof that these discharges are not commingled and are appropriately controlled so as to protect all receiving waters.

Today's permit clarifies in Part III.A.2. (Prohibition of Non-storm Water Discharges) that non-storm water discharges, including vehicle and equipment washwaters, are not authorized by this permit. The operators of such non-storm water discharges must obtain coverage under a separate NPDES permit if discharged to waters of the U.S. or through a municipal separate storm sewer system or comply with applicable industrial pretreatment requirements if discharged to a municipal sanitary sewer system. In a related requirement under the storm water pollution prevention plan requirements, the permittee is required to attach a copy of the NPDES permit issued for vehicle washwaters or, if an NPDES permit has not yet been issued, a copy of pending application to the plan. For facilities that discharge vehicle and equipment washwaters to the sanitary sewer system, the operator of the sanitary system and associated treatment plant must be notified. A copy of the notification letter must be attached to the plan. If an industrial user permit is issued under a pretreatment program, a copy of that permit must be attached in the plan as does any other permit to which the facility is subject. Some facilities may use other methods of disposal, such as collecting and hauling the wash water offsite. In these cases, the facility must document how the wash water is disposed and attach all pertinent documentation of that disposal practice to the plan.

6. Storm Water Pollution Prevention Plan Requirements

a. Description of Potential Pollutant Sources. Under the description of potential pollutant sources in the storm water pollution prevention plan requirements, permittees are required to include storage areas for vehicles and equipment awaiting maintenance on their facility site map. EPA believes that this is appropriate since this area may potentially be a significant source of pollutants to storm water.

b. Measures and Controls. Under the description of measures and controls in the storm water pollution prevention plan requirements, this section requires that all areas that may contribute pollutants to storm waters discharges shall be maintained in a clean, orderly manner. This section also requires that the following areas must be specifically addressed:

(1) Vehicle and Equipment Storage Areas. The storage of vehicles and equipment with actual or potential fluid leaks must be confined to designated areas (delineated on the site map). The plan must describe measures that prevent or minimize contamination of the storm water runoff from these areas. The facility shall consider the use of drip pans under vehicles and equipment, indoor storage of the vehicles and equipment, installation of berming and diking of this area, use of absorbents, roofing or covering storage areas, cleaning pavement surface to remove oil and grease, or other equivalent methods.

(2) Fueling Areas. The plan must describe measures that prevent or minimize contamination of the storm water runoff from fueling areas. The facility shall consider covering the fueling area, using spill and overflow protection and cleanup equipment, minimizing runon of storm water to the fueling area, using dry cleanup methods, collecting the storm water runoff and providing treatment or recycling, or other equivalent measures.

(3) Material Storage Areas. Storage units of all materials (e.g., used oil, used oil filters, spent solvents, paint wastes, radiator fluids, transmission fluids, hydraulic fluids) must be maintained in good condition, so as to prevent contamination of storm water, and plainly labeled (e.g., "used oil," "spent solvents," etc.). The plan must describe measures that prevent or minimize contamination of the storm water runoff from such storage areas. The facility shall consider indoor storage of the materials, installation of berming and diking of the area or other equivalent methods.

(4) Vehicle and Equipment Cleaning Areas. The plan must describe measures that prevent or minimize contamination of the storm water runoff from all areas used for vehicle and equipment cleaning. The facility shall consider performing all cleaning operations indoors, covering the cleaning operation, ensuring that all washwaters drain to the intended collection system (i.e., not the storm water drainage system unless NPDES permitted), collecting the storm water runoff from the cleaning area and providing treatment or recycling, or other equivalent measures. The discharge of vehicle and equipment wash waters, including tank cleaning operations, are

not authorized by this section and must be covered under a separate NPDES permit or discharged to a sanitary sewer in accordance with applicable industrial pretreatment requirements.

(5) Vehicle and Equipment Maintenance Areas. The plan must describe measures that prevent or minimize contamination of the storm water runoff from all areas used for vehicle and equipment maintenance. The facility shall consider performing all maintenance activities indoors, using drip pans, maintaining an organized inventory of materials used in the shop, draining all parts of fluids prior to disposal, prohibiting the practice of hosing down the shop floor where the practice would result in the exposure of pollutants to storm water, using dry cleanup methods, collecting the storm water runoff from the maintenance area and providing treatment or recycling, or other equivalent measures.

(6) Locomotive Sanding (Loading Sand for Traction) Areas. The plan must describe measures that prevent or minimize contamination of the storm water runoff from areas used for locomotive sanding (including locomotive sanding). The facility shall consider covering sanding areas, minimizing storm water runon/runoff, appropriate sediment removal practices to minimize the offsite transport of sanding material by storm water, or other equivalent measures.

As documented earlier, these six areas are the common sources of pollutants in storm water from vehicle and equipment cleaning and maintenance activities. Based upon the information provided in part 1 of the group application process, the suggested management measures are commonly used at ground transportation facilities. EPA believes that the incorporation of management practices such as those suggested, in conjunction with the baseline requirements, will substantially reduce the potential that these activities and areas will significantly contribute to the pollution of storm water discharges. In addition, EPA believes that these requirements continue to provide the necessary flexibility to address the variable risk for pollutants in storm water discharges associated with different facilities. Further, many facilities will find that management measures that they have already incorporated into the facility's operation, such as the installation of overfill protection equipment and labelling and maintenance of used oil storage units, that are already required under existing EPA programs will meet the requirements of this section.

Under the inspection requirements of the storm water pollution prevention plan elements, this section requires that in addition to the comprehensive site evaluation required under Part XI of today's permit, qualified facility personnel shall be identified to inspect designated equipment and areas of the facility, at a minimum, on a quarterly basis. The following areas shall be included in all inspections: storage areas for vehicles and equipment awaiting maintenance, fueling areas, vehicle and equipment maintenance areas (both indoors and outdoors), material storage areas, vehicle and equipment cleaning areas, and loading and unloading areas. A set of tracking or follow-up procedures shall be used to ensure that appropriate actions are taken in response to the inspections. Records of all inspections shall be maintained.

The purpose of the inspections is to check on the implementation of the storm water pollution prevention plan. The inspections allow facility personnel to monitor the success or failure of elements of the plan on a regular basis. The discharger is encouraged to coordinate these quarterly inspections with the quarterly visual examinations of storm water discharges required under the monitoring section of the permit. The use of an inspection checklist is recommended. The checklist will ensure that all required areas are inspected, as well as help to meet the recordkeeping requirements.

Under the employee training component of the storm water pollution prevention plan requirements, the permittee is required to identify annual (once per year) dates for such training. Employee training must, at a minimum, address the following areas when applicable to a facility: used oil management; spent solvent management; spill prevention and control; fueling procedures; general good housekeeping practices; proper painting procedures; and used battery management. Unlike some industrial operations, the industrial activities associated with vehicle and equipment maintenance that may affect storm water quality require the cooperation of many employees, not just one or two people. EPA, therefore, is requiring that employee training take place at least once a year to serve as: (1) training for new employees that may be involved in storm water pollution prevention; (2) a refresher course for existing employees involved in storm water pollution prevention; and (3) training for all affected employees on any storm water pollution prevention techniques recently incorporated into the plan.

7. Monitoring and Reporting Requirements

a. Monitoring Requirements. The regulatory modifications at 40 CFR 122.44(i)(2) established on April 2, 1992, grant permit writers the flexibility to reduce monitoring requirements in storm water discharge permits. EPA has determined that the potential for storm water discharges to contain pollutants above benchmark levels, because of the industrial activities and materials exposed to precipitation, does not support sampling at facilities in this section of today's permit. Based on a consideration of the BMPs typically used at these facilities, and generally low pollutant values from the application data, EPA believes that the pollution prevention plan with visual observations of storm water discharges will help to ensure storm water contamination is minimized. Because permittees are not required to conduct sampling, they will be able to focus their resources on developing and implementing the pollution prevention plan.

Under the Storm Water Regulations at 40 CFR 122.26(b)(14), EPA defined "storm water discharge associated with industrial activity". The focus of today's permit is to address the presence of pollutants that are associated with the industrial activities identified in this definition and that might be found in storm water discharges. Under the methodology for determining analytical monitoring requirements, described in section VI.E.1 of this fact sheet, nitrate plus nitrite nitrogen, lead and/or zinc are above the bench mark concentrations for the railroad transportation, local and highway passenger transportation, motor freight transportation and warehousing, and United States Postal services subsectors. After a review of the nature of industrial activities and the significant materials exposed to storm water described by facilities in these subsectors, EPA has determined that the higher concentrations of nitrate plus nitrite nitrogen, lead and/or zinc are not likely to be caused by the industrial activity, but may be primarily due to non-industrial activities on-site. Today's permit does not require railroad transportation, local and highway passenger transportation, motor freight transportation and warehousing, and United States Postal services facilities to conduct analytical monitoring for these parameters.

Quarterly visual examinations of a storm water discharge from each outfall are required at ground transportation facilities. The examination must be of a grab sample collected from each storm water outfall. The examination of storm water grab samples shall include any observations of color, odor, turbidity, floating solids, foam, oil sheen, or other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on these samples.

The examination must be made at least once in each designated period during facility operation in the daylight hours unless there is insufficient rainfall or snow-melt to runoff. EPA expects that, whenever practicable, the same individual should carry out the collection and examination of discharges throughout the life of the permit to ensure the greatest degree of consistency possible. Examinations shall be conducted in each of the following periods for the purposes of inspecting storm water quality associated with storm water runoff and snow melt: January through March; April through June; July through September; October through December. Grab samples shall be collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 60 minutes) of when the runoff begins discharging. Reports of the visual examination include: the examination date and time, examination personnel, visual quality of the storm water discharge, and probable sources of any observed storm water contamination. The visual examination reports must be maintained onsite with the pollution prevention plan.

EPA believes that this quick and simple assessment will help the permittee to determine the effectiveness of his/her plan on a regular basis at very little cost. Although the visual examination cannot assess the chemical properties of the storm water discharged from the site, the examination will provide meaningful results upon which the facility may act quickly. The frequency of this visual examination will also allow for timely adjustments to be made to the plan. If BMPs are performing ineffectively, corrective action must be implemented. A set of tracking or follow-up procedures must be used to ensure that appropriate actions are taken in response to the examinations. The visual examination is intended to be performed by members of the pollution prevention team. This hands-on examination will enhance the staff's understanding of the storm water problems on that site and the effects of the management practices that are included in the plan.

When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the results of the visual examinations. Adverse weather conditions which may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

EPA realizes that if a facility is inactive and unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly visual examination.

As discussed above, EPA does not believe that chemical monitoring is necessary for facilities in this section of today's permit. EPA believes that between quarterly inspections, quarterly visual examinations, and site compliance evaluations potential sources of contaminants can be recognized, addressed, and then controlled with BMPs. In determining the monitoring requirements, EPA considered the nature of the industrial activities and significant materials exposed at these sites, and performed a review of data provided in Part 2 group applications.

Q. Storm Water Discharges Associated With Industrial Activity From Water Transportation Facilities That Have Vehicle Maintenance Shops and/or Equipment Cleaning Operations

1. Discharges Covered Under This Section

Special conditions have been developed for water transportation facilities that have vehicle and equipment maintenance shops (vehicle and equipment rehabilitation, mechanical repairs, painting, fueling, and lubrication) and equipment cleaning operations. Vehicle and equipment maintenance is a broad term used to include the following activities: vessel and equipment fluid changes, mechanical repairs, parts cleaning, sanding, blasting, welding, refinishing, painting, fueling, and storage of the related materials and waste materials, such as oil, fuel, batteries, or oil filters. Equipment cleaning operations include areas where vessel and vehicle exterior washdown takes place. The conditions in this section apply to storm water discharges from vehicle and equipment maintenance shops or cleaning operations located at water transportation facilities covered under the storm water application regulations (40 CFR 122.26) and applying for coverage under today's permit.

The storm water application regulations define storm water discharges associated with industrial activity at 40 CFR 122.26(b)(14). Category (viii) of this definition includes transportation facilities classified as Standard Industrial Classification (SIC) codes 40, 41, 42 (except 4221–25), 43, 44, 45, and 5171 that have vehicle and equipment maintenance shops, equipment cleaning operations, or airport deicing operations. The category further states that only those portions of the facility that are either involved in vehicle and equipment maintenance (including vehicle and equipment rehabilitation, mechanical repairs, painting, fueling, and lubrication), equipment cleaning operations, or airport deicing operations are associated with industrial activity. The conditions in this section only apply to water transportation facilities.

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

Facilities covered by this section of today's permit are commonly identified by SIC code major group 44.

SIC code 44 includes facilities primarily engaged in furnishing water transportation services. The following types of facilities are examples of those covered under SIC code 44:

a. Deep Sea Foreign Transportation of Freight (SIC 4412).

b. Deep Sea Domestic Transportation of Freight (SIC 4424).

c. Freight Transportation on the Great Lakes—St. Lawrence Seaway (SIC 4432).

d. Water Transportation of Freight, Not Elsewhere Classified (SIC 4449). Including: canal barge operations; canal freight transportation; intracoastal freight transportation lake freight transportation, except on the Great Lakes; log rafting and towing; river freight transportation, except on the St. Lawrence Seaway; and transportation of freight on bays and sounds of the oceans.

e. Deep Sea Transportation of Passengers, Except by Ferry (SIC 4481).

f. Ferries (SIC 4482). Including: car lighters (ferries); and railroad ferries.

g. Water Transportation of Passengers, Not Elsewhere Classified (SIC 4489). Including: airboats (swamp buggy rides); excursion boat operations; passenger water transportation on rivers and canals; sightseeing boats; and water taxis.

h. Marine Cargo Handling (SIC 4491). Including: docks, including buildings and facilities; loading vessels; marine cargo handling; piers, including buildings and facilities; ship hold cleaning; stevedoring; unloading vessels; and waterfront terminal operation.

i. Towing and Tugboat Services (SIC 4492). Including: docking of ocean vessels; shifting of floating equipment within harbors; towing services, marine; tugboat service; and undocking of ocean vessels.

j. Marinas (SIC 4493).[97] Including: boat yards, storage and incidental repair; and yacht basins.

k. Water Transportation Services, Not Elsewhere Classified (SIC 4499). Including: boat cleaning; boat hiring, except pleasure; boat livery, except pleasure; boat rental, commercial; canal operation; cargo salvaging, from distressed vessels; chartering of commercial boats; dismantling ships; lighterage; marine railways for drydocks; marine salvaging; marine surveyors, except cargo; marine wrecking, ships for scrap; piloting vessels in and out of harbors; ship cleaning, except hold cleaning; ship registers: survey and classification of ships and marine equipment; and steamship leasing.

2. Pollutants Found in Storm Water Discharges

Table Q–1 lists potential pollutant source activities that commonly take place at water transportation vehicle maintenance and equipment cleaning operations.

TABLE Q–1.—INDUSTRIAL ACTIVITIES, POLLUTANT SOURCES, AND POLLUTANTS

Activity	Pollutant source	Pollutant
Pressure Washing	Wash water	Paint solids, heavy metals, suspended solids.
Surface Preparation Paint Removal Sanding	Sanding; mechanical grinding; abrasive blasting; paint stripping.	Spent abrasives, paint solids, heavy metals, solvents, dust.
Painting	Paint and paint thinner spills; spray painting; paint stripping; sanding; paint cleanup.	Paint solids, spent solvents, heavy metals, dust.
Engine Maintenance and Repairs	Parts cleaning; waste disposal of greasy rags, used fluids, and batteries; use of cleaners & degreasers; fluid spills; fluid replacement.	Spent solvents, oil, heavy metals, ethylene glycol, acid/alkaline wastes, detergents.
Material Handling: Transfer Storage Disposal	Fueling: spills; leaks; and hosing area	Fuel, oil, heavy metals.
	Liquid Storage in Above Ground Storage: spills and overfills; external corrosion; failure of piping systems.	Fuel, oil, heavy metals, material being stored.
	Waste Material Storage and Disposal: paint solids; solvents; trash; spent abrasives, petroleum products.	Paint solids, heavy metals, spent solvents, oil.
Shipboard Processes improperly discharged to storm sewer or into receiving water.	Process & cooling water; sanitary waste; bilge & ballast water.	Biochemical oxygen demand (BOD), bacteria, suspended solids, oil, fuel.

Sources: EPA, Office of Water and Hazardous Materials. December 1979. "Draft Development Document for Proposed Effluent Limitations Guidelines and Standards for the Shipbuilding and Repair Industry." EPA/440/1–79/076–b.

University of South Alabama, College of Engineering. September 1992. "Best Management Practices for the Shipbuilding and Repair Industry and for Bridge Maintenance Activities." College of Engineering Report No. 92–2.

NPDES Storm Water Group Applications—Part 1. Received by EPA March 18, 1991, through December 31, 1992.

EPA, Office of Research and Development. October 1991. "Guides to Pollution Prevention—The Automotive Refinishing Industry." EPA/625/7–91/016.

EPA, Office of Research and Development. October 1991. "Guides to Pollution Prevention—The Automotive Repair Industry." EPA/625/7–91/013.

EPA, Office of Research and Development. May 1992. "Facility Pollution Prevention Guide." EPA/600/R–92/088.

EPA, Office of Water. September 1992. "Storm Water Management for Industrial Activities—Developing Pollution Prevention Plans and Best Management Practices." EPA 832–R–92–006.

U.S. Postal Service. May 1992. "NPDES/Storm Water Guide." AS–554.

Based on the similarities of the facilities included in this sector in terms of industrial activities and significant materials, EPA believes it is appropriate to discuss the potential pollutants at water transportation facilities having vehicle maintenance and/or equipment cleaning operations as a whole and not subdivide this sector. Therefore, Table Q–2 lists data for selected parameters from facilities in the water transportation sector. These data include the eight pollutants that all facilities were required to monitor for under Form 2F, as well as the pollutants that EPA determined merit further monitoring.

[97] "Guidelines for the Determination of Regulatory Status of Marinas and Related Operations." Facilities that are "primarily engaged" in operating marinas are best classified as SIC 4493—marinas. These facilities rent boat skips, store boats and generally perform a range of other marine services including boat cleaning and incidental boat repair. They frequently sell food, fuel, fishing supplies and may sell boats. For facilities classified as 4493 that are involved in vehicle (vessel) maintenance activities (including vehicle rehabilitation, mechanical repairs, painting, fueling, and lubrication) or equipment cleaning operations, those portions of the facility that are involved in such vehicle maintenance activities are considered to be associated with industrial activity and are covered under the storm water regulations.

Facilities classified as 4493 that are not involved in equipment cleaning or vessel maintenance activities (including vehicle rehabilitation, mechanical repairs, painting, and lubrication) are not intended to be covered under 40 CFR Section 122.26(b)(14)(viii) of the storm water permit application regulations. The retail sale of fuel alone at marinas, without any other vessel maintenance or equipment cleaning operations, is not considered to be grounds for coverage under the storm water regulations.

TABLE Q–2.—STATISTICS FOR CONVENTIONAL POLLUTANTS AND STORM WATER[i] (IN mg/L UNLESS OTHERWISE INDICATED)

Pollutant Sample type	No. of Facilities		No. of Samples		Mean		Minimum		Maximum		Median		95th Percentile		99th Percentile	
	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	15	14	15	14	8.6	6.0	0.0	0.0	39.0	11.0	7.0	6.0	36.3	13.4	76.3	18.7
COD	15	14	15	14	130.9	75.8	0.0	10.0	500.0	203.0	93.0	50.5	588	254.8	1327.6	496.8
Nitrate + Nitrite Nitrogen	15	14	15	14	4.23	0.66	0.00	0.00	54.00	1.61	0.60	0.65	8.61	1.89	23.9	3.07
Total Kjeldahl Nitrogen	15	14	15	14	2.64	9.41	0.00	0.00	16.00	118.00	1.60	0.75	9.72	16.96	20.67	51.31
Oil & Grease	15	N/A	15	N/A	11.9	N/A	0.0	N/A	96.0	N/A	2.0	N/A	40.9	N/A	109.9	N/A
pH (s.u)	15	11	15	N/A	N/A	N/A	4.1	N/A	8.8	N/A	7.0	N/A	9.5	N/A	10.8	N/A
Total Phosphorus	15	14	15	14	0.27	0.15	0.00	0.00	1.20	0.32	0.10	0.17	1.32	0.51	3.19	.90
Total Suspended Solids	15	14	15	14	634	224	3	5	4330	944	135	68	3906	1116	1635.2	3351
Aluminum	4	3	4	3	3.1	2.2	0.2	0.2	6.3	5.4	3.0	1.0	24.4	14.2	81.2	40.9
Iron	4	3	4	3	26.7	5.0	0.2	0.4	94.0	8.9	8.3	5.7	N/A	40.6	40.9	122.8
Lead	4	3	4	3	0.2	0.1	0.0	0.0	0.7	0.1	0.1	0.1	N/A	.1	N/A	0.2
Zinc	4	3	4	3	0.7	0.4	0.1	0.2	2.2	0.9	0.2	0.2	N/A	1.3	N/A	2.4

[i] Mean, Maximum, Minimum, Median, and Percentiles include all detects and nondetects.
[ii] Composite samples.
Note: There is no information for 95th percentile columns.

3. Options for Controlling Pollutants

The measures commonly implemented to reduce pollutants in storm water associated with water transportation vehicle maintenance and/or equipment cleaning operations are generally simple to implement and are uncomplicated practices. Table Q–3 identifies Best Management Practices (BMPs) associated with different activities that routinely take place at water transportation facilities with vehicle maintenance and equipment cleaning operations.

TABLE Q–3.—INDUSTRIAL ACTIVITIES AND POTENTIAL BEST MANAGEMENT PRACTICES

Activity	BMPs
Pressure washing	Collect discharge water and remove all visible solids before discharging to a sewer system, or where permitted, to a drainage system, or receiving water.
	Perform pressure washing only in designated areas where wash water containment can be effectively achieved.
	Use no detergents or additives in the pressure wash water.
	Direct deck drainage to a collection system sump for settling and/or additional treatment.
	Implement diagonal trenches or berms and sumps to contain and collect wash water at marine railways.
	Use solid decking, gutters, and sumps at lift platforms to contain and collect wash water for possible reuse.
Surface preparation, sanding, and paint removal.	Enclose, cover, or contain blasting and sanding activities to the extent practical to prevent abrasives, dust, and paint chips from reaching storm sewers or receiving water.
	Where feasible, cover drains, trenches, and drainage channels to prevent entry of blasting debris to the system.
	Prohibit uncontained blasting or sanding activities performed over open water.
	Prohibit blasting or sanding activities performed during windy conditions which render containment ineffective.
	Inspect and clean sediment traps to ensure the interception and retention of solids prior to entering the drainage system.
	Sweep accessible areas of the drydock to remove debris and spent sandblasting material prior to flooding.
	Collect spent abrasives routinely and store under a cover to await proper disposal.
Painting	Enclose, cover, or contain painting activities to the maximum extent practical to prevent overspray from reaching the receiving water.
	Prohibit uncontained spray painting activities over open water.
	Prohibit spray painting activities during windy conditions which render containment ineffective.
	Mix paints and solvents in designated areas away from drains, ditches, piers, and surface waters, preferably indoors or under cover.
	Have absorbent and other cleanup items readily available for immediate cleanup of spills.
	Allow empty paint cans to dry before disposal.
	Keep paint and paint thinner away from traffic areas to avoid spills.
	Recycle paint, paint thinner, and solvents.
	Train employees on proper painting and spraying techniques, and use effective spray equipment that delivers more paint to the target and less overspray.
Drydock maintenance	Clean and maintain drydock on a regular basis to minimize the potential for pollutants in the storm water runoff.
	Sweep accessible areas of the drydock to remove debris and spent sandblasting material prior to flooding.
	If hosing must be used as a removal method, collect wash water to remove solids and potential metals.
	Clean the remaining areas of the dock after a vessel has been removed and the dock raised.
	Remove and properly dispose of floatable and other low-density waste (wood, plastic, insulations, etc.).
Drydocking	Use plastic barriers beneath the hull, between the hull and drydock walls for containment.
	Use plastic barriers hung from the flying bridge of the drydock, from the bow or stern of the vessel, or from temporary structures for containment.

TABLE Q–3.—INDUSTRIAL ACTIVITIES AND POTENTIAL BEST MANAGEMENT PRACTICES—Continued

Activity	BMPs
	Weight the bottom edge of the containment tarpaulins or plastic sheeting during a light breeze.
	Use plywood and/or plastic sheeting to cover open areas between decks when sandblasting (scuppers, railings, freeing ports, ladders, and doorways).
	Install tie rings or cleats, cable suspension systems, or scaffolding to make implementation containment easier.
Nondrydock containment	Hang tarpaulin from the boat, fixed, or floating platforms to reduce pollutants transported by wind.
	Pave or tarp surfaces under marine railways.
	Clean railways before the incoming tide.
	Haul vessels beyond the high tide zone before work commences or halt work during high tide.
	Place plastic sheeting or tarpaulin underneath boats to contain and collect waste and spent materials and clean and sweep regularly to remove debris.
	Use fixed or floating platforms with appropriate plastic or tarpaulin barriers as work surfaces and for containment when work is performed on a vessel in the water to prevent blast material or paint overspray from contacting storm water or the receiving water.
	Sweep, rather than hose, debris present on the dock.
Engine maintenance and repairs	Maintain an organized inventory of materials used in the maintenance shop.
	Dispose of greasy rag, oil filters, air filters, batteries, spent coolant, and degreasers properly.
	Label and track the recycling of waste material (i.e., used oil, spent solvents, batteries).
	Drain oil filters before disposal or recycling.
	Store cracked batteries in a nonleaking secondary container.
	Promptly transfer used fluids to the proper container; do not leave full drip pans or other open containers around the shop. Empty and clean drip pans and containers.
	Do not pour liquid waste down floor drains, sinks, or outdoor storm drain inlets.
	Plug floor drains that are connected to the storm or sanitary sewer; if necessary, install a sump that is pumped regularly.
	Inspect the maintenance area regularly for proper implementation of control measures.
	Train employees on proper waste control and disposal procedures.
Material Handling: Bulk liquid storage and containment.	Store permanent tanks in a paved area surrounded by a dike system which provides sufficient containment for the larger of either 10 percent of the volume of all containers or 110 percent of the volume of the largest tank.
	Maintain good integrity of all storage tanks.
	Inspect storage tanks to detect potential leaks and perform preventive maintenance.
	Inspect piping systems (pipes, pumps, flanges, couplings, hoses, valves) for failures or leaks.
	Train employees on proper filling and transfer procedures.
Material Handling: Containerized material storage.	Store containerized materials (fuels, paints, solvents, etc.) in a protected, secure location and away from drains.
	Store reactive, ignitable, or flammable liquids in compliance with the local fire code.
	Identify potentially hazardous materials, their characteristics, and use.
	Control excessive purchasing, storage, and handling of potentially hazardous materials.
	Keep records to identify quantity, receipt date, service life, users, and disposal routes.
	Secure and carefully monitor hazardous materials to prevent theft, vandalism, and misuse of materials.
	Educate personnel for proper storage, use, cleanup, and disposal of materials.
	Provide sufficient containment for outdoor storage areas for the larger of either 10 percent of the volume of all containers or 110 percent of the volume of the largest tank.
	Use temporary containment where required by portable drip pans.
	Use spill troughs for drums with taps.
Material Handling	Mix paints and solvents in designated areas away from drains, ditches, piers, and surface waters. Locate designated areas preferably indoors or under a shed.
Designated material mixing areas	If spills occur,
	• Stop the source of the spill immediately.
	• Contain the liquid until cleanup is complete.
	• Deploy oil containment booms if the spill may reach the water.
	• Cover the spill with absorbent material.
	• Keep the area well ventilated.
	• Dispose of cleanup materials properly.
	• Do not use emulsifier or dispersant.
Shipboard process water handling	Keep process and cooling water used aboard ships separate from sanitary wastes to minimize disposal costs for the sanitary wastes.
	Keep process and cooling water from contact with spent abrasives and paint to avoid discharging these pollutants.
	Inspect connecting hoses for leaks.
Shipboard sanitary waste disposal	Discharge sanitary wastes from the ship being repaired to the yard's sanitary system or dispose of by a commercial waste disposal company.
	Use appropriate material transfer procedures, including spill prevention and containment activities.
Bilge and Ballast water	Collect and dispose of bilge and ballast waters which contain oils, solvents, detergents, or other additives to a licensed waste disposal company.

Sources: University of South Alabama, College of Engineering. September 1992. "Best Management Practices for the Shipbuilding and Repair Industry and for Bridge Maintenance Activities." College of Engineering Report No. 92–2.

NPDES Storm Water Group Applications—Part 1. Received by EPA March 18, 1991 through December 31, 1992.
EPA, Office of Water. January 1993. "Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters." 840-B-92-002.

4. Pollutant Control Measures Required Through Other EPA Programs

EPA recognizes that the Resource Conservation and Recovery Act (RCRA) and the Underground Storage Tank (UST) programs require careful management of materials used at Water Transportation Facilities and Boat Building & Repairing Facilities.

Under the RCRA program, on September 10, 1992, EPA promulgated standards in 40 CFR Part 279 for the management of used oils that are recycled (57 FR 41566). These standards include requirements for used oil generators, transporters, processors/re-refiners, and burners. The standards for used oil generators apply to all generators, regardless of the amount of used oil they generate. Do-it-yourself (DIY) generators which generate used oil from the maintenance of their personal vehicles, however, are not subject to the management standards (Section 279.20(a)(1)).

The requirements for used oil generators were designed to impose a minimal burden on generators while protecting human health and the environment from the risks associated with managing used oil. Under Subpart C of 40 CFR Part 279, used oil generators must not store used oil in units other than tanks, containers, or units subject to regulation under Part 264 or 265 of 40 CFR (Section 279.22(a)). In other words, generators may store used oil in tanks or containers that are not subject to Subpart J (Hazardous Waste Tanks) or Subpart I (Containers) of Parts 264/265, as long as such tanks or containers are maintained in compliance with the used oil management standards. This does not preclude generators from storing used oil in Subpart J tanks or Subpart I containers or other units, such as surface impoundments (Subpart K), that are subject to regulation under Part 264 or 265.

Storage units at generator facilities must be maintained in good condition and labeled with the words "used oil." Upon detection of a release of used oil to the environment, a generator must take steps to stop the release, contain the released used oil, and properly manage the released used oil and other materials (Section 279.22(b) to (d)). Generators storing used oil in underground storage tanks are subject to the UST regulations (40 CFR Part 280).

If used oil generators ship used oil offsite for recycling, they must use a transporter who has notified EPA and obtained an EPA identification number (Section 279.24).

The technical standards for USTs at 40 CFR Part 280 require that new UST systems (defined as systems for which installation commenced after December 12, 1988) use overfill prevention equipment that will: (1) Automatically shut off flow into the tank when the tank is no more than 95 percent full; or (2) alert the transfer operator when the tank is no more than 90 percent full by restricting the flow into the tank or triggering a high level alarm. The preceding requirements do no apply to systems that are filled by transfers of no more than 25 gallons at one time. Existing UST systems (defined as systems for which installation has commenced on or before December 12, 1988) are required to have installed the described overfill prevention equipment by December 12, 1998.

5. Special Conditions

a. Prohibition of Non-storm Water Discharges. In addition to the non-storm water discharges prohibited in part III.A of the permit, this section specifically prohibits the following: bilge and ballast water, pressure wash water, sanitary wastes, and cooling water originating from vessels are not authorized by this section. The operators of such discharges must obtain coverage under a separate NPDES permit if discharged to waters of the U.S. or through a municipal separate storm sewer system. Certain non-storm water discharges, however, may be authorized by this permit. Part III.A.2 of today's permit lists these discharges.

This section does not authorize the non-storm water discharge of pressure wash water. Pressure washing is used to remove marine growth from vessels. EPA has found that unpermitted releases of pressure wash water is a habitual problem at water transportation facilities. Marine growths and paint debris found in the wash water can contain significant quantities of heavy metals, and this water cannot be discharged.

6. Storm Water Pollution Prevention Plan Requirements

The conditions that apply to water transportation facilities with vehicle maintenance and/or equipment cleaning operations build upon the requirements set forth in the baseline conditions permit for storm water discharges from industrial activities discussed previously.

a. Contents of the Plan.

(1) Description of Potential Pollutant Sources.

Under the description of potential pollutant sources in the storm water pollution prevention plan requirements, permittees are required to include the location(s) on their facility site map where engine maintenance and repair work, vessel maintenance and repair work, and pressure washing are performed. This requirement is the same as the permit conditions listed in the front section of this factsheet, which are based on the baseline general permit of September 9, 1992 Here it is expressed in more appropriate terms for the water transportation industry. The baseline general permit includes "vehicle and equipment maintenance and/or cleaning areas." The language "processing areas", as described under the baseline general permit, has been specified to include painting, blasting, welding, and metal fabrication for this section. EPA believes that this specificity is appropriate for the water transportation industry and that these areas may potentially be a significant source of pollutants to storm water. Rather than requiring the location of "storage areas" as in the baseline general permit, this storm water pollution prevention plan specifies that the location of liquid storage areas (i.e., paint, solvents, resins) and material storage areas (i.e., blasting media, aluminum, steel) be shown. This again is the same requirement, but it is expressed in more specific terms for this industry. In addition, the site map must also indicate the outfall locations and the types of discharges contained in the drainage areas of the outfalls (e.g. storm water and air conditioner condensate). In order to increase the readability of the map, the inventory of the types of discharges contained in each outfall may be kept as an attachment to the site map.

(2) Measures and Controls.

Under the description of measures and controls in the storm water pollution prevention plan requirements, this section requires that all areas that may contribute pollutants to storm waters discharges shall be maintained in a clean, orderly manner. This section also requires that the following areas must be specifically addressed:

(a) Pressure Washing Area—When pressure washing is used to remove

marine growth from vessels, the discharge water must be permitted by an NPDES permit. The plan must describe the measures to collect or contain the discharge from the pressure washing area, detail the method for the removal of the visible solids, describe the method of disposal of the collected solids, and identify where the discharge will be released (i.e., the receiving waterbody, storm sewer system, sanitary sewer system).

(b) Blasting and Painting Areas—The facility must consider containing all blasting and painting activities to prevent abrasives, paint chips, and overspray from reaching the receiving water or the storm sewer system. The plan must describe measures taken at the facility to prevent or minimize the discharge of spent abrasive, paint chips, and paint into the receiving waterbody and storm sewer system. The facility may consider hanging plastic barriers or tarpaulins during blasting or painting operations to contain debris. Where required, a schedule for cleaning storm systems to remove deposits of abrasive blasting debris and paint chips should be addressed within the plan. The plan should include any standard operating practices with regard to blasting and painting activities. Such included items may be the prohibition of performing uncontained blasting and painting over open water or blasting and painting during windy conditions which can render containment ineffective.

(3) Material Storage Areas—All stored and containerized materials (fuels, paints, solvents, waste oil, antifreeze, batteries) must be stored in a protected, secure location away from drains and plainly labeled. The plan must describe measures that prevent or minimize contamination of the storm water runoff from such storage areas. The facility must specify which materials are stored indoors and consider containment or enclosure for materials that are stored outdoors. Above ground storage tanks, drums, and barrels permanently stored outside must be delineated on the site map with a description of the containment measures in place to prevent leaks and spills. The facility must consider implementing an inventory control plan to prevent excessive purchasing, storage, and handling of potentially hazardous materials. Those facilities where abrasive blasting is performed must specifically include a discussion on the storage and disposal of spent abrasive materials generated at the facility.

(d) Engine Maintenance and Repair Areas—The plan must describe measures that prevent or minimize contamination of the storm water runoff from all areas used for engine maintenance and repair. The facility may consider performing all maintenance activities indoors, maintaining an organized inventory of materials used in the shop, draining all parts of fluids prior to disposal, prohibiting the practice of hosing down the shop floor, using dry cleanup methods, and/or collecting the storm water runoff from the maintenance area and providing treatment or recycling.

(e) Material Handling Areas—The plan must describe measures that prevent or minimize contamination of the storm water runoff from material handling operations and areas (i.e., fueling, paint & solvent mixing, disposal of process wastewater streams from vessels). The facility may consider covering fueling areas; using spill and overflow protection; mixing paints and solvents in a designated area, preferably indoors or under a shed; and minimizing runon of storm water to material handling areas. Where applicable, the plan must address the replacement or repair of leaking connections, valves, pipes, hoses, and soil chutes carrying wastewater from vessels.

(f) Drydock Activities—The plan must address the routine maintenance and cleaning of the drydock to minimize the potential for pollutants in the storm water runoff. The plan must describe the procedures for cleaning the accessible areas of the drydock prior to flooding and final cleanup after the vessel is removed and the dock is raised. Cleanup procedures for oil, grease, or fuel spills occurring on the drydock must also be included within the plan. The facility should consider items such as sweeping rather than hosing off debris and spent blasting material from the accessible areas of the drydock prior to flooding and having absorbent materials and oil containment booms readily available to contain and cleanup any spills.

(g) General Yard Area—The plan must include a schedule for routine yard maintenance and cleanup. Scrap metal, wood, plastic, miscellaneous trash, paper, glass, industrial scrap, insulation, welding rods, packaging, etc., must be routinely removed from the general yard area. The facility may consider such measures as providing covered trash receptacles in each yard, on each pier, and on board each vessel being repaired.

These seven areas are the common sources of pollutants in storm water runoff from water transportation facilities which have vehicle maintenance and/or equipment cleaning activities. Based upon the September 1992 "Best Management Practices for the Shipbuilding and Repair Industry and for Bridge Maintenance Activities" prepared by the College of Engineering at the University of South Alabama, the suggested management measures are commonly used at water transportation facilities. EPA believes that the incorporation of management practices such as those suggested will substantially reduce the potential that these activities and areas will significantly contribute to the pollution of storm water discharges. In addition, EPA believes that these requirements continue to provide the necessary flexibility to address the variable risk for pollutants in storm water discharges associated with different facilities. Further, many facilities will find that management measures that they have already incorporated into the facility's operation, such as the installation of overfill protection equipment and labelling and maintenance of used oil storage units, that are already required under existing EPA programs will meet the requirements of this section.

Under the preventive maintenance requirements of the storm water pollution prevention plan elements, the plan specifically includes the routine inspection of sediment traps to ensure that spent abrasives, paint chips, and solids will be intercepted and retained prior to entering the storm drainage system. Because of the nature of operations such as abrasive blasting which occur at water transportation facilities, specific routine attention needs to be placed on the collection and proper disposal of spent abrasive materials, paint chips, and other solids.

Under the inspection requirements of the storm water pollution prevention plan elements, qualified facility personnel shall be identified to inspect designated equipment and areas of the facility, at a minimum, on a monthly basis. The following areas shall be included in all inspections: pressure washing area, blasting and painting areas, material storage areas, engine maintenance and repair areas, material handling areas, drydock area, and general yard area. A set of tracking or follow-up procedures shall be used to ensure that appropriate actions are taken in response to the inspections. Records shall be maintained.

The purpose of the inspections is to check on the implementation of the storm water pollution prevention plan. The inspections allow facility personnel to monitor the success or failure of elements of the plan on a regular basis. The use of an inspection checklist is highly encouraged. The checklist will ensure that all required areas are inspected, as well as help to meet the record keeping requirements.

Under the employee training component of the storm water pollution prevention plan requirements, the permittee is required to identify at least annual (once per year) dates for such training. Employee training must, at a minimum address the following areas when applicable to a facility: used oil management; spent solvent management; proper disposal of spent abrasives; proper disposal of vessel wastewaters, spill prevention and control; fueling procedures; general good housekeeping practices; proper painting and blasting procedures; and used battery management. Employees, independent contractors, and customers must be informed about BMPs and be required to perform in accordance with these practices. The facility must consider posting easy to read descriptions or graphic depictions of BMPs and emergency phone numbers in the work areas. Unlike some industrial operations, the industrial activities associated with water transportation facilities that may affect storm water quality require the cooperation of all employees. EPA, therefore, is requiring that employee training take place at least once a year to serve as: (1) Training for new employees; (2) a refresher course for existing employees; (3) training for all employees on any storm water pollution prevention techniques recently incorporated into the plan; and (4) a forum for the facility to invite independent contractors and customers to inform them on pollution prevention procedures and requirements.

Monitoring and Reporting Requirements

a. Analytical Monitoring Requirements. Under the revised methodology for determining pollutants of concern for the various industrial sectors water transportation facilities must perform analytical monitoring. Facilities must collect and analyze samples of their storm water discharges for the pollutants listed in Table Q–4. The median levels of the pollutants listed in Table Q–4 were found to be above benchmark levels for water transportation facilities that submitted quantitative data in the group application process. EPA is requiring monitoring after the pollution prevention plan has been implemented to ensure that a reduction of pollutants is realized.

At a minimum, storm water discharges from water transportation facilities must be monitored quarterly during the second year of permit coverage. Samples must be collected at least once in each of the following periods: January through March; April through June; July through September; and October through December. At the end of the second year of permit coverage, a facility must calculate the average concentration for each parameter listed in Table Q–4. If the permittee collects more than four samples in this period, then they must calculate an average concentration for each pollutant of concern for all samples analyzed.

TABLE Q–4.—INDUSTRY MONITORING REQUIREMENTS

Pollutants of concern	Cut-off concentration
Total Recoverable Aluminum	0.75 mg/L.
Total Recoverable Iron	1.0 mg/L.
Total Recoverable Lead	0.0816 mg/L.
Total Recoverable Zinc	0.117 mg/L

If the average concentration for a parameter is less than or equal to the value listed in Table Q–4, then the permittee is not required to conduct quantitative analysis for that parameter during the fourth year of the permit. If, however, the average concentration for a parameter is greater than the cut-off concentration listed in Table Q–4, then the permittee is required to conduct quarterly monitoring for that parameter during the fourth year of permit coverage. Monitoring is not required during the first, third, and fifth year of the permit. The exclusion from monitoring in the fourth year of the permit is conditional on the facility maintaining industrial operations and BMPs that will ensure a quality of storm water discharges consistent with the average concentrations recorded during the second year of the permit. The schedule of monitoring is presented in Table Q–5.

TABLE Q–5.—SCHEDULE OF MONITORING

2nd Year of Permit Coverage	• Conduct quarterly monitoring. • Calculate the average concentration for all parameters analyzed during this period. • If average concentration is greater than the value listed in Table Q–5, then quarterly sampling is required during the fourth year of the permit. • If average concentration is less than or equal to the value listed in Table Q–5, then no further sampling is required for that parameter.
4th Year of Permit Coverage	• Conduct quarterly monitoring for any parameter where the average concentration in year 2 of the permit is greater than the value listed in Table Q–5. • If industrial activities or the pollution prevention plan have been altered such that storm water discharges may be adversely affected, quarterly monitoring is required for all parameters of concern.

In cases where the average concentration of a parameter exceeds the cut-off concentration, EPA expects permittees to place special emphasis on methods for reducing the presence of those parameters in storm water discharges. Quarterly monitoring in the fourth year of the permit will reassess the effectiveness of the adjusted pollution prevention plan.

EPA realizes that if a facility is inactive and unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly chemical sampling.

b. Alternative Certification. Throughout today's permit, EPA has included monitoring requirements for facilities which the Agency believes have the potential for contributing significant levels of pollutants to storm water discharges. The alternative described below is necessary to ensure that monitoring requirements are only imposed on those facilities that do, in fact, have storm water discharges containing pollutants at concentrations of concern. EPA has determined that if materials and activities are not exposed to storm water at the site, then the potential for pollutants to contaminate storm water discharges does not warrant monitoring.

Therefore, a discharger is not subject to the monitoring requirements of this Part provided the discharger makes a certification for a given outfall, on a pollutant-by-pollutant basis in lieu of monitoring reports required under paragraph *c* below under penalty of law, signed in accordance with Part VII.G. (Signatory Requirements), that material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, industrial machinery or operations, significant materials from past industrial activity, that are located in areas of the facility that are within the drainage area of the outfall are not presently exposed to storm water and will not be exposed to storm water for the certification period. Such certification must be retained in the storm water pollution prevention plan and submitted to EPA. In the case of certifying that a pollutant is not present, the permittee must submit the certification along with the monitoring reports required under paragraph (*c*) below. If the permittee cannot certify for an entire period, they must submit the date exposure was eliminated and any monitoring required up until that date. This certification option is not applicable to compliance monitoring requirements associated with effluent limitations. EPA does not expect facilities to be able to exercise this certification for indicator parameters, such as TSS and BOD.

c. Reporting Requirements. Permittees are required to submit all monitoring results obtained during the second and fourth year of permit coverage within 3 months of the conclusion of each year. For each outfall, one signed Discharge Monitoring Report Form must be submitted per storm event sampled. For facilities conducting monitoring beyond the minimum requirements an additional Discharge Monitoring Report Form must be filed for each analysis. The permittee must include a measurement or estimate of the total precipitation, volume of runoff, and peak flow rate of runoff for each storm event sampled.

d. Sample Type. All discharge data shall be reported for grab samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The required 72-hour storm event interval is waived where the preceding measurable storm event did not result in a measurable discharge from the facility. The required 72-hour storm event interval may also be waived where the permittee documents that less than a 72-hour interval is representative for local storm events during the season when sampling is being conducted. The grab sample shall be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable. If storm water discharges associated with industrial activity commingle with process or nonprocess water, then where practicable permittees must attempt to sample the storm water discharge before it mixes with the non-storm water discharge.

e. Representative Discharge. When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may test the effluent of one of such outfalls and report that the quantitative data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluent. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

f. Quarterly Visual Examination of Storm Water Quality. Quarterly visual examinations of storm water discharges from each outfall are required at water transportation facilities. The examination must be of a grab sample collected from each storm water outfall. The examination of storm water grab samples shall include any observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, or other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on these samples.

The examination must be made at least once in each of the designated periods during daylight unless there is insufficient rainfall or snow-melt to runoff. Where practicable, the same individual should carry out the collection and examination of discharges throughout the life of the permit to ensure the greatest degree of consistency possible. Grab samples shall be collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 60 minutes) of when the runoff begins discharging. Reports of the visual examination include: the examination date and time, examination personnel, visual quality of the storm water discharge, and probable sources of any observed storm water contamination. The visual examination reports must be maintained onsite with the pollution prevention plan. The visual examination must be conducted in each of the following periods: January through March; April through June; July through September; and October through December.

When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain such documentation on-site with the results of the visual examinations. Adverse weather conditions which may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

EPA realizes that if a facility is inactive and unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly visual examination.

EPA believes that this quick and simple assessment will allow the permittee to approximate the effectiveness of his/her plan on a regular basis at very little cost. Although the visual examination cannot assess the chemical properties of the storm water discharged from the site, the examination will provide meaningful results upon which the facility may act quickly. The frequency of this visual examination will also allow for timely adjustments to be made to the plan. If BMPs are performing ineffectively, corrective action must be implemented. A set of tracking or follow-up procedures must be used to ensure that appropriate actions are taken in response to the inspections. The visual examination is intended to be performed by members of the pollution prevention team. This hands-on examination will enhance the staff's understanding of the storm water problems on that site and the effects of the management practices that are included in the plan.

R. Storm Water Discharges Associated With Industrial Activity From Ship and Boat Building or Repairing Yards

1. Discharges Covered Under This Section

The storm water application regulations define storm water discharges associated with industrial activity at 40 CFR 122.26(b)(14). Category (ii) of this definition includes facilities commonly identified by Standard Industrial Classification (SIC) codes 24 (except 2434), 26 (except 265 and 267), 28 (except 283 and 285), 29, 311, 32 (except 323), 33, 3441, and 373. The conditions in this section apply to those facilities primarily engaged in ship and boat building and repairing services (SIC code 373). The following is a list of the types of facilities engaged in ship and boat building and repairing services:

a. Ship Building and Repairing (SIC code 3731)—These are establishments primarily engaged in building and repairing ships, barges, and lighters, whether self-propelled or towed by other crafts. The industry also includes the conversion and alteration of ships and the manufacture of off-shore oil and gas well drilling and production platforms (whether or not self-propelled). Examples include building and repairing of barges, cargo vessels, combat ships, crew boats, dredges, ferryboats, fishing vessels, lighthouse tenders, naval ships, offshore supply boats, passenger-cargo vessels, patrol boats, sailing vessels, towboats, trawlers, and tugboats.

b. Boat Building and Repairing (SIC code 3732)—These facilities are primarily engaged in building and repairing boats. Examples include building and repairing of fiberglass boats, motor-boats, sailboats, rowboats, canoes, dinghies, dories, small fishing boats, houseboats, kayaks, lifeboats, pontoons, and skiffs.

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

2. Pollutants Found in Storm Water Discharges

Special conditions have been developed for boat and ship building and repairing operations. Common activities at ship and boat yards include: vessel and equipment cleaning fluid changes, mechanical repairs, parts cleaning, sanding, blasting, welding, refinishing, painting, fueling, and storage of the related materials and waste materials, such as oil, fuel, batteries, or oil filters. All of these areas are potential sources of pollutants to storm water discharges. Table R–1 lists pollutants associated with activities that commonly take place at Ship Building and Repairing Facilities (SIC 3731) and Boat Building and Repairing Facilities (SIC 3732).

TABLE R–1.—COMMON POLLUTANT SOURCES AT SHIP AND BOAT BUILDING AND REPAIRING FACILITIES

Activity	Pollutant source	Pollutant
Pressure Washing	Wash water	Paint solids, heavy metals, suspended solids.
Surface Preparation, Paint Removal, Sanding	Sanding; mechanical grinding; abrasive blasting; paint stripping.	Spent abrasives, paint solids, heavy metals, solvents, dust.
Painting	Paint and paint thinner spills; spray painting; paint stripping; sanding; paint cleanup.	Paint solids, spent solvents, heavy metals, dust.
Engine Maintenance and Repairs	Parts cleaning; waste disposal of greasy rags, used fluids, and batteries; use of cleaners and degreasers; fluid spills; fluid replacement.	Spent solvents, oil, heavy metals, ethylene glycol, acid/alkaline wastes, detergents.
Material Handling: Transfer Storage Disposal	Fueling: spills; leaks; and hosing area	Fuel, oil, heavy metals.
	Liquid Storage in Above Ground Storage: spills and overfills; external corrosion; failure of piping systems.	Fuel, oil, heavy metals, material being stored.
	Waste Material Storage and Disposal: paint solids; solvents; trash; spent abrasives, petroleum products.	Paint solids, heavy metals, spent solvents, oil.
Shipboard Processes improperly discharged to storm sewer or into receiving water.	Process and cooling water; sanitary waste; bilge and ballast water.	Biochemical oxygen demand (BOD), bacteria, suspended solids, oil, fuel.

Sources: Executive Office of the President, Office of Management and Budget, 1987. Standard Industrial Classification Manual 1987. National Technical Information Service Order no. PB 87–100012.

NPDES Storm Water Group Applications—Part 1 and Part 2. Received by EPA March 18, 1991 through December 31, 1992.

EPA, Office of Research and Development. October 1991. "Guides to Pollution Prevention the Automotive Refinishing Industry." EPA/625/7–91/016.

EPA, Office of Research and Development. October 1991. "Guides to Pollution Prevention the Automotive Repair Industry." EPA/625/7–91/016.

EPA, Office of Research and Development. May 1992. "Facility Pollution Prevention Guide." EPA/600/R–92/088.

EPA, Office of Water. September 1992. "Storm Water Management for Industrial Activities—Developing Pollution Prevention Plans and Best Management Practices." EPA 832–R–92–006.

EPA, Office of Water and Hazardous Materials. December 1979. "Draft Development Document for Proposed Effluent Limitations Guidelines and Standards for the Shipbuilding and Repair Industry." EPA/440/1–79/076-b.

University of South Alabama, College of Engineering. September 1992. "Best Management Practices for the Shipbuilding and Repair Industry and for Bridge Maintenance Activities." College of Engineering Report No. 92-2.

Based on the similarities of the facilities included in this sector in terms of industrial activities and significant materials, EPA believes it is appropriate to discuss the potential pollutants at ship and boat building and repairing facilities as a whole and not subdivide this sector. Therefore, Table R-2 lists data for selected parameters from facilities in the ship and boat building and repairing sector. These data include the eight pollutants that all facilities were required to monitor for under Form 2F, as well as the pollutants that EPA determined may merit further monitoring.

TABLE R-2.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY SHIP AND BOAT BUILDING OR REPAIRING YARDS SUBMITTING PART II SAMPLING DATA [i] (mg/L)

Pollutant Sample Type	No. of Facilities		No. of Samples		Mean		Minimum		Maximum		Median		95th Percentile		99th Percentile	
	Grab	Comp [ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	29	28	51	48	4.4	6.3	0.0	0.0	23.0	138.0	2.3	0.8	17.1	25.5	32.6	67.4
COD	29	28	51	49	73.2	70.0	0.0	0.0	450.0	810.0	53.0	33.0	259.1	264.3	503.9	579.8
Nitrate + Nitrite Nitrogen	29	28	51	49	0.79	0.82	0.00	0.00	6.00	5.00	0.72	0.71	2.36	2.35	4.28	4.22
Total Kjeldahl Nitrogen	29	28	51	49	1.19	2.20	0.00	0.00	3.40	48.00	1.00	0.97	2.57	4.69	3.73	8.67
Oil & Grease	29	N/A	52	N/A	1.0	N/A	0.0	N/A	14.0	N/A	0.0	N/A	5.1	N/A	15.9	N/A
pH	23	N/A	43	N/A	N/A	N/A	4.7	N/A	8.7	N/A	7.3	N/A	8.8	N/A	9.6	N/A
Total Phosphorus	29	28	51	48	0.21	0.86	0.00	0.00	2.20	32.00	0.00	0.06	0.94	1.75	1.98	4.51
Total Suspended Solids	29	27	51	48	92	45	0	0	1200	300	17	10	525	366	2294	1537

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.
[ii] Composite samples.

3. Options for Controlling Pollutants

The measures commonly implemented to reduce pollutants in storm water discharges from boat and ship building and repairing facilities are generally uncomplicated and simple to implement. Table R-3 identifies Best Management Practices (BMPs) associated with various activities that routinely occur at boat and ship building and repair facilities.

TABLE R-3.—COMMON MANAGEMENT PRACTICES FOR STORM WATER POLLUTION PREVENTION AT SHIP AND BOAT BUILDING AND REPAIRING FACILITIES

Activity	BMPs
Pressure washing	Collect discharge water and remove all visible solids before discharging to a sewer system, or where permitted by an individual NPDES permit, to a drainage system, or receiving water.
	Perform pressure washing only in designated areas where wash water containment can be effectively achieved.
	Use no detergents or additives in the pressure wash water.
	Direct deck drainage to a collection system sump for settling and/or additional treatment.
	Implement diagonal trenches or berms and sumps to contain and collect wash water at marine railways.
	Use solid decking, gutters, and sumps at lift platforms to contain and collect wash water for possible reuse.
Surface preparation, sanding, and paint removal.	Enclose, cover, or contain blasting and sanding activities to the maximum extent practical to prevent abrasives, dust, and paint chips from reaching storm sewers or receiving water.
	Where feasible, cover drains, trenches, and drainage channels to prevent entry of blasting debris to the system.
	Prohibit uncontained blasting or sanding activities over open water.
	Prohibit blasting or sanding activities during windy conditions which render containment ineffective.
	Inspect and clean sediment traps to ensure the interception and retention of solids prior to entering the drainage system.
	Sweep accessible areas of the drydock to remove debris and spent sandblasting material prior to flooding.
	Collect spent abrasives routinely and store under a cover to await proper disposal.
Painting	Enclose, cover, or contain painting activities to the maximum extent practical to prevent overspray from reaching the receiving water.
	Prohibit uncontained spray painting activities over open water.
	Prohibit spray painting activities during windy conditions which render containment ineffective.
	Mix paints and solvents in designated areas away from drains, ditches, piers, and surface waters, preferably indoors or under a shed.
	Have absorbent and other cleanup items readily available for immediate cleanup of spills.
	Allow empty paint cans to dry before disposal.
	Keep paint and paint thinner away from traffic areas to avoid spills.
	Recycle paint, paint thinner, and solvents.
	Train employees on proper painting and spraying techniques, and use effective spray equipment that delivers more paint to the target and less overspray.
Drydock maintenance	Clean and maintain drydock on a regular basis to minimize the potential for pollutants in the storm water runoff.
	Sweep accessible areas of the drydock to remove debris and spent sandblasting material prior to flooding.

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TABLE R-3.—COMMON MANAGEMENT PRACTICES FOR STORM WATER POLLUTION PREVENTION AT SHIP AND BOAT BUILDING AND REPAIRING FACILITIES—Continued

Activity	BMPs
	If hosing must be used as a removal method, collect wash water to remove solids and potential metals.
	Clean the remaining areas of the dock after a vessel has been removed and the dock raised.
	Remove and properly dispose of floatable and other low-density waste (wood, plastic, insulations, etc.).
Drydock activities	Use plastic barriers beneath the hull, between the hull and drydock walls for containment.
	Use plastic barriers hung from the flying bridge of the drydock, from the bow or stern of the vessel, or from temporary structures for containment.
	Weight the bottom edge of the containment tarpaulins or plastic sheeting during a light breeze.
	Use plywood and/or plastic sheeting to cover open areas between decks when sandblasting (scuppers, railings, freeing ports, ladders, and doorways).
	Install tie rings or cleats, cable suspension systems, or scaffolding to make implementation containment easier.
Nondrydock activities.	Hang tarpaulin from the boat, fixed, or floating platforms to reduce pollutants transported by wind.
	Pave or tarp surfaces under marine railways.
	Clean railways before the incoming tide.
	Haul vessels beyond the high tide zone before work commences or halt work during high tide.
	Place plastic sheeting or tarpaulin underneath boats to contain and collect waste and spent materials and clean and sweep regularly to remove debris.
	Use fixed or floating platforms with appropriate plastic or tarpaulin barriers as work surfaces and for containment when work is performed on a vessel in the water to prevent blast material or paint overspray from contacting storm water or the receiving water.
	Sweep rather than hose debris present on the dock.
Engine maintenance and repairs	Maintain an organized inventory of materials used in the maintenance shop.
	Dispose of greasy rag, oil filters, air filters, batteries, spent coolant, and degreasers properly.
	Label and track the recycling of waste material (i.e., used oil, spent solvents, batteries).
	Drain oil filters before disposal or recycling.
	Store cracked batteries in a nonleaking secondary container.
	Promptly transfer used fluids to the proper container; do not leave full drip pans or other open containers around the shop. Empty and clean drip pans and containers.
	Do not pour liquid waste down floor drains, sinks, or outdoor storm drain inlets.
	Plug floor drains that are connected to the storm or sanitary sewer; if necessary, install a sump that is pumped regularly.
	Inspect the maintenance area regularly for proper implementation of control measures.
	Train employees on proper waste control and disposal procedures.
Material Handling	Store permanent tanks in a paved area surrounded by a dike system which provides sufficient containment for the larger of either 10 percent of the volume of all containers or 110 percent of the volume of the largest tank.
Bulk liquid storage and containment	Maintain good integrity of all storage tanks.
	Inspect storage tanks to detect potential leaks and perform preventive maintenance.
	Inspect piping systems (pipes, pumps, flanges, couplings, hoses, valves) for failures or leaks.
	Train employees on proper filling and transfer procedures.
Material Handling	Store containerized materials (fuels, paints, solvents, etc.) in a protected, secure location and away from drains.
Containerized material storage	Store reactive, ignitable, or flammable liquids in compliance with the local fire code.
	Identify potentially hazardous materials, their characteristics, and use.
	Control excessive purchasing, storage, and handling of potentially hazardous materials.
	Keep records to identify quantity, receipt date, service life, users, and disposal routes.
	Secure and carefully monitor hazardous materials to prevent theft, vandalism, and misuse of materials.
	Educate personnel for proper storage, use, cleanup, and disposal of materials.
	Provide sufficient containment for outdoor storage areas for the larger of either 10 percent of the volume of all containers or 110 percent of the volume of the largest tank.
	Use temporary containment where required by portable drip pans.
	Use spill troughs for drums with taps.
Material Handling	Mix paints and solvents in designated areas away from drains, ditches, piers, and surface waters. Locate designated areas preferably indoors or under a shed.
Designated material mixing areas	If spills occur,
	Stop the source of the spill immediately.
	Contain the liquid until cleanup is complete.
	Deploy oil containment booms if the spill may reach the water.
	Cover the spill with absorbent material.
	Keep the area well ventilated.
	Dispose of cleanup materials properly.
	Do not use emulsifier or dispersant.
Shipboard process water handling	Keep process and cooling water used aboard ships separate from sanitary wastes to minimize disposal costs for the sanitary wastes.
	Keep process and cooling water from contact with spent abrasives and paint to avoid pollution of the receiving water.
	Inspect connecting hoses for leaks.

TABLE R-3.—COMMON MANAGEMENT PRACTICES FOR STORM WATER POLLUTION PREVENTION AT SHIP AND BOAT BUILDING AND REPAIRING FACILITIES—Continued

Activity	BMPs
Shipboard sanitary waste disposal	Discharge sanitary wastes from the ship being repaired to the yard's sanitary system or dispose of by a commercial waste disposal company. Use appropriate material transfer procedures, including spill prevention and containment activities.
Bilge and Ballast water	Collect and dispose of bilge and ballast waters which contain oils, solvents, detergents, or other additives to a licensed waste disposal company.

Sources: EPA, Office of Water. 1993. "Guidance Specifying Management Measures for Survey of Nonpoint Pollution in Coastal Waters." 840-B-92-002.
University of South Alabama, College of Engineering. September 1992. Best Management Practices for the Shipbuilding and Repair Industry and for Bridge Maintenance Activities. College of Engineering Report No. 92-2.
NPDES Storm Water Group Applications—Part 1. Received by EPA March 18, 1991 through December 31, 1992.

4. Pollutant Control Measures Required Through Other EPA Programs

EPA recognizes that the Resource Conservation and Recovery Act (RCRA) and the Underground Storage Tank (UST) programs require careful management of materials used at Ship Building and Repairing Facilities and Boat Building and Repairing Facilities.

Under the RCRA program, on September 10, 1992, EPA promulgated standards in 40 CFR Part 279 for the management of used oils that are recycled (57 FR 41566). These standards include requirements for used oil generators, transporters, processors/re-refiners, and burners. The standards for used oil generators apply to all generators, regardless of the amount of used oil they generate. Do-it-yourself (DIY) generators which generate used oil from the maintenance of their personal vehicles, however, are not subject to the management standards (Subsection 279.20(a)(1)).

The requirements for used oil generators were designed to impose minimal burden on generators while protecting human health and the environment from the risks associated with managing used oil. Under Subpart C of 40 CFR Part 279, used oil generators must not store used oil in units other than tanks, containers, or units subject to regulation under Part 264 or 265 of 40 CFR 279.22(a). In other words, generators may store used oil in tanks or containers that are not subject to Subpart J (Hazardous Waste Tanks) or Subpart I (Containers) of Parts 264/265, as long as such tanks or containers are maintained in compliance with the used oil management standards. This does not preclude generators from storing used oil in Subpart J tanks or Subpart I containers or other units, such as surface impoundments (Subpart K), that are subject to regulation under Part 264 or 265.

Storage units at generator facilities must be maintained in good condition and labeled with the words "used oil." Upon detection of a release of used oil to the environment, a generator must take steps to stop the release, contain the released used oil, and properly manage the released used oil and other materials (Sections 279.22(b)-(d)). Generators storing used oil in underground storage tanks are subject to the UST regulations (40 CFR Part 280).

If used oil generators ship used oil offsite for recycling, they must use a transporter who has notified EPA and obtained an EPA identification number (Section 279.24).

The technical standards for USTs at 40 CFR Part 280 require that new UST systems (defined as systems for which installation commenced after December 12, 1988) use overfill prevention equipment that will: (1) Automatically shut off flow into the tank when the tank is no more than 95 percent full; or (2) alert the transfer operator when the tank is no more than 90 percent full by restricting the flow into the tank or triggering a high level alarm. The preceding requirements do no apply to systems that are filled by transfers of no more than 25 gallons at one time. Existing UST systems (defined as systems for which installation has commenced on or before December 12, 1988) are required to have installed the described overfill prevention equipment by December 12, 1998.

5. Special Conditions

a. Prohibition of Non-storm Water Discharges. In addition to the prohibitions in part III.A., this section of today's permit does not authorize prohibited non-storm water discharges of wastewaters, such as bilge and ballast water, sanitary wastes, pressure washwater, and cooling water originating from vessels. The operators of such discharges must obtain coverage under a separate NPDES permit if discharged to waters of the U.S. or through a municipal separate storm sewer system. Part III.A.2 of today's permit does, however, authorize certain non-storm water discharges.

6. Storm Water Pollution Prevention Plan Requirements

The conditions that apply to ship and boat building and repairing facilities build upon the requirements set forth in the front of this fact sheet which are based on the requirements of the September 9, 1992 baseline general permit. The discussion which follows, therefore, only addresses conditions that differ from those baseline conditions.

a. Contents of the Plan

(1) Description of Potential Pollutant Sources. Under the description of potential pollutant sources in the storm water pollution prevention plan requirements, permittees are required to include the location(s) on their facility site map where engine maintenance and repair work, vessel maintenance and repair work, and pressure washing are performed. This requirement is the same as the baseline requirements presented in the front of this fact sheet, but here it is expressed in more appropriate terms for the ship and boat industry. Rather than requiring the location of "storage areas" as in the baseline general permit, this storm water pollution prevention plan specifies that the location of liquid storage areas (i.e., paint, solvents, resins) and material storage areas (i.e., blasting media, aluminum, steel) be shown. In addition, the site map must also indicate the outfall locations and the types of discharges contained in the drainage areas of the outfalls (e.g. storm water and air conditioner condensate). In order to increase the readability of the map, the inventory of the types of discharges contained in each outfall may be kept as an attachment to the site map.

(2) Measures and Controls. Under the description of measures and controls in the storm water pollution prevention plan requirements, this section requires

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that all areas that may contribute pollutants to storm waters discharges shall be maintained in a clean and orderly manner. This section of today's permit also requires that the following areas be specifically addressed:

(a) Pressure Washing Area—When pressure washing is used to remove marine growth from vessels, the discharge water must be collected or contained and disposed of as required by the NPDES permit for this process water, if the discharge is to waters of the U.S. or through a municipal separate storm sewer. The plan must describe the measures to collect or contain the discharge from the pressure washing area, detail the method for the removal of the visible solids, describe the method of disposal of the collected solids, and identify where the discharge will be released (i.e., the receiving waterbody, storm sewer system, sanitary sewer system).

(b) Blasting and Painting Areas—The facility must consider containing all blasting and painting activities to prevent abrasives, paint chips, and overspray from reaching a receiving waterbody or storm sewer system. The plan must describe measures taken at the facility to prevent or minimize the discharge of spent abrasive, paint chips, and paint into the receiving waterbody and storm sewer system. The facility may consider hanging plastic barriers or tarpaulins during blasting or painting operations to contain debris. Where appropriate, a schedule for cleaning storm water conveyances to remove deposits of abrasive blasting debris and paint chips should be addressed within the plan. The plan should include any standard operating practices with regard to blasting and painting activities. Such items may include the prohibition of performing uncontained blasting and painting over open water or blasting and painting during windy conditions which can render containment ineffective.

(c) Material Storage Areas—All stored and containerized materials (fuels, paints, solvents, waste oil, antifreeze, batteries) must be stored in a protected, secure location away from drains and plainly labeled. The plan must describe measures that prevent or minimize contamination of the storm water runoff from such storage areas. The facility must specify which materials are stored indoors and consider containment or cover for materials that are stored outdoors. Above ground storage tanks, drums, and barrels permanently stored outside must be delineated on the site map with a description of the containment measures in place to prevent leaks and spills. The facility must consider implementing an inventory control plan to prevent excessive purchasing, storage, and handling of potentially hazardous materials. Those facilities where abrasive blasting is performed must specifically include within the plan discussion on the storage and proper disposal of spent abrasive generated at the facility.

(d) Engine Maintenance and Repair Areas—The plan must describe measures that prevent or minimize contamination of the storm water runoff from all areas used for engine maintenance and repair. The facility must consider performing all maintenance activities indoors, maintaining an organized inventory of materials used in the shop, draining all parts of fluids prior to disposal, prohibiting the practice of hosing down the shop floor where the practice would result in the exposure of pollutants to storm water, using dry cleanup methods, and/or collecting the storm water runoff from the maintenance area and providing treatment or recycling.

(e) Material Handling Areas—The plan must describe measures that prevent or minimize contamination of the storm water runoff from material handling operations and areas (i.e., fueling, paint and solvent mixing, disposal of process wastewater streams from vessels). The facility must consider covering fueling areas; using spill and overflow protection; mixing paints and solvents in a designated area, preferably indoors or under a shed; and minimizing runon of storm water to material handling areas. Where applicable, the plan must address the replacement or repair of leaking connections, valves, pipes, hoses, and soil chutes carrying wastewater from vessels.

(f) Drydock Activities—The plan must address the routine maintenance and cleaning of the drydock to minimize the potential for pollutants in storm water runoff. The facility must describe the procedures for cleaning the accessible areas of the drydock prior to flooding and the final cleanup after the vessel is removed and the dock is raised. Cleanup procedures for oil, grease, or fuel spills occurring on the drydock must also be included within the plan. The facility must consider items such as sweeping rather than hosing off debris and spent blasting material from the accessible areas of the drydock prior to flooding and having absorbent materials and oil containment booms readily available to contain and cleanup any spills.

(g) General Yard Area—The plan must include a schedule for routine yard maintenance and cleanup. Scrap metal, wood, plastic, miscellaneous trash, paper, glass, industrial scrap, insulation, welding rods, packaging, etc., must be routinely removed from the general yard area. The facility must consider such measures as providing covered trash receptacles in each yard, on each pier, and on board each vessel being repaired.

These seven areas are the common sources of pollutants in storm water from ship building and repairing and boat building and repairing activities. Based upon Best Management Practices for the Shipbuilding and Repair Industry and for Bridge Maintenance Activities prepared by the College of Engineering at the University of South Alabama, the suggested management measures are commonly used at ship and boat facilities. EPA believes that the incorporation of management practices such as those suggested will substantially reduce the potential for these activities and areas to contribute pollutants to storm water discharges. In addition, EPA believes that these requirements will continue to provide the necessary flexibility to address the variable risk for pollutants in storm water discharges associated with different facilities. Many facilities will find that appropriate management measures are already employed at the facility because they have been required under an existing EPA program.

The preventive maintenance requirements specifically include the routine inspection of sediment traps to ensure that spent abrasives, paint chips, and solids will be intercepted and retained prior to entering the storm drainage system. Because of the nature of operations occurring at ship and boat facilities, routine attention needs to be placed on the collection and proper disposal of spent abrasive, paint chips, and other solids.

In addition to the comprehensive site evaluation required under Part XI.R.3.a.(4) of today's permit, qualified facility personnel shall be identified to inspect designated equipment and areas of the facility, at a minimum, on a monthly basis. The following areas shall be included in all inspections: pressure washing areas, blasting and painting areas, material storage areas, engine maintenance and repair areas, material handling areas, drydock areas, and general yard areas. A set of tracking or follow-up procedures shall be used to ensure that appropriate actions are taken in response to the inspections. Records shall be maintained.

The purpose of the inspections is to check on the implementation and effectiveness of the storm water pollution prevention plan. The inspections allow facility personnel to monitor the success or failure of elements of the plan on a regular basis. The use of an inspection checklist is encouraged. The checklist will ensure that all required areas are inspected, as well as help to meet the record keeping requirements.

The permittee is required to identify annual (once per year) dates for employee training. Employee training must, at a minimum address the following areas when applicable to a facility: used oil management; spent solvent management; proper disposal of spent abrasives; proper disposal of vessel wastewaters, spill prevention and control; fueling procedures; general good housekeeping practices; proper painting and blasting procedures; and used battery management. Employees, independent contractors, and customers must be informed about BMPs and be required to perform in accordance with these practices. The permittee is required to consider posting easy to read or graphic depictions of BMPs that are included in the plan as well as emergency phone numbers in the work areas. This practice will enhance employees understanding the pollutant control measures. Unlike some industrial operations, the industrial activities associated with ship and boat building and repair facilities that may affect storm water quality require the cooperation of all employees. EPA, therefore, is requiring that employee training take place at least once a year to serve as: (1) Training for new employees; (2) a refresher course for existing employees; (3) training for all employees on any storm water pollution prevention techniques recently incorporated into the plan; and (4) a forum for the facility to invite independent contractors and customers to inform them of pollution prevention procedures and requirements.

7. Numeric Effluent Limitation

There are no additional numeric effluent limitations beyond those described in Part V.B. of today's permit.

8. Monitoring and Reporting Requirements

a. Analytical Monitoring Requirements. Under the Storm Water Regulations at 40 CFR 122.26(b)(14), EPA defined "storm water discharge associated with industrial activity." The focus of today's permit is to address the presence of pollutants that are associated with the industrial activities identified in this definition and that might be found in storm water discharges. Under the methodology for determining analytical monitoring requirements, described in section VI.E.1 of this fact sheet, nitrate plus nitrite nitrogen is above the bench mark concentrations for the ship and boat building or repair yards sector. After a review of the nature of industrial activities and the significant materials exposed to storm water described by facilities in this sector, EPA has determined that the higher concentrations of nitrate plus nitrite nitrogen are not likely to be caused by the industrial activity, but may be primarily due to non-industrial activities on-site. Today's permit does not require ship and boat building or repair yards facilities to conduct analytical monitoring for this parameter. Therefore, under the revised methodology for determining pollutants of concern in the various industrial sectors, no analytical monitoring is required by ship and boat building and repairing facilities.

b. Quarterly Visual Examination of Storm Water Quality. Ship and boat building or repair yard facilities shall perform and document a visual examination of a storm water discharge associated with industrial activity from each outfall, except discharges exempted under paragraph (3) below. The examination(s) must be made at least once in each of the following 3-month periods: January through March, April through June, July through September, and October through December. The examination shall be made during daylight hours unless there is insufficient rainfall or snow melt to produce a runoff event.

(1) Examinations shall be made of grab samples collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 1 hour) of when the runoff or snowmelt begins discharging. The examinations shall document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on the samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. Where practicable, the same individual should carry out the collection and examination of discharges for entire permit term.

(2) Visual examination reports must be maintained onsite in the pollution prevention plan. The report shall include the examination date and time, examination personnel, the nature of the discharge (i.e., runoff or snow melt), visual quality of the storm water discharge (including observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution), and probable sources of any observed storm water contamination.

(3) When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may collect a sample of effluent of one of such outfalls and report that the examination data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

(4) When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the records of the visual examinations. Adverse weather conditions that may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(5) EPA realizes that if a facility is inactive and unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly visual examination.

EPA believes that this quick and simple assessment will allow the permittee to approximate the effectiveness of his/her plan on a regular basis at very little cost. Although the visual examination cannot assess the chemical properties of the storm water discharged from the site, the examination will provide meaningful results upon which the facility may act quickly. The frequency of this visual examination will also allow for timely adjustments to be made to the plan. If BMPs are performing ineffectively, corrective action must be implemented. A set of tracking or follow-up procedures must be used to ensure that appropriate actions are taken in response to the examinations. The visual examination is intended to be performed by members of the pollution prevention team. This hands-on examination will enhance the staff's understanding of the storm water problems on that site and the effects of the management practices that are included in the plan.

S. Storm Water Discharges Associated With Industrial Activity From Vehicle Maintenance Areas, Equipment Cleaning Areas, or Deicing Areas Located at Air Transportation Facilities

1. Discharges Covered Under This Section

The conditions in this section apply to airports, airport terminals, airline carriers, and establishments engaged in servicing, repairing, or maintaining aircraft and ground vehicles, equipment cleaning and maintenance (including vehicle and equipment rehabilitation mechanical repairs, painting, fueling, lubrication) or deicing/anti-icing operations which conduct the above described activities (facilities generally classified as SIC code 45). For the purpose of this final permit, the term "deicing" is defined as the process to remove frost, snow, or ice and "anti-icing" is the process which prevents the accumulation of frost, snow, or ice. Both of these activities are covered under this permit.

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

a. Responsible Parties. Airports typically operate under a single management organization known as the airport "authority" which in most cases is a public agency. Airline carriers and other fixed base operators (e.g., fueling companies and maintenance shops) that have contracts with the airport authority to conduct business on airport property are commonly referred to as "tenants" of the airport. Tenants may be of two types—those that are regulated as storm water dischargers associated with industrial activities under 40 CFR 122.26(b)(14) and those that are not. The operator and the tenants of the airport that conduct industrial activities as described above, or as described anywhere in 40 CFR 122.26(b)(14) and which have storm water discharges, are required to apply for coverage under an NPDES storm water permit for the discharges from their areas of operation. Where an airport has multiple operators (airport authority and tenants) that have storm water discharges associated with industrial activity, as described above, each operator is required to apply for coverage under an NPDES storm water permit. This may be done as separate operators or may be done as co-permittees. Regardless, each individual party, whether a co-permittee or a separate permittee, must submit a notice of intent (NOI) to be covered under today's permit. During implementation of the storm water pollution prevention plan, the airport authority should work cooperatively with tenants that are not required to have a NPDES permit for their storm water discharges. The airport authority may accomplish this through negotiated agreements, contractual requirements, or other means. Ultimately, the operator(s)/owner(s) (the airport authority) of the storm water outfalls from the airport is(are) responsible for compliance with all terms and conditions of this or other NPDES permits applicable to those outfalls. Storm water pollution prevention plans developed separately for areas of the airport facility occupied by tenants of the airport that are regulated under 40 CFR 122.26(b)(14) as a storm water discharge associated with industrial activity shall be integrated into the storm water pollution prevention plan for the entire airport facility.

The airport authority and tenants of the airport are encouraged to apply as co-permittees under today's permit, and to work in partnership in the development and implementation of a storm water pollution prevention plan.

2. Pollutants Found in Storm Water Discharges

In general, the quantitative data submitted thus far has not raised any particular areas of concern with respect to discharges of pollutants resulting from vehicle maintenance and/or deicing/anti-icing operations conducted at airport facilities. However, EPA believes that the part 2 sampling data does not provide justification that discharges resulting from deicing/anti-icing operations are not a significant source of pollutants. The sampling requirements for part 2 of the group application did not specify that facilities must sample storm water discharges from areas where deicing/anti-icing activities occur and/or during times when such operations were being conducted. As a result, only one facility indicated that the sampling data submitted was collected from areas where deicing activities were being conducted. After reviewing recent case studies on the effects of glycol discharges to receiving waters, EPA reports and the results of FAA surveys, EPA believes that additional information on the discharges of deicing/anti-icing chemicals to receiving waters as a result of aircraft and runway deicing/anti-icing operations is warranted and necessary.

Both ethylene and propylene glycols exert high oxygen demands when released into receiving waters. As such, this section requires that facilities report both the Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) of discharges sampled at facilities that use at least 100,000 gallons or more of glycol-based deicing/anti-icing chemicals. The concentration of nitrogen and possibly ammonia are the concern with respect to deicing/anti-icing operations where urea is used. Therefore, this section requires that facilities subject to the monitoring requirements in Part XI.S.5. of the permit also report the concentration of Total Kjeldahl Nitrogen (TKN) in discharges sampled.

The results of the storm water survey conducted by the FAA (June 1992) showed that 10 percent of the respondents who conduct deicing/anti-icing activities used more than 100,000 gallons of glycol-based deicing/anti-icing chemicals during winter seasons. In addition, those facilities using more than 100,000 gallons of glycol-based deicing/anti-icing chemicals accounted for 71 percent of the total amount of glycol-based deicing/anti-icing chemicals reported in the survey. In a similar survey conducted by the American Association of Airport

Executives, 4 percent of the airports conducting deicing/anti-icing activities used more than 100,000 gallons of ethylene glycol which represented approximately 76 percent of the total amount of ethylene glycol used by all airports surveyed.

3. Special Conditions

a. Prohibition of Non-storm Water Discharges. In addition to the non-storm water prohibitions described under Part III.A.2, today's permit clarifies in Part XI.S.2.a (Prohibition of Non-storm Water Discharges) that non-storm water discharges, including discharges from aircraft, ground vehicle and equipment washwaters, dry weather discharges from airport deicing/anti-icing operations, and dry weather discharges resulting from runway maintenance are not authorized under this permit. Dry weather discharges are generated from processes other than those described in the definition of storm water. The definition of storm water includes storm water runoff, snow melt runoff, and surface runoff and drainage. There is no limit on the time between the snowfall and snow melt for the purpose of including a snow melt discharge in the definition of storm water. All other discharges not included in the definition of storm water constitute non-storm water discharges. Operators of non-storm water discharges must obtain coverage under a separate NPDES wastewater permit if such discharges are a point source discharge to waters of the U.S. or are discharged through a municipal separate storm sewer system. In a related requirement, the permittee is required to attach a copy of the NPDES permit issued for the discharge of non-storm water runoff or, if an NPDES permit has not yet been issued, a copy of the pending application to the plan. For facilities that discharge the waters mentioned above to a sanitary sewer system, the operator of the sanitary sewer system must be notified. A copy of the notification letter must be attached to the plan. If an industrial user permit has been issued under a pretreatment program, a copy of the permit must be attached to the plan as does any other permit to which the facility's discharge waters are subject. This will help to prevent confusion and help to ensure that non-storm water discharges are not inadvertently authorized by this permit.

b. Releases of Reportable Quantities of Hazardous Substances and Oil. Today's permit clarifies in Part XI.S.2.b (Releases of Reportable Quantities of Hazardous Substances and Oil) that each individual permittee is required to report spills equal to or exceeding the RQ levels specified at 40 CFR 110, 117 and 302. If the airport authority is the sole permittee, then the sum total of all spills at the airport must be assessed against the RQ. If the airport authority is a co-permittee with other deicing/anti-icing operators at the airport, such as numerous different airlines, the assessed amount must be the summation of spills by each co-permittee. If separate, distinct individual permittees exist at the airport, then the amount spilled by each separate permittee must be the assessed amount for the RQ determination.

4. Storm Water Pollution Prevention Plan Requirements

a. Contents of the Plan. The pollution prevention plan requirements described below are in addition to those found under Part VI.C.

(1) Description of Potential Pollutant Sources. In addition to the common pollution prevention plan requirements discussed in Part VI.C.2.a. (Drainage), the site map developed for an entire airport shall identify the location of each tenant of the facility describe their activities.

In addition to the pollution prevention requirements discussed in Part VI.C.2. (Description of Potential Pollutant Sources), airport facilities, including areas operated by tenants of the facility that conduct industrial activities, must address the following specific operations and areas where the operations occur:

Aircraft Deicing/Anti-icing—Includes both deicing to removė frost, snow or ice, and anti-icing which prevents the accumulation of frost, snow or ice. Deicing/anti-icing of an airplane is accomplished through the application of a freezing point depressant fluid, commonly ethylene glycol or propylene glycol, to the exterior surface of an aircraft. Both ethylene and propylene glycol have high biochemical oxygen demands (BOD) when discharged to receiving waters. Environmental impacts on surface waters due to glycol discharges includes glycol odors and glycol contaminated surface water and ground water systems, diminished dissolved oxygen levels and fish kills.

The Federal Aviation Administration (FAA) recently conducted a survey which focused on aircraft and runway deicing/anti-icing operations at U.S. airports. Ninety-six airports responded to the survey and results are summarized in a final report dated June 1, 1992. In summary, 65 airports indicated the amounts of ethylene glycol used for aircraft deicing for the winter periods of 1989–90 and 1990–91 and the volumes used by each airport ranged significantly, from a few gallons to 520,000 gallons. The average annual volume of ethylene glycol used by all respondents for the winter periods of 1989–90 and 1990–91 was approximately 2.16 million gallons.

The FAA survey summary reported that the majority of aircraft deicing operations occur on the apron adjacent to the passenger terminal and runoff generally drains to a nearby storm water inlet. In fact, 31 of the respondents to the FAA survey indicated that 75 percent or more of the spent deicing chemicals were discharged to a storm sewer system. In general, the remainder of spent chemical resulting from aircraft deicing operations drained to ditches or open areas.

All aspects of aircraft deicing/anti-icing operations, including quantities used and stored, as well as application, handling and storage procedures are required to be addressed under the conditions of this section.

(b) Runway Deicing/Anti-icing—Includes both deicing and anti-icing operations conducted on runways, taxiways and ramps. Runway deicing/anti-icing commonly involves either the application of chemical fluids such as ethylene glycol or solid constituents such as pelletized urea. Urea has a high nitrogen content, therefore degradation of urea in a receiving water causes an increase in nutrient loadings resulting in an accelerated growth of algae and eutrophic conditions. Under certain ambient conditions, the degradation of urea in receiving waters can also result in ammonia concentrations toxic to aquatic life.

The FAA's storm water survey reported that, of the facilities that indicated using urea for runway deicing/anti-icing for the winter periods of 1989–90 and 1990–91, the amount of urea used during a single winter period ranged from 100 pounds to 1,450,000 pounds (715 tons). With regard to disposal of spent deicing/anti-icing chemicals from runways, taxiways and ramps, 20 airports indicated that they discharged 50 percent or more of runoff from deicing areas directly to a storm sewer system. In response to questions concerning collection and treatment of spent deicing chemicals from runway deicing/anti-icing activities, only five facilities indicated that runoff from runway deicing/anti-icing operations was collected and treated.

All aspects of runway deicing/anti-icing operations, including types of deicing/anti-icing chemicals, quantities used and stored, as well as application, handling and storage procedures are required to be addressed under the conditions of this section.

(c) Aircraft Servicing—Typically conducted on the apron area adjacent to the passenger terminal, the servicing of aircraft could potentially contribute pollutants to storm water. As a result of spills or leaks during the servicing of aircraft, fluids such as engine oil, hydraulic fluid, fuel and lavatory waste could potentially enter the storm water system and/or be discharged to receiving waters. All spillage other than potable water should be prevented from entering the storm sewer system.

(d) Aircraft, Ground Vehicle and Equipment Maintenance and Washing—Maintenance activities included in this section include both minor and major operations conducted either on the apron adjacent to the passenger terminal, or at dedicated maintenance facilities. Potential pollutant sources from all types of maintenance activities include spills and leaks of engine oils, hydraulic fluids, transmission oil, radiator fluids, and chemical solvents used for parts cleaning. In addition, the disposal of waste parts, batteries, oil and fuel filters, and oily rags also have a potential for contaminating storm water runoff from maintenance areas unless proper management practices and operating procedures are implemented. The spent wash water from aircraft and ground vehicle washing activities could potentially be contaminated with surface dirt, metals, and fluids (fuel, hydraulic fluid, oil, lavatory waste).

(e) Runway Maintenance—Over time, materials such as tire rubber, oil and grease, paint chips, and jet fuel can build up on the surface of a runway causing a reduction in the friction of the pavement surface. When the friction level of a runway falls below a specific level, then maintenance must be performed. The Federal Aviation Administration (FAA) recommends several methods for removing rubber deposits and other contaminants from a runway surface including high pressure water, chemical solvents, high velocity particle impact, and mechanical grinding. If not properly managed, the materials removed from the runway surface could be discharged into nearby surface waters. Similarly, if chemical solvents are used in the maintenance operation, improper management practices could result in discharges of the chemical solvents in the storm water runoff from runway areas to nearby surface waters.

(2) Measures and Controls. In addition to the common pollution prevention plan requirements discussed in Part VI.C.3. (Measures and Controls), this section specifies that permittees must address particular Best Management Practices (BMP) for specific areas and operations identified as potential sources of pollutants. This section further specifies that a schedule for implementation shall be provided for each BMP selected. The BMPs specified in this section are not intended to be the only alternative management practices considered by operators, simply the minimum to be considered. In most cases, the BMPs specified are common sense approaches that are already in practice at many airport facilities. As such, operators may only need to include the information in their storm water pollution prevention plan. Specific areas and industrial operations mentioned in this section and the corresponding BMPs for such areas are the following:

(a) Aircraft, Ground Vehicle and Equipment Maintenance Areas (including aircraft service areas)—The plan must describe measures that prevent or minimize the contamination of storm water runoff from all areas used for aircraft, ground vehicle and equipment maintenance and servicing. Management practices such as performing all maintenance activities indoors, maintaining an organized inventory of materials used, draining all parts of fluids prior to disposal, prohibiting the practice of hosing down the apron or hangar floor, using dry cleanup methods in the event of spills, and/or collecting the storm water runoff from maintenance and/or service areas and providing treatment, or recycling should be considered.

(b) Aircraft, Ground Vehicle, and Equipment Cleaning Areas—The plan must describe measures that prevent or minimize the contamination of the storm water runoff from all areas used for aircraft, ground vehicle, and equipment maintenance. Management practices such as performing all cleaning operations indoors, and/or collecting the storm water runoff from the area and providing treatment or recycling should be considered.

(c) Aircraft, Ground Vehicle, and Equipment Storage Areas—The storage of aircraft, ground vehicles, and equipment awaiting maintenance must be confined to designated areas (delineated on the site map). The plan must describe measures that prevent or minimize the contamination of storm water runoff from these areas. Management practices such as indoor storage of aircraft and ground vehicles, the use of drip pans for the collection of fluid leaks, and perimeter drains, dikes or berms surrounding storage areas should be considered.

(d) Material Storage Areas—Storage units of all materials (e.g., used oils, hydraulic fluids, spent solvents and waste aircraft fuel) must be maintained in good condition, so as to prevent contamination of storm water, and plainly labeled (e.g., "used oil," "Contaminated Jet-A," etc.). The plan must describe measures that prevent or minimize contamination of the storm water runoff from storage areas. Management practices such as indoor storage of materials, centralized storage areas for waste materials, and/or installation of berms and dikes around storage areas should be considered for implementation.

(e) Airport Fuel System and Fueling Areas—The plan must describe measures that prevent or minimize the discharge of fuels to the storm sewer resulting from fuel servicing activities or other operations conducted in support of the airport fuel system. Where the discharge of fuels into the storm sewer cannot be prevented, the plan shall indicate measures that will be employed to prevent or minimize the discharge of the contaminated runoff into receiving surface waters.

Where above ground storage timers are present, pollution prevention plan requirements shall be consistent with requirements established in 40 CFR 112.7 guidelines for the preparation and implementation of a spill prevention control and countermeasure (SPCC) plan. Where a SPCC plan already exists, the storm water pollution prevention plan may incorporate requirements into the PPP by reference.

(f) Source Reduction—This section specifies that facilities which conduct aircraft and/or runway (including taxiways and ramps) deicing/anti-icing operations shall evaluate present operating procedures to consider alternative practices which would reduce the overall amount of deicing/anti-icing chemical used and/or lessen the environmental impact of the pollutant source.

With regard to runway deicing operations, operators should begin by evaluating present chemical application rates to ensure against excessive over application. Devices which meter the amount of chemical being applied to runways help to prevent over application. Operators should also emphasize anti-icing operations which would preclude the need to deice; less chemical is required to prevent the formation of ice on a runway than is required to remove ice from a runway. To further assist in implementing anti-icing procedures, operators should also consider installing runway ice detection systems (RID) otherwise known as "pavement sensors" which monitor runway temperatures. Pavement sensors provide an indication of when runway temperatures are approaching freezing conditions, thus alerting operators of the need to conduct anti-icing operations. Deicing/anti-icing chemicals applied during extremely cold, dry conditions, are often ineffective since they do not adhere to the ice surface and may be scattered as a result of windy conditions or aircraft movement. In an effort to improve the efficiency of the application, operators should consider pre-wetting the deicing chemical to improve the adhesion to the iced surface.

With regard to substitute deicing/ chemicals for runway use, operators should consider using chemicals which have less of an environmental impact on receiving waters. Potassium acetate, has a lower oxygen demand than glycol, is nontoxic to aquatic habitat or humans, and was approved by the FAA for runway deicing operations in November, 1991 (AC No. 150/5200–30A CHG 1).

In considering alternative management practices for aircraft deicing/ operations, operators should evaluate present application rates to ensure against excessive over application. In addition, operators may consider pretreating aircraft with hot water or forced air prior to the application of chemical deicer. The goal of this management practice is to reduce the amount of chemical deicer used during the operation. This management practice alone is not sufficient since discharges of small concentrations of glycol can have significant effects on receiving waters. It is, however, an effective measure to reduce the amount of glycol needed per operation.

(g) Management of Runoff—A number of reports including EPA's Guidance For Issuing NPDES Storm Water Permits For Airports, September 28, 1991 and Federal Aviation Administration (FAA) Advisory Circular (AC 150–5320–15) indicate that the most common location for deicing/anti-icing aircraft at U.S. airports is along the apron areas where mobile deicing vehicles operate from gate to gate. In a recent FAA survey of deicing/anti-icing operations at U.S. airports (June 1992), the majority of respondents indicated that spent deicer chemicals from aircraft deicing/anti-icing operations either drain to the storm sewer system, open areas, or are left to evaporate on the ramp.

This section specifies that operators shall provide a narrative description of BMPs to control or manage storm water runoff from areas where deicing/anti-icing operations occur in an effort to minimize or reduce the amount of pollutants being discharged from the site. For example, when deicing/anti-icing operations are conducted on aircraft during periods of dry weather, operators should ensure that storm water inlets are blocked to prevent the discharge of deicing/anti-icing chemicals to the storm sewer system. Mechanical vacuum systems or other similar devices can then be used to collect the spent deicing chemical from the apron surface for proper disposal to prevent those materials from later becoming a source of storm water contamination. Establishing a centralized deicing station would also provide better control over aircraft deicing/anti-icing operations in that it enables operators to readily collect spent deicing/anti-icing chemicals.

Once spent deicer/anti-icer chemicals are collected, operators can then select from various methods of disposal such as:

(i) Disposal to Sanitary Sewage Facility—Because glycols are readily biodegradable, runoff can be treated along with sanitary sewage. The receiving treatment plant would, however, have to have the capacity to handle the hydraulic load as well as the additional biochemical oxygen demand associated with the deicing/anti-icing chemical. Measurements have shown that the average oxygen demand for glycol is between 400,000 and 600,000 mg O2/L even if diluted per fluid manufacturers specifications (FAA AC 150–5320–15 CHG 1, 1991). To lessen both the increased hydraulic and pollutant loads due to runoff from airport deicing/anti-icing operations, retention basins may be located at the airport facility.

(ii) Retention and Detention Ponds—Conversion of suitable unused airport land into retention or detention basins allows for collection of large volumes of glycol waste from pavement surface runoff. The design capacity for such basins should at least handle surface runoffs for winter months noting the decreased microbial activity during the winter season which is needed for biodegradation, plus additional capacity for runoff during thawing periods. Continuous aeration would supply required oxygen and allow for faster biodegradation and release of glycol waste, which may reduce capacity requirements. Metering the discharge of flow from an onsite basin allows the operator to better control the rate of flow during peak flight hours and to avoid BOD shock loadings to a sanitary treatment facility or a surface water.

(iii) Recycling—Glycol recycling provides operators with a chemical cost savings since recaptured glycol can be sold or reused for other non-aircraft applications (FAA AC 150–5320–15, February 1991). Studies indicate that collected deicing chemicals which have glycol concentrations ranging from 15 to 25 percent can be cost effectively recycled. The optimal conditions for collecting the highest concentration of glycol in spent deicing fluid is directly from the apron or centralized deicing station when deicing operations are conducted during dry weather or light precipitation events. Deicing/anti-icing chemicals discharged to retention basins which are then allowed to mix with additional surface runoff typically result in glycol concentrations well below the acceptable range for recycling. There are, however, methods of physical separation presently available which increase the concentration of glycol and allow operators to recover a relatively reusable product.

(h) Inspections—In addition to the common pollution prevention plan requirements discussed in Part VI.C.3.d (Inspections), qualified personnel shall inspect equipment and areas involved in deicing/anti-icing operations on a weekly basis during periods when deicing/anti-icing operations are being conducted.

(i) Pollution Prevention Training—Pollution Prevention training programs shall inform management and personnel responsible for implementing activities identified in the storm water pollution prevention plan of the components and goals of the plan. Training should address topics such as spill response, good housekeeping, material management practices and deicing/anti-icing procedures. The pollution prevention plan shall identify periodic dates for such training. EPA recommends that facilities conduct training annually at a minimum. However, more frequent training may be necessary at facilities with high turnover of employees or where employee participation is essential to the storm water pollution prevention plan.

(3) Comprehensive Site Compliance Evaluation. The storm water pollution prevention plan must describe the scope and content of comprehensive site evaluation that qualified personnel will conduct to: (1) Confirm the accuracy of the description of potential pollution sources contained in the plan, (2) determine the effectiveness of the plan, and (3) assess compliance with the terms and conditions of the permit. Comprehensive site compliance evaluations must be conducted at least annually. The individual or individuals who will conduct the evaluations must be identified in the plan and should be members of the pollution prevention team. Evaluation reports must be

retained for a period of at least 3 years following the date of evaluation.

Based on the results of each evaluation, the description of potential pollution sources, and measures and controls, the plan must be revised as appropriate within 2 weeks after each inspection. Changes in the measures and controls must be implemented on the site in a timely manner, and no later than 12 weeks after completion of the inspection.

5. Numeric Effluent Limitation

There are no additional numerical limitations beyond those in Part V.B. of this permit.

6. Monitoring and Reporting Requirements

In general, the quantitative data submitted with part 2 of the group application was inadequate to clearly identify particular areas of concern with respect to discharges of pollutants resulting from vehicle maintenance and/or deicing/anti-icing operations conducted at airport facilities. EPA believes that the part 2 sampling data does not provide justification that discharges resulting from deicing/anti-icing operations are not a significant source of pollutants. The sampling requirements for part 2 of the group application did not specify that facilities must sample storm water discharges from areas where deicing/anti-icing activities occur and/or during times when such operations were being conducted. As a result, only one facility indicated that the sampling data submitted was collected from areas where deicing/anti-icing activities were being conducted. After reviewing recent case studies on the effects of glycol discharges to receiving waters, EPA reports, and the results of FAA surveys, EPA believes that additional information on the impacts of discharges of deicing/anti-icing chemicals to receiving waters resulting from aircraft and runway deicing/anti-icing operations is warranted and necessary.

Both ethylene and propylene glycols exert high oxygen demands when released into receiving waters. As such, this section requires that facilities report both the Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) of discharges sampled at facilities that use at least 100,000 gallons or more of glycol-based deicing/anti-icing chemicals. The concentration of nitrogen and possibly ammonia are the concern with respect to deicing/anti-icing operations where urea is used. Therefore, this section requires that facilities subject to the monitoring requirements in Part XI.S.5. of the permit also report the concentration of Total Kjeldahl Nitrogen (TKN) in discharges sampled.

The results of the storm water survey conducted by FAA (June 1992) showed that 10 percent of the respondents who conduct deicing activities used more than 100,000 gallons of glycol-based deicing chemicals during winter seasons. In addition, those facilities using more than 100,000 gallons of glycol-based deicing chemicals accounted for 71 percent of the total amount of glycol-based deiced chemicals reported by all respondents in the survey. In a similar survey conducted by the American Association of Airport Executives, 4 percent of the airports conducting deicing activities used more than 100,000 gallons of ethylene glycol which represented approximately 76 percent of the total amount of ethylene glycol used by all airports surveyed.

a. Annual Loading Estimates. All facilities that use more than 100,000 gallons of glycol-based deicing/anti-icing chemicals and/or 100 tons or more of urea on an average annual basis shall prepare estimates of annual pollutant loadings resulting from discharges of spent deicing/anti-icing chemicals from the facility. The loading estimates shall reflect the amounts of deicing/anti-icing chemicals discharged to separate storm sewer systems or surface waters, prior to and after implementation of the facility's storm water pollution prevention plan. The purpose of these estimates is to calculate the net reduction in deicing/anti-icing chemical loadings to receiving streams. Such estimates shall be reviewed and certified by an environmental professional (engineer, scientist, etc.) with experience in storm water pollution prevention. The environmental professional need not be certified or registered, however, experience with development of storm water pollution prevention plans and with airport operations is critical to prepare accurate estimates. By means of the certification, the environmental professional, having examined the facility's deicing/anti-icing procedures and proposed control measures described in the storm water pollution prevention plan, shall attest that the loading estimates have been accurately prepared.

b. Analytical Monitoring Requirements. EPA believes that airports may reduce the level of pollutants in storm water runoff from their sites through the development and proper implementation of the storm water pollution prevention plan requirements discussed in today's permit. In order to provide a tool for evaluating the effectiveness of the pollution prevention plan and to characterize the discharge for potential environmental impacts, the permit requires airport facilities that use 100,000 gallons or more of glycol-based deicing/anti-icing chemicals and/or 100 tons or more of urea on an average annual basis to collect and analyze samples of their storm water discharges from areas where deicing/anti-icing activities occur for the pollutants listed in Table S–1. Airport facilities which use less than 100,000 gallons of glycol-based deicing/anti-icing chemicals and/or less than 100 tons of urea on an average annual basis are not required to monitor discharges resulting from deicing/anti-icing activities.

In determining if an airport is subject to the monitoring requirements, airport authorities must determine the "average annual usage rate" of deicing/anti-icing chemicals at their particular facility. The "average annual usage rate" is determined by averaging the total amounts of deicing/anti-icing chemicals used at the facility for the three previous calendar years. The total amount of deicing/anti-icing chemicals used at an airport facility is the cumulative amount used by the airport authority and each tenant of the airport facility. EPA recognizes that glycol-based deicing/anti-icing chemicals are often diluted with water prior to deicing aircraft. In some cases, deicing/anti-icing chemicals may constitute only 50 percent of the applied volume of liquid to aircraft. Therefore, in determining the fluid amounts of deicing/anti-icing chemicals used at a facility, operators should use the pre-dilution volume.

At a minimum, storm water discharges from airport facilities that use 100,000 gallons or more of glycol-based deicing/anti-icing chemicals and/or 100 tons or more of urea on an average basis must be monitored four times during the second year of permit coverage when deicing/anti-icing activities are occurring and from outfalls that receive storm water runoff from those areas. At the end of the second year of permit coverage, a facility must calculate the average concentration for all grab samples analyzed for each parameter listed in Table S–1 on an outfall-by-outfall basis. If more than four different events are sampled during a monitoring period, then the average concentration for each parameter shall be determined using all grab samples analyzed.

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TABLE S–1.—INDUSTRY MONITORING REQUIREMENTS

Parameter	Cut-off concentration
Biochemical Oxygen Demand (BOD_5).	30 mg/L
Chemical Oxygen Demand (COD).	120 mg/L
Ammonia	19 mg/L
pH	6.0 to 9 s.u.

If the average concentration for all grab samples analyzed for a parameter is less than or equal to the value listed in Table S–1, then the permittee is not required to conduct quantitative analysis for that parameter during the fourth year of the permit. If, however, the average concentration for all grab samples analyzed for a parameter is greater than the cut-off concentration listed in Table S–1, then the permittee is required to conduct monitoring four times for that parameter while deicing/anti-icing operations are occurring in the fourth year of the permit. Monitoring is not required during the first, third, and fifth year of the permit. The exclusion from monitoring in the fourth year of the permit is conditional on the facility maintaining industrial operations and BMPs that will ensure a quality of storm water discharges consistent with the average concentrations recorded during the second year of the permit.

TABLE S–2.—SCHEDULE OF MONITORING

2nd Year of Permit Coverage	• Collect a minimum of four samples during months of deicing/anti-icing (December–February) Conduct monitoring for four separate events during months of deicing/anti-icing (December–February) • Calculate the average concentration on an outfall by outfall basis, for all parameters analyzed during this period • If average concentration is greater than the value listed in Table S–1, then sampling is required during the fourth year of the permit • If average concentration is less than or equal to the value listed in Table S–1, then no further sampling is required for that parameter
4th Year of Permit Coverage	• Conduct monitoring four times, on an outfall by outfall basis, during the months of deicing/anti-icing (December–February) for any parameter where the average concentration in year 2 of the permit is greater than the value listed in Table S–1 • If industrial activities or the pollution prevention plan have been altered such that storm water discharges may be adversely affected, monitoring is required for all parameters of concern during the months of deicing/anti-icing (December–February)

In cases where the average concentration for all grabs analyzed for a parameter exceeds the cut-off concentration, EPA expects permittees to place special emphasis on methods for reducing the presence of those parameters in storm water discharges. Quarterly monitoring in the fourth year of the permit will reassess the effectiveness of the adjusted pollution prevention plan.

EPA realizes that if a facility is inactive and unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly chemical sampling.

c. Alternative Certification. The alternative certification provision discussed in other industry sectors described in Part VIII of this fact sheet are not applicable to discharges resulting from deicing/anti-icing operations. As structured, today's permit only requires monitoring from airports that use more than 100,000 gallons of glycol-based deicing/anti-icing chemicals and/or 100 tons of urea. In addition, airports that use less than the stated thresholds of deicing/anti-icing chemicals are not required to submit an alternative certification.

d. Reporting Requirements. Permittees are required to submit all monitoring results obtained during the second and fourth year of permit coverage no later than the 31st day of March following the monitoring period. For each outfall, one signed Discharge Monitoring Report form must be submitted to the Director per storm event sampled. For facilities conducting monitoring beyond the minimum requirements an additional Discharge Monitoring Report Form must be filed for each analysis.

e. Sample Type. A minimum of one grab and one flow-weighted composite sample shall be taken from each outfall that collects runoff from areas where deicing/anti-icing activities occur. The required 72-hour storm event interval is waived where the preceding measurable storm event did not result in a measurable discharge from the facility. The required 72-hour storm event interval may also be waived where the permittee documents that less than a 72-hour interval is representative for local storm events during the season when sampling is being conducted. The grab sample is intended to provide information on the maximum expected concentrations of BOD5, COD, and ammonia as a result of deicing/anti-icing chemicals discharged during the precipitation event. The composite sample is intended to provide a measure of the BOD5, COD, ammonia loadings for the entire precipitation event as a result of the discharge of deicing/anti-icing chemicals. It will also provide site-specific information necessary for calculating the estimates of the annual pollutant loadings also required by this permit. The recommended methodology for performing grab and composite sampling is described at 40 CFR 122.21(g)(7). The permittee has the option to submit site-specific deicing/anti-icing discharge monitoring protocol and methodology, better suited to the particular facility, to the Director for approval.

f. Representative Discharge. When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may test the effluent of one of such outfalls and report that the quantitative data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluent. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

T. Storm Water Discharges Associated With Industrial Activity From Treatment Works

1. Discharges Covered Under this Section

On November 16, 1990 (55 FR 47990), the U.S. Environmental Protection Agency (EPA) promulgated the regulatory definition of "storm water discharges associated with industrial activity." This definition includes point source discharges of storm water from eleven categories of facilities, including "* * * (ix) treatment works treating domestic sewage or any other sewage sludge or wastewater treatment device or system, used in the storage, treatment, recycling, and reclamation of municipal or domestic sewage, including land dedicated to the disposal of sewage sludge that are located within the confines of the facility, with a design flow of 1.0 M.G.D. or more or required to have an approved pretreatment program under 40 CFR part 403."

This section establishes special conditions for storm water discharges associated with industrial activity from treatment works treating domestic sewage with a design flow of 1.0 M.G.D. or more, or for treatment works that are required to have an approved pretreatment program under 40 CFR Part 403, or for those having land dedicated to the disposal of sewage sludge within the confines of the facility. Please note that storm water discharges from farm lands, domestic gardens, or lands used for sludge management where sludge is beneficially reused and which are not physically located in the confines of the facility, or areas that are in compliance with Section 405 of the Clean Water Act (CWA), are not currently regulated under the Federal storm water regulations.

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

2. Industry Profile

Wastewater treatment plants remove organic and inorganic contaminants from domestic sewage and sludge. This section provides a description of the treatment processes for reducing pollutants in domestic sewage. The operations are basically the same at all treatment plants and may be categorized by three general processes: primary treatment, secondary treatment, and tertiary treatment.

Primary Treatment—The objective of primary treatment is the removal of settleable and suspended organic pollutants. This typically involves at least one of the following operations: screening, grit removal, and sedimentation. Chemical processes, such as disinfection, may also occur during primary treatment operations.

Secondary Treatment—The objective of secondary treatment is further removal of settleable solids and soluble organic matter. The operations employed during secondary treatment include biological oxidation via suspended growth or fixed film processes, such as activated sludge, rotating biological contractors or trickling filters.

Tertiary Treatment—The objectives of tertiary treatment include further treatment of wastewater, such as removal of suspended solids by filtration; removal of nutrients, such as phosphorus and nitrogen, typically through chemical additions and biological processes, or by selective ion exchange; and further removal of pollutants through activated carbon treatment.

Prior to discharge into a receiving water body, treated wastewater is disinfected using chlorination followed by dechlorination. Sludge produced during primary and secondary treatment is commonly combined, thickened, stabilized, and then mechanically dewatered. Sludge is aerobically or anaerobically stabilized by adjusting the pH with lime. This is followed by dewatering process where a polymer is added to condition the sludge for dewatering. Sludge is often stored onsite in piles exposed to weather, until final disposal (e.g., surface disposal, or incineration). When sludge is to be land applied, sludge drying beds or composting piles may be exposed to precipitation. In cases where sludge is incinerated onsite of the treatment plant, ash piles or impoundments may be exposed to precipitation.

3. Pollutants Found in Storm Water Discharges From Treatment Works

The impact of industrial activities at treatment works on storm water discharges will vary. Factors at a site which influence the water quality include geographic location, hydrogeology, the industrial activities exposed to storm water discharges, the facility's size, the types of pollution prevention measures/best management practices in place, and the type, duration, and intensity of storm events. Taken together or separately, these factors determine how polluted the storm water discharges will be at a given facility. For example, caustic soda may be significant source of pollutants at some facilities, while incinerator ash may be the primary pollutant source at others. Additionally, pollutant sources other than storm water, such as illicit connections, spills, and other improperly dumped materials, may increase the pollutant loading discharged into Waters of the United States.

Table T–1 lists industrial activities that commonly occur at treatment works, common pollutant sources at these facilities, and pollutants that are associated with these sources. Table T–1 identifies parameters as potential pollutants of concern associated with facilities covered by this section.

TABLE T–1.—DESCRIPTION OF INDUSTRIAL ACTIVITIES, POTENTIAL POLLUTANT SOURCES, AND POSSIBLE POLLUTANTS

Activity	Pollutant source	Pollutant
Preparation of biological and physical treatment processes.	Spills and leaks of process chemicals	Disinfectants, polymers and coagulants, alum, ferric chloride, soda ash, lime, sodium aluminate, sodium hypochlorite, caustic soda.

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TABLE T-1.—DESCRIPTION OF INDUSTRIAL ACTIVITIES, POTENTIAL POLLUTANT SOURCES, AND POSSIBLE POLLUTANTS—Continued

Activity	Pollutant source	Pollutant
Soil amending and grass fertilizing	Over fertilizing	Commercial brands of balance fertilizers (6–6–6, 8–8–8 or 12–12–12), commercial sludge based products, nitrogen, other nutrients, phosphorous, ammonia.
Liquid storage in above ground storage	External corrosion and structural failure	Aluminum sulfate, liquid chlorine, liquid polymer, fuel, oil.
	Installation problems	Aluminum sulfate, liquid chlorine, liquid polymer, fuel, oil.
	Spills and overfills due to operator error	aluminum sulfate, liquid chlorine, liquid polymer, fuel, oil.
	Failure of piping systems (pipes, pumps, flanges, couplings, hoses, and valves).	Aluminum sulfate, liquid chlorine, liquid polymer, fuel, oil.
	Leaks or spills during pumping of liquids from barges, trucks, or rail cars to a storage facility.	Aluminum sulfate, liquid chlorine, liquid polymer, fuel, oil.
Pest Control	Large quantities of pesticide application, pesticide storage.	Diazanon, malathion, amdro, dimethylphthalate, diethyl phthalate, dichlorvos, carbaryl, skeetal, batex, liquid copper.
Sludge Drying Beds	Sludge	Nitrate, TDS, TSS, ammonia.
Sludge Storage Piles	Sludge	Nitrate, TDS, TSS, ammonia.
Sludge Transfer	Sludge, vehicles, transfer equipment	Nitrate, TDS, TSS, oil, fuel, hydraulic fluids, ammonia.
Incineration	Ash impoundments/piles	Heavy metals, TDS, TSS.
Miscellaneous	Grit and scum piles from clarifiers, screens, exposed soil.	TSS, heavy metals, fecal coliform, nitrate, TSS.

Sources: EPA, Risk Reduction Engineering Lab, Cincinnati, OH, and U.S. of America National Committee for Representation of the United States to the International Association of Water Pollution Research and Control. November 1989. "Developments at International Conference on Water Pollution Research (14th)." EPA/600/2–89/059.
EPA, Office of Water Program Operations. June 1983. "Need Survey, 1982. Conveyance, Treatment, and Control of Municipal Wastewater, Combined Sewer Overflows, and Storm Water Runoff: Summaries of Technical Data." EPA/430/9–83/002.
EPA, Office of Research and Development. May 1992. "Facility Pollution Prevention Guide." EPA/600/R–92/088.
EPA, Office of Water. September 1992. "Storm Water Management for Industrial Activities—Developing Pollution Prevention Plans and Best Management Practices." EPA 832–R–92–006.

Based on the similarities of the facilities included in this sector in terms of industrial activities and significant materials, EPA believes it is appropriate to discuss the potential pollutants at treatment works facilities as a whole and not subdivide this sector. Therefore, Table T-2 lists data for selected parameters from facilities in the treatment works sector. These data include the eight pollutants that all facilities were required to monitor for under Form 2F, as well as the pollutants that EPA has determined may merit further monitoring.

TABLE T-2.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY TREATMENT WORKS FACILITIES SUBMITTING PART II SAMPLING DATA[i] (mg/L)

Pollutant Sample type	No. of Facilities		No. of Samples		Mean		Minimum		Maximum		Median		95th Percentile		99th Percentile	
	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	49	48	94	93	32.7	44.2	0.0	0.0	1300.0	1300.0	12.0	7.5	78.0	83.0	171.6	203.4
COD	47	46	85	84	131.8	155.7	0.0	0.0	1900.0	2000.0	67.3	61.7	437.4	431.9	932.2	942.3
Nitrate + Nitrite Nitrogen	47	46	89	88	19.70	19.34	0.00	0.00	427.00	396.78	0.93	0.76	41.56	35.04	167.28	137.67
Total Kjeldahl Nitrogen	46	45	84	83	7.67	4.52	0.00	0.00	213.00	150.00	1.35	1.31	14.24	9.30	32.94	19.05
Oil & Grease	49	N/A	96	N/A	35.7	N/A	0.0	N/A	1210.0	N/A	1.2	N/A	60.5	N/A	202.8	N/A
pH	43	N/A	86	N/A	N/A	N/A	0.4	N/A	8.9	N/A	7.0	N/A	11.5	N/A	14.5	N/A
Total Phosphorus	49	48	91	89	0.91	0.67	0.00	0.00	9.50	5.92	0.47	0.45	2.91	2.20	6.21	4.39
Total Suspended Solids	50	49	95	93	153	111	0	2	1836	845	64	55	638	422	1661	1013

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.
[ii] Composite samples.

4. Options for Controlling Pollutants

Part 1 group application data indicate that BMPs have not been widely implemented at the representative sampling facilities. Less than 3 percent of the sampling subgroup reported that they cover loading areas, storage areas, or material handling areas; approximately 10 percent reported that they use containment; less than 4 percent of the representative facilities use concrete pads. The most commonly listed (approximately 15 percent) material management practice is catch basins. Because BMPs described in part 1 data are limited, the following table is provided to identify BMPs associated with activities that routinely occur at treatment works.

TABLE T-3.—GENERAL STORM WATER BMPS FOR TREATMENT WORKS

Activity	BMPs
Preparation of biological and physical treatment process.	Use drip pans under drums and equipment where feasible. Store process chemicals inside buildings. Inspect the storage yard for filling drip pans and other problems regularly. Train employees on procedures for storing and inspecting chemicals.
Soil amending and grass fertilizing	Use the appropriate amount of fertilizer. Do not overfertilize. Train employee on proper fertilizing techniques.
Liquid storage in above ground storage containers.	Maintain good integrity of all storage containers. Install safeguards (such as diking or berming) against accidental releases at the storage area. Inspect storage tanks to detect potential leaks and perform preventive maintenance. Inspect piping systems (pipes, pumps, flanges, couplings, hoses, and valves) for failures or leaks. Train employees on proper filling and transfer procedures.
Pest Control	Minimize pesticide application. Only apply pesticide if needed. Train employees on proper pesticide application.
Sludge Drying Beds	Ensure drying bed is draining properly (e.g., check for clogging); avoid overfilling drying bed; grade the land to divert flow around drying bed; berm, dike, or curb drying bed areas; cover drying beds.
Sludge Storage Piles	Confine storage of sludge to a designated area as far from any receiving water body as possible; store sludge on an impervious surface (e.g., concrete pad); grade the land to divert flow around storage piles; berm, dike, or curb sludge storage piles; cover sludge storage piles.
Sludge Transfer	Promptly remove any sludge spilled during transfer; conduct transfer operations over an impervious surface; avoid transferring sludge during rain events; grade the land to divert flow around transfer areas; berm, curb, or dike transfer areas; avoid locating transfer operations near receiving water bodies.
Incineration—ash impoundments/piles	Line ash impoundments with clay (or other type of impervious material); ensure ash impoundments will hold maximum volume of ash and a 10-year, 24-hour rain event; curb, berm, or dike ash storage areas; avoid locating ash storage areas near receiving water bodies.
Miscellaneous	Properly dispose of grit/scum; properly dispose of screens on a daily basis; maximize vegetative cover to stabilize soil and reduce erosion.

Sources: NPDES Storm Water Group Applications—Part 1. Received by EPA March 18, 1991 through December 31, 1992.
EPA, Office of Research and Development. May 1992. "Facility Pollution Prevention Guide." EPA/600/R-92/088.
EPA, Office of Water. September 1992. "Storm Water Management for Industrial Activities—Developing Pollution Prevention Plans and Best Management Practices." EPA 832-R-92-006.
U.S. Postal Service. May 1992. "NPDES/Storm Water Guide." AS-554.

5. Special Conditions

There are no additional requirements under this section other than those described in part VI.B of this fact sheet.

6. Storm Water Pollution Prevention Plan Requirements

There are no additional requirements under this section other than those described in Part VI.C. of this fact sheet.

7. Monitoring and Reporting Requirements

The regulatory modifications at 40 CFR 122.44(i)(2) established on April 2, 1992, grant permit writers the flexibility to reduce monitoring requirements in storm water discharge permits. EPA has determined that the potential for storm water discharges to contain pollutants above benchmark levels, because of the industrial activities and materials exposed to precipitation, does not support sampling at treatment works facilities.

Under the Storm Water Regulations at 40 CFR 122.26(b)(14), EPA defined "storm water discharge associated with industrial activity". The focus of today's permit is to address the presence of pollutants that are associated with the industrial activities identified in this definition and that might be found in storm water discharges. Under the methodology for determining analytical monitoring requirements, described in section VI.E.1 of this fact sheet, nitrate plus nitrite nitrogen is above the bench mark concentrations for the treatment works sector. After a review of the nature of industrial activities and the significant materials exposed to storm water described by facilities in this sector, EPA has determined that the higher concentrations of nitrate plus nitrite nitrogen are not likely to be caused by the industrial activity, but may be primarily due to non-industrial activities on-site. Today's permit does not require treatment works facilities to conduct analytical monitoring for this parameter.

Based on a consideration of the BMPs typically used at these facilities, and generally low pollutant values from the application data, EPA believes that the pollution prevention plan with visual examinations of storm water discharges will help ensure storm water contamination is minimized.

a. Quarterly Visual Examination of Storm Water. Quarterly visual examinations are required of a storm water discharge from each outfall at the treatment works. The examination must be of a grab sample collected from each storm water outfall. The examination of storm water grab samples shall include any observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, or other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on these samples.

The examination must be made at least once in each of the following 3-month periods during daylight unless there is insufficient rainfall or snow-melt to runoff: January through March, April through June, July through September, and October through December. Whenever practicable, the

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same individual should carry out the collection and examination of discharges throughout the life of the permit to ensure the greatest degree of consistency possible. Grab samples shall be collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 1 hour) of when the runoff begins discharging. Reports of the visual examination include: the examination date and time, examination personnel, visual quality of the storm water discharge, and probable sources of any observed storm water contamination. The visual examination reports must be maintained onsite with the pollution prevention plan.

When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the records of the visual examinations. Adverse weather conditions which may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

EPA realizes that if a facility is inactive and unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly visual examination.

When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may test the effluent of one of such outfalls and report that the quantitative data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluent. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

EPA believes that this quick and simple assessment will allow the permittee to approximate the effectiveness of his/her plan on a regular basis at very little cost. Although the visual examination cannot assess the chemical properties of the storm water discharged from the site, the examination will provide meaningful results upon which the facility may act quickly. The frequency of this visual examination will also allow for timely adjustments to be made to the plan. If BMPs are performing ineffectively, corrective action must be implemented. A set of tracking or follow-up procedures must be used to ensure that appropriate actions are taken in response to the examinations. The visual examination is intended to be performed by members of the pollution prevention team. This hands-on examination will enhance the staff's understanding of the storm water problems on that site and the effects of the management practices that are included in the plan.

EPA believes that with quarterly visual examinations and site compliance evaluations, potential sources of contaminants can be identified and controlled with BMPs. In determining the monitoring requirements, EPA considered the nature of the industrial activities and significant materials exposed at these sites, and performed a review of data provided in Part 2 group applications.

U. Storm Water Discharges Associated With Industrial Activity From Food and Kindred Products Facilities

1. Discharges Covered Under this Section

On November 16, 1990 (55 FR 47990), EPA promulgated the regulatory definition of "storm water discharges associated with industrial activity." This definition included point source discharges of storm water from 11 major categories of facilities, including: "* * * (xi) Facilities under Standard Industrial Classifications 20, 21 * * *."

This section covers storm water discharges associated with industrial activities from establishments manufacturing or processing foods and beverages for human consumption, and related products, and prepared feeds for animals and fowls. This section also covers establishments engaged in manufacturing cigarettes, cigars, and other tobacco products. Food and kindred products processing facilities subject to requirements under this section include the following types of operations (i.e., subsectors):

a. Meat Products (generally described by SIC Codes 2011, 2013, and 2015).

b. Dairy Products (generally described by SIC Codes 2021, 2022, 2023, 2024, and 2026).

c. Canned, Frozen, and Preserved Fruits, Vegetables, and Food Specialties (generally described by SIC Codes 2032, 2033, 2034, 2035, 2037, and 2038).

d. Grain Mill Products (generally described by SIC Codes 2041, 2043, 2044, 2045, 2046, 2047, and 2048).

e. Bakery Products (generally described by SIC Codes 2051, 2052, and 2053).

f. Sugar and Confectionery Products (generally described by SIC Codes 2061, 2062, 2063, 2064, 2066, 2067, and 2068).

g. Fats and Oils (generally described by SIC Codes 2074, 2075, 2076, 2077, and 2079).

h. Beverages (generally described by SIC Codes 2082, 2083, 2084, 2085, 2086, and 2087).

i. Miscellaneous Food Preparations and Kindred Products (generally described by SIC Codes 2091, 2092, 2095, 2096, 2097, 2098, and 2099).

j. Tobacco Products (generally described by SIC Codes 2111, 2121, 2131, and 2141).

Storm water discharges covered by this section include discharges from industrial plant yards; material handling sites; refuse sites; sites used for application or disposal of process wastewaters; sites used for storage and maintenance of material handling equipment; sites used for residual treatment, storage, or disposal; shipping and receiving areas; manufacturing buildings; storage areas for raw materials and intermediate and finished products; and areas where industrial activity has taken place in the past and significant materials remain and where the aforementioned areas are exposed to storm water.

This section does not cover any discharges subject to effluent limitations guidelines, including storm water that combines with process wastewater. Also, storm water that does not come into contact with any raw material, intermediate product, finished product, by-product, or waste product located on the site of the operation are not subject to permitting under this section according to 40 CFR 122.26(b)(14).

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

2. Industry Profile

From subsectors comprising the Food and Kindred Products Sector, as of January 1, 1993, 26 Part 2 Group Storm Water Applications were received from 9 of the 10 industrial subsectors (excluding tobacco products) and 31 different primary SIC Codes. Subsector descriptions for all facilities within the Food and Kindred Products sector are as follows:

a. Meat Products Subsector (SIC Code 201X). The Meat Products subsector is separated into three segments. These include meat packing plants (SIC 2011); sausages and other prepared meat products (SIC 2013); and poultry slaughtering and processing (SIC 2015). All three of the industrial segments submitted group application information. Production related activities for these segments include stockyards, slaughtering (killing, blood processing, viscera handling, and hide processing), cutting and deboning, meat processing, rendering, and materials recovery.

b. Dairy Products Subsector (SIC Code 202X). The Dairy Products subsector is separated into five segments. These segments include creamery butter; natural, processed, and imitation cheese; dry, condensed, and evaporated dairy products; ice cream and frozen desserts; and fluid milk. All five of the industrial segments submitted group application information. Although a variety of operations are encountered in the Dairy Products subsector, the initial operations (e.g., receiving stations, clarification, separation, and pasteurization) are common to most dairy plants and products. However, after these initial operations, the processes and equipment become highly dependent on the product segments. These operations may include: culturing, churning, pressing, curing, blending, condensing, sweetening, drying, milling, and packaging.

c. Canned Frozen and Preserved Fruits, Vegetables, and Frozen Specialties Subsector (SIC Code 203X). The Canned Frozen and Preserved Fruits, Vegetables, and Frozen Specialties subsector is separated into six segments. They include canned specialties; canned fruits, vegetables, preserves, jams, and jellies; dried and dehydrated fruits, vegetables, and soup mixes; pickled fruits and vegetables, vegetable sauces and seasonings, and salad dressings; frozen fruits, fruit juices, and vegetables; and other frozen specialties. Five of the six segments are represented in the part 2 application information with the pickled fruits and vegetables, vegetable sauces and seasonings, and salad dressings being the lone segment not represented in the part 2 data by a primary SIC Code (although this segment is represented as a secondary SIC Code). All of the facilities use various fruits or vegetables as the primary raw material. Sweeteners, such as sugar and corn syrup, are used as secondary raw materials. Typically, fruits and vegetables are washed, cut, blanched, and cooked prior to being classified as finished product. Additional operations may include drying, dehydrating, and freezing.

d. Grain Mills Subsector (SIC Code 204X). The Grain Mills subsector is separated into seven segments. These include flour and other grain mill products; cereal breakfast foods; rice milling; prepared flour mixes and doughs; wet corn milling; dog and cat food; and prepared feeds and feed ingredients for animals and fowls, except dogs and cats. Six of the seven segments are represented in the part 2 application information with the rice milling segment being the lone segment not represented in the part 2 data by a primary SIC Code. Process operations performed in the grain mill subsector include: washing, milling, debranning, heat treatment (i.e., steeping, parboiling, drying and cooking), screening, shaping (i.e., extruding, grinding, molding, and flaking), and vitamin and mineral supplementing.

e. Bakery Products Subsector (SIC Code 205X). The Bakery Products subsector is separated into three segments. These include the following industrial activities: bread and other bakery products, except cookies and crackers; cookies and crackers; and frozen bakery products, except bread. All three segments are represented in the part 2 application information by a primary SIC Code. Process operations in this subsector include mixing, shaping of dough, cooling, and decorating.

f. Sugar and Confectionery Subsector (SIC Code 206X). The Sugar and Confectionery subsector is separated into seven segments. These include the following industrial activities: cane sugar, except refining; cane sugar refining; beet sugar; candy and other confectionery products; chocolate and cocoa products; chewing gum; and salted and roasted nuts and seeds. Only two of the seven segments are represented in the part 2 application information (i.e., candy and other confectionery products and chocolate and other cocoa products). The primary raw materials include sugar, flavorings (including chocolate), flour, nuts, and milk, which are then mixed together, cooked, and then formed using various techniques into specified product shapes. The manufacture of chocolate products requires shelling, roasting, and grinding of the cocoa beans followed by the typical sugar processing operations identified above.

g. Fats and Oils Subsector (SIC Code 207X). The Fats and Oils subsector is separated into five segments. These include the cottonseed oil mills; soybean oil mills; vegetable oil mills, except corn, cottonseed, and soybean; animal and marine fats and oils; and shortening, table oils, margarine, and other edible fats and oils, not elsewhere classified. Only two of the five segments are represented in the part 2 application information (i.e., animal and marine fats and oils and shortening, table oils, margarine, and other edible fats and oils, not elsewhere classified). Typical process operations at an animal and marine fats and oils facility include cooking of inedible fats and oils from butcher shops, supermarkets, food manufacturing facilities, restaurants, and slaughterhouses, tallow and grease separation from proteinaceous solids. The solids are then ground to produce meat and bone meal. Operations at an edible oils manufacturer include refining, bleaching, hydrogenation, fractionation, emulsification, deodorization, filtration, and blending of the crude oils into edible products.

h. Beverages Subsector (SIC Code 208X). The Beverages subsector is separated into six segments. These include the malt beverages; malt; wines, brandy, and brandy spirits; distilled and blended liquors; bottled and canned soft drinks and carbonated waters; and flavoring extracts and flavoring syrups, not elsewhere classified segments. Four the six segments are represented by the part 2 application with malt and wines, brandy, and brandy spirits being the two segments not represented by the part 2 application information. Process operations may include brewing, distilling, fermentation, blending, and packaging (i.e., bottling, canning, or bulk packaging).

i. Miscellaneous Food Preparation and Kindred Products Subsector (SIC Code 209X). The Miscellaneous Food Preparation and Kindred Products

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subsector is separated into seven industrial segments. These include canned and cured fish and seafood; prepared fresh or frozen fish and seafoods; roasted coffee; potato chips, corn chips, and similar snacks; manufactured ice; macaroni, spaghetti, vermicelli, and noodles; and food preparations, not elsewhere classified segments. Three of the seven segments are represented by the part 2 application information (i.e., prepared fresh or frozen fish and seafoods; potato chips, corn chips, and similar snacks; and macaroni, spaghetti, vermicelli, and noodles). Process operations may include shelling, washing, drying, shaping, baking, frying, and seasoning.

j. Tobacco Products Subsector (SIC Code 21XX). The tobacco products subsector is separated into four segments. These include cigarettes, cigars, chewing and smoking tobacco and snuff, and tobacco stemming and redrying. None of these four segments submitted part 2 application information. Typical process operations may include drying, blending, shaping, cutting and rolling.

3. Pollutants in Storm Water Discharges Associated with Food and Kindred Products Processing Facilities.

Typical food and kindred products processing facilities do not conduct many processing operations outdoors. The nature of the business, and the required sanitary conditions, require that the raw materials through final product be protected from storm water. As such, the contamination of storm water from this sector is primarily from the loading and unloading of products and raw materials, spillage and leaks from tanks and containers stored outdoors, waste management practices, pest control, and improper connections to the storm sewer. Table U–1 lists potential pollutant sources from activities that commonly take place at food and kindred products processing facilities.

TABLE U–1.—DESCRIPTION OF POTENTIAL POLLUTANT SOURCES [i, ii, iii]

Activity	Pollutant source	Pollutant(s)
A. Raw Material Unloading/Product Loading.	• Container defects (bags, drums, bottles, crates) • Spills and leaks during unloading/ loading (tanks, rail cars) • Failed connections (hoses and couplings) • Washdown of unloading/loading area	BOD, TSS, O&G, pH, TKN.
B. Storage Containers:		
Liquid Storage (i.e., above ground storage tanks).	• Failed piping and connections (couplings, flanges, hoses, and valves) • External corrosion and structural failure • Spills and overflows due to operator error	BOD, TSS, O&G, pH.
Liquid Storage (drums, carboys, and gallon jugs).	• Outside containers • Open containers • External corrosion of the containers • Operator handling and transporting • Spills and leaks from damaged containers	BOD, TSS, O&G, pH.
Solid Storage (silos, holding bins, fiber drums, etc.).	• Dust and particulates • Operator handling and transporting • Spills and leaks	BOD, TSS, pH.
C. Waste Management:		
Air Emissions	• Oven emissions • Vents • Fine solids handling	BOD, TSS, O&G, pH.
Solid Waste	• Dumpsters and trash cans • Spent equipment, scraps, etc.	BOD, TSS, O&G, pH, copper, manganese.
Wastewater	• Treatment processes (e.g., hydraulic overflow) • Outside piping and connections (couplings, flanges, hoses, valves, and pumps)	BOD, TSS, O&G, pH, fecal coliform.
D. Pest Control:		
Pesticides, rodenticides, insecticides.	• Outside areas of applications	Miscellaneous insecticides, rodenticides, pesticides, etc., TKN.
E. Improper Connections to the Storm Sewer.	• Process wastewaters • Process floor drains • Sanitary sewers • USTs	BOD, TSS, O&G, pH.

[i] "Standard Handbook of Environmental Engineering," Corbitt, Robert A., McGraw-Hill, Inc., 1990.
[ii] Air Pollution Engineering Manual, Air and Waste Management Association, Edited by Anthony J. Buonicore and Wayne T. Davis, Van Nostrand Reinhold, New York, 1992.
[iii] "Environmental Engineering and Sanitation," Fourth Edition, Salvato, Joseph A., John Wiley & Sons, Inc., 1992.

Impacts caused by storm water discharges from food and kindred products processing facilities will vary from facility to facility. Several factors influence to what extent operations at the site can affect water quality. Such factors include: geographic location; hydrogeology; the types of industrial activities exposed to storm water; the size of the operation; the nature of storm water control measures in place; and the type, duration, and intensity of precipitation events. Each of these factors interact to influence the quantity and quality of storm water runoff. For example, flour/oil particulate emissions from vents (e.g., from baking operations) may be a significant source of pollutants at some facilities, while material storage may be a primary source at others. Similarly, a facility with all storm water from exposed industrial activity diverted to the sanitary sewer would have less of an impact than a facility not practicing this control option. In addition, sources of pollutants other than storm water, such as illicit connections, spills, and improperly dumped materials, may increase the pollutant loadings discharged in the receiving stream.

EPA reviewed Part 1 Group Storm Water Applications for facilities identified as sampling facilities to determine the types of significant materials from food and kindred products processing that are exposed to storm water. A list of these significant materials is presented in Table U–2. Note that significant materials related to vehicle maintenance (e.g., diesel fuel) and other miscellaneous nonprocessing materials (e.g., lumber) are not included in Table U–2.

TABLE U–2.—SIGNIFICANT MATERIALS EXPOSED TO STORM WATER

Acids (phosphoric, sulfuric)	Feathers
Activated carbon	Feed
Ammonia	Ferric chloride
Animal cages	Fruits, vegetables, coffee beans
Bleach	Gel bone
Blood	Grain (flour, oats, wheat)
Bone meal	Hides
Brewing residuals	Lard
Calcium oxide	Manure
Carbon dioxide	Milk
Caustic soda	Salts (brine)
Chlorine	Skim powder
Cheese	Starch
Coke oven tar	Sugar (sweetner, honey, fructose, syrup)
Detergent	Tallow
Eggs	Wastes (off-spec product, sludge)
Ethyl alcohol	Whey
Fats, greases, shortening, oils	Yeast

Based on the wide variety of industrial activities and significant materials at the facilities included in this sector, EPA believes it is appropriate to divide the food and kindred products industry into subsectors to properly analyze sampling data and determine monitoring requirements. As a result, this sector has been divided into the following subsectors: meat products; dairy products; canned, frozen, and preserved fruits; grain mill products; bakery products; sugar and confectionery products; fats and oils; beverages; miscellaneous food and kindred products; and tobacco products. Tables below include data for the eight pollutants that all facilities were required to monitor for under Form 2F. The tables also list those parameters that EPA has determined may merit further monitoring. A table has not been included for the following subsectors because less than 3 facilities submitted data in that subsector: sugar and confectionery products facilities; and tobacco products facilities.

TABLE U–3.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY MEAT PRODUCTS FACILITIES SUBMITTING PART II SAMPLING DATA[i] (mg/L)

Pollutant Sample type	No. of facilities		No. of samples		Mean		Minimum		Maximum		Median		95th percentile		99th percentile	
	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	30	29	51	50	25.8	19.2	0.0	0.0	170.0	81.0	12.0	9.2	102.5	78.7	248.436	182.3
COD	30	29	51	50	184.3	122.8	0.0	0.0	1307.0	1307.0	80.0	72.0	717.3	350.7	1623.7	659.3
Nitrate + Nitrite Nitrogen	30	29	51	50	1.35	1.24	0.00	0.00	4.75	8.66	0.86	0.60	4.54	3.78	8.84	7.10
Total Kjeldahl Nitrogen	30	29	51	50	3.30	3.57	0.00	0.00	18.00	27.00	2.00	1.80	9.59	12.55	16.92	26.07
Oil & Grease	31	N/A	52	N/A	7.7	N/A	0.0	N/A	34.0	N/A	6.6	N/A	25.3	N/A	41.7	N/A
pH	24	N/A	38	N/A	N/A	N/A	5.9	N/A	8.6	N/A	7.7	N/A	8.9	N/A	9.5	N/A
Total Phosphorus	30	29	51	50	20.45	0.94	0.02	0.02	970.00	9.70	0.28	0.28	9.89	3.11	36.98	8.25
Total Suspended Solids	30	29	51	50	397	206	0	0	2540	2120	98	68	2266	902	7830	2618

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.

[ii] Composite samples.

TABLE U–4.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY DAIRY PRODUCTS FACILITIES SUBMITTING PART II SAMPLING DATA[i] (mg/L)

Pollutant Sample type	No. of facilities		No. of samples		Mean		Minimum		Maximum		Median		95th percentile		99th percentile	
	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	33	33	81	81	66.4	49.6	0.0	0.0	1400.0	1360.0	17.0	10.0	185.0	122.4	479.0	297.5
COD	33	33	81	81	214.7	149.3	15.0	0.0	3010.0	2100.0	94.0	78.4	647.0	418.0	1385.3	836.8
Nitrate + Nitrite Nitrogen	33	33	81	81	1.24	0.99	0.00	0.00	25.52	8.88	0.61	0.57	3.53	3.16	7.18	6.31
Total Kjeldahl Nitrogen	33	33	81	81	4.35	3.68	0.00	0.00	32.00	32.40	2.50	2.44	12.40	10.18	22.65	18.04
Oil & Grease	33	N/A	81	N/A	6.1	N/A	0.0	N/A	92.4	N/A	2.0	N/A	26.1	N/A	58.9	N/A
pH	31	N/A	78	N/A	N/A	N/A	4.4	N/A	9.0	N/A	7.0	N/A	8.6	N/A	9.4	N/A
Total Phosphorus	33	33	80	80	1.68	1.07	0.00	0.00	24.40	6.80	0.50	0.38	7.59	4.71	19.51	11.35
Total Suspended Solids	32	32	79	79	225	218	0	0	2667	3110	56	53	967	798	2932	2274

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.

[ii] Composite samples.

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TABLE U–5.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY CANNED, FROZEN, AND PRESERVED FRUITS, VEGETABLES AND FOOD SPECIALTIES FACILITIES SUBMITTING PART II SAMPLING DATA[i] (mg/L)

Pollutant Sample type	No. of facilities		No. of samples		Mean		Minimum		Maximum		Median		95th percentile		99th percentile	
	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	29	26	71	56	48.9	44.0	0.0	0.0	1550.0	1150.0	9.1	8.5	122.9	98.1	305.3	232.0
COD	27	24	69	55	174.6	153.4	0.0	0.0	3810.0	2820.0	39.0	40.0	522.0	492.0	1293.2	1280.8
Nitrate + Nitrite Nitrogen	28	26	68	57	1.20	0.93	0.00	0.00	14.70	9.60	0.59	0.40	3.89	2.74	8.17	5.53
Total Kjeldahl Nitrogen	30	27	73	59	4.44	3.45	0.00	0.00	64.00	33.90	1.80	1.60	14.27	12.53	32.44	29.35
Oil & Grease	28	N/A	68	N/A	5.3	N/A	0.0	N/A	35.0	N/A	1.2	N/A	27.7	N/A	70.0	N/A
pH	26	N/A	68	N/A	N/A	N/A	4.3	N/A	10.3	N/A	7.1	N/A	8.7	N/A	9.7	N/A
Total Phosphorus	28	26	68	57	1.02	0.95	0.00	0.00	11.80	8.30	0.42	0.54	3.52	3.45	8.18	7.73
Total Suspended Solids	30	27	73	58	147	112	0	0	1840	800	67	49	787	585	2445	1681

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.
[ii] Composite samples.

TABLE U–6.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY GRAIN MILL PRODUCTS FACILITIES SUBMITTING PART II SAMPLING DATA[i] (mg/L)

Pollutant Sample type	No. of facilities		No. of samples		Mean		Minimum		Maximum		Median		95th percentile		99th percentile	
	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	72	70	77	75	86.4	73.9	0.0	0.0	713.0	968.0	20.0	21.0	296.2	249.8	770.8	613.7
COD	72	70	77	74	273.9	211.4	0.0	0.0	2000.0	2040.0	89.0	81.0	937.4	640.9	2170.9	1339.3
Nitrate + Nitrite Nitrogen	73	71	79	75	1.62	1.08	0.00	0.00	44.90	17.70	0.36	0.50	6.51	5.29	18.50	13.97
Total Kjeldahl Nitrogen	72	70	77	74	10.3	7.62	0.00	0.00	78.00	75.00	4.00	3.00	39.01	25.19	88.55	51.97
Oil & Grease	73	N/A	78	N/A	4.4	N/A	0.0	N/A	44.0	N/A	0.00	N/A	21.6	N/A	46.2	N/A
pH	73	N/A	78	N/A	N/A	N/A	5.0	N/A	8.9	N/A	7.0	N/A	8.2	N/A	8.8	N/A
Total Phosphorus	72	70	77	74	8.17	2.90	0.08	0.06	314.00	19.70	1.74	1.70	18.69	10.52	48.77	22.82
Total Suspended Solids	72	70	77	74	324	320	4	4	3300	4530	112	110	1468	1233	4338	3469
Zinc, Total	17	17	17	17	1.409	1.342	0.060	0.110	13.500	7.350	0.30	0.31	4.775	4.793	13.091	11.564

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.
[ii] Composite samples.

TABLE U–7.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY BAKERY PRODUCTS FACILITIES SUBMITTING PART II SAMPLING DATA[i] (mg/L)

Pollutant Sample type	No. of facilities		No. of samples		Mean		Minimum		Maximum		Median		95th percentile		99th percentile	
	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	16	17	32	34	18.8	17.5	4.0	0.0	82.0	85.0	13.0	11.50	45.7	46.6	74.6	79.4
COD	16	17	32	34	103.7	92.3	16.2	14.0	514.0	426.0	72.0	59.0	270.3	238.2	465.9	407.8
Nitrate + Nitrite Nitrogen	16	17	32	34	0.47	0.56	0.00	0.00	1.94	1.90	0.40	0.46	1.29	1.64	2.00	2.67
Total Kjeldahl Nitrogen	16	17	32	34	2.89	2.41	0.00	0.00	10.00	6.60	2.40	2.15	9.15	6.33	16.22	10.14
Oil & Grease	16	N/A	32	N/A	14.0	N/A	0.0	N/A	93.0	N/A	5.0	N/A	63.6	N/A	149.9	N/A
pH	14	N/A	30	N/A	N/A	N/A	6.1	N/A	8.4	N/A	7.1	N/A	8.3	N/A	8.9	N/A
Total Phosphorus	16	17	32	34	0.56	0.49	0.00	0.00	2.10	1.80	0.47	0.38	1.51	1.71	2.47	3.23
Total Suspended Solids	16	17	32	34	140	64	2	2	410	200	103	41	888	295	2686	750

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.
[ii] Composite samples.

TABLE U–8.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY FATS AND OILS MANUFACTURING FACILITIES SUBMITTING PART II SAMPLING DATA[i] (mg/L)

Pollutant Sample type	No. of facilities		No. of samples		Mean		Minimum		Maximum		Median		95th percentile		99th percentile	
	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	12	12	19	19	68.0	38.6	0.0	0.0	180.0	75.0	57.0	41.0	240.7	108.0	466.2	177.1
COD	12	12	19	19	322.6	191.1	17.0	9.60	1040.0	840.0	230.0	150.0	1253.4	640.1	2622.1	1216.4
Nitrate + Nitrite Nitrogen	12	12	19	19	2.69	1.65	0.32	0.23	18.30	4.90	1.37	1.01	7.97	4.82	15.95	8.58
Total Kjeldahl Nitrogen	12	12	19	19	19.60	7.96	0.00	0.0	240.00	65.2	3.40	2.75	55.66	24.1	156.55	53.5
Oil & Grease	11	N/A	18	N/A	28.5	N/A	0.0	N/A	150.0	N/A	7.8	N/A	178.1	N/A	527.7	N/A
pH	11	N/A	17	N/A	N/A	N/A	5.7	N/A	10.0	N/A	7.6	N/A	10.0	N/A	11.1	N/A
Total Phosphorus	12	12	19	19	0.91	1.96	0.00	0.00	8.11	15.8	0.37	0.23	3.18	6.75	7.65	21.73
Total Suspended Solids	10	11	17	18	635	442	3	0	4850	3060	290	175	3746	1725	12233	4158

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.
[ii] Composite samples.

TABLE U–9.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY BEVERAGES FACILITIES SUBMITTING PART II SAMPLING DATA[i] (mg/L)

Pollutant Sample type	No. of facilities		No. of samples		Mean		Minimum		Maximum		Median		95th percentile		99th percentile	
	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	18	15	29	23	16.8	8.61	1.0	1.0	153.0	35.0	6.0	5.0	52.7	25.1	115.4	45.6
COD	18	15	29	23	70.1	42.1	9.0	5.0	270.0	88.0	49.0	46.0	214.3	125.2	401.6	217.3
Nitrate + Nitrite Nitrogen	18	15	29	23	0.60	0.65	0.00	0.04	1.90	2.10	0.41	0.60	1.67	2.12	2.85	3.96
Total Kjeldahl Nitrogen	18	15	29	23	1.54	0.95	0.31	0.27	7.45	2.9	1.00	0.74	3.82	2.11	6.35	3.15

TABLE U–9.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY BEVERAGES FACILITIES SUBMITTING PART II SAMPLING DATA[i] (mg/L)—Continued

Pollutant Sample type	No. of facilities		No. of samples		Mean		Minimum		Maximum		Median		95th percentile		99th percentile	
	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
Oil & Grease	18	N/A	29	N/A	1.7	N/A	0.0	N/A	7.0	N/A	1.2	N/A	4.3	N/A	6.4	N/A
pH	18	N/A	29	N/A	N/A	N/A	4.8	N/A	8.9	N/A	7.3	N/A	8.9	N/A	9.8	N/A
Total Phosphorus	18	15	29	23	0.51	0.36	0.05	0.06	5.40	2.70	0.26	0.20	1.39	0.94	2.79	1.71
Total Suspended Solids	18	15	29	23	29	9.7	3	0	170	36	18	5	95	32	193	65
Zinc, Total	10	8	11	9	0.179	0.141	0.000	0.000	0.440	0.400	0.13	0.07	0.549	0.517	0.922	0.969

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.
[ii] Composite samples.

TABLE U–10.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY MISCELLANEOUS FOOD PREPARATIONS AND KINDRED PRODUCTS FACILITIES SUBMITTING PART II SAMPLING DATA[i] (mg/L)

Pollutant Sample type	No. of facilities		No. of samples		Mean		Minimum		Maximum		Median		95th percentile		99th percentile	
	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	7	7	15	15	16.8	11.9	0.0	0.0	67.0	66.0	8.5	4.20	59.0	39.5	118.5	80.6
COD	7	7	15	15	103.1	81.1	13.0	17.0	297.0	504.0	63.0	52.0	371.2	211.4	759.3	384.2
Nitrate + Nitrite Nitrogen	7	7	15	15	0.49	0.47	0.00	0.0	1.17	1.22	0.48	0.38	1.79	1.65	3.11	2.93
Total Kjeldahl Nitrogen	7	7	15	15	2.76	1.96	0.44	0.40	11.90	7.61	1.59	1.35	8.88	5.51	17.42	9.99
Oil & Grease	7	N/A	15	N/A	4.4	N/A	0.0	N/A	16.0	N/A	2.9	N/A	15.7	N/A	26.5	N/A
pH	8	N/A	16	N/A	N/A	N/A	2.3	N/A	8.6	N/A	6.9	N/A	12.0	N/A	N/A	
Total Phosphorus	7	7	15	15	0.52	0.423	0.03	0.03	1.67	1.67	0.30	0.23	2.50	1.91	6.31	4.91
Total Suspended Solids	7	7	15	14	481	132	0	1	2880	1063	179	51	4441	719	21493	2499

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.
[ii] Composite samples.

4. Options for Controlling Pollutants.

One option for controlling pollutants in storm water is to set effluent limitations for these discharges. EPA does not consider this to be feasible because of the lack of performance data necessary to develop limitations.

Pursuant to 40 CFR 122.44(k), permits may contain Best Management Practices (BMPs) to control or abate the discharge of pollutants in storm water, when applicable (and where numeric effluent limitations are infeasible). EPA believes that the most effective BMPs for reducing pollutants in storm water discharges from food and kindred products processing facilities is through exposure minimization and good housekeeping practices. Exposure minimization practices reduce the potential for storm water to come in contact with pollutants. Good housekeeping practices ensure that the facility is responsive to routine and non-routine activities that may increase exposure of pollutants to storm water. The BMPs necessary to address these two concerns are generally uncomplicated and inexpensive practices. They are easy to implement, and require little or no maintenance. Minor capital expenses, such as construction of cement pads or berms/dikes, may be necessary in some cases, although these types of control structures already exist at many food and kindred products processing facilities. In a few instances, more intensive BMPs, such as detention ponds or filtering devices, may be necessary depending on the type of discharge, types and concentrations of contaminants, and volume of flow, although these occurrences are expected to be very low for the sector as a whole. The types of material management practices identified in the storm water group applications for the food and kindred products processing sector, for sampling facilities only, are identified in Table U–11. In fact, part 1 group application data indicate that BMPs are widely implemented at food and kindred products processing facilities.

The selection of the most effective BMPs will be based on site-specific considerations such as: facility size, climate, geographic location, geology/hydrogeology and the environmental setting of each facility, and volume and type of discharge generated. Each facility will be unique in that the source, type, and volume of contaminated storm water will differ. In addition, the fate and transport of pollutants in these discharges will vary. EPA believes that the management practices discussed herein are well suited mechanisms to prevent or control the contamination of storm water discharges associated with food and kindred products processing facilities.

TABLE U–11.—MATERIAL MANAGEMENT PRACTICES[i,ii]

Absorbent mats	Preventative maintenance
Baghouse	Retaining wall
BMPs	Roof drains
Catch basin	Sealed tanks
Concrete pad	Shoveling
Containment	Site inspection
Cover (drums, holding pen, loading, storage)	Spill prevention plan
Curbing	Spillstoppers
Diking	Stone filters
Diversion	Sumps
Drains	Swales
Dust control	Sweeping
Housekeeping	Tarps (i.e., temporary covers)
Indoor storage	Training
Infiltration	V-Strips

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TABLE U–11.—MATERIAL MANAGEMENT PRACTICES[i,ii]—Continued

Mopping	Vacuuming
Oil interceptor	Valves
Oil/water separators	Vinyl socks
Overfill protection	Waste minimization procedures
Ponds	Wetland

[i] NPDES Storm Water Group Applications—Part 2. Application Nos. 12, 13, 37, 81, 125, 159, 178, 179, 312, 436, 437, 446, 541, 557, 583, 584, 599, 630, 730, 789, 811, 819, 935, 936, 1006, 1096, 1147, and 1159.
[ii] NPDES Storm Water Group Applications—Part 1. Application Nos. 12, 13, 37, 60, 81, 125, 144, 159, 178, 179, 312, 436, 437, 446, 533, 541, 545, 557, 583, 584, 599, 630, 680, 730, 733, 789, 811, 819, 932, 935, 936, 1006, 1096, 1147, 1159, and 1217.

Table U–12 identifies general BMPs that are applicable to a variety of food and kindred products processing subsectors, while Table U–13 identifies BMPs for specific processing operations.

TABLE U–12.—GENERAL STORM WATER BMPS FOR THE FOOD AND KINDRED PRODUCTS PROCESSING SECTOR [i,ii,iii,iv]

Activity	BMPs
A. Raw Material Unloading/Product Loading	• Ensure that a facility representative is present during unloading/loading activities. • Inspect the unloading/loading areas to detect problems before they occur.
Shipping and Receiving	• Close storm drains during loading/unloading activities in surrounding area. • Inspect all containers prior to unloading/loading of any raw or spent materials. • Install backflow prevention devices on liquid transfer equipment. • Inspect all connection equipment (e.g., hoses and couplings), and replace when necessary, before performing unloading/loading activities. • Perform all unloading/loading activities in a covered and/or enclosed areas. • Use drip pans when loading/unloading liquid product. • Situate loading/unloading areas indoors or in a covered area. • Use rubber seals in truck loading dock areas to contain spills indoors. • Drain hoses back into truck, railcar, etc. after loading/unloading materials. • Install high level alarm on tanks to prevent overfilling. • Ensure that berms and dikes are built around the unloading/loading areas, if applicable. • If outside or in covered areas, minimize runon of storm water into the unloading/loading areas by grading the areas to ensure that storm water runs off. • Use dry cleanup methods for unloading/loading areas rather than washing the areas down. • Train employees on proper unloading/loading techniques. • Initiate an inventory control for all raw and spent materials.
B. Storage Containers:	
Liquid Storage	• Inspect the external condition (corrosion, leaks) of the containers. • Inspect the general area around the containers. • Ensure that beams and dikes are built around the containers. • Cover and/or enclose. • Bulkhead liquid storage tanks indoors (i.e., tank outlets located inside buildings).
Liquid Storage (drums, carboys, and gallon jugs).	• Ensure that all containers are closed (e.g., valves shut, lids and manways sealed, caps closed). • Wash containers indoors before storing empty containers outdoors. • If outside or in a covered area, minimize runon of storm water into a storage area by grading area to ensure that storm water runs "off" and not "on". • Train employees on proper storage techniques (e.g., filling and transferring contents). • Maintain employee training on proper handling and transportation of materials. • Maintain an inventory control of all raw and spent materials. • Employ measures to protect against spillage from the overflows (e.g., high level sensors, alarms).
Solid Storage (silos, holding bins, fiber drums, etc.).	• Consider vacuum emission control systems for airborne dust and particulate matter.
C. Waste Management:	
Wastewater	• Perform treatment processes in-house, if possible. • Inspect the outside pipe connections (couplings, valve seals and gaskets, flanges, etc.) of the treatment system for leaks, corrosion, and poor maintenance upkeep.
Solid Waste (paper, wood pellets, scrap metals, refuse, etc.).	• Inspect the general area around the solid waste (e.g., look for signs of leaching). • Store waste so that it is physically contained (dumpsters, drums, bags). • Store waste in an enclosed/covered area. • If outside or in a covered area, minimize exposure to storm water by grading the area to ensure that storm water runs "off" and not "on". • Ensure hazardous waste disposal practices are performed in accordance with Federal, State, and local requirements. • Route trash compactor leakage to treatment system or sanitary sewer.
Air Emissions	• Clean around vents and stacks to atmosphere from process and storage areas. • Place tubs around vents and stacks for easy collection of settling particles. • Inspect air emission control systems (e.g., baghouses) regularly and repair and replace as necessary. • Route overflows/condensates from process vents to onsite treatment system or to the sanitary sewer.
D. Pest Control	• Follow manufacturers directions for application of pest control materials to site.

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TABLE U-12.—GENERAL STORM WATER BMPS FOR THE FOOD AND KINDRED PRODUCTS PROCESSING SECTOR[i,ii,iii,iv]—Continued

Activity	BMPs
	• Time application for dry weather conditions. • Store partially full containers indoors or undercover. • Apply insecticides during breeding months. • Protect rat bait houses from storm water.
E. Improper Connections to the Storm Sewer ...	• Perform smoke or dye testing to determine if interconnections exist between the sanitary and storm sewers. • Plug all floor drains leading to storm sewers. • Update facility schematics to accurately reflect all plumbing connections.
F. General	• Offer employee incentives so that employees will develop cost effective, worker efficient BMPs. • Request outside firm to conduct a storm water inspection/audit. • Inspect material transfer lines/connections for leaks or signs of wear and repair or replace as necessary.

[i] "Standard Handbook of Environmental Engineering," Corbitt, Robert A., McGraw-Hill, Inc., 1990.
[ii] Air Pollution Engineering Manual, Air and Waste Management Association, Edited by Anthony J. Buonicore and Wayne T. Davis, Van Nostrand Reinhold, New York, 1992.
[iii] "Environmental Engineering and Sanitation," Fourth Edition, Salvato, Joseph A., John Wiley & Sons, Inc., 1992.
[iv] Storm Water Management for Industrial Activities: Developing Pollution Prevention Plans and Best Management Practices (EPA 832-R-92-006), EPA, Office of Water, September 1992.

TABLE U-13.—SPECIFIC STORM WATER BMPS FOR THE FOOD AND KINDRED PRODUCTS PROCESSING SECTOR[i,ii,iii,iv]

Activity	BMPs
A. Meat Products:	
• Animal Holding Pens (beef, chicken)	• Inspect area around animal holding pens. • Enclose/cover fowl hanging area. • Enclose/cover the animal holding pens. • Grade the areas around the animal holding pens to ensure storm water "runs off" and not "on" to the holding pen. • Train employees on proper material (i.e., hide, hair, feathers, animal parts) clean-up procedures around and within the animal holding pens. • Store animal manure and other materials from clean-up activities in appropriate containers in an enclosed/covered area. • Area for trailers holding empty bird cages should have storm water runon/runoff controls in place. • Use mechanical sweepers around site to clean up fugitive feathers, dust, and manure.
B. Dairy Products:	
• Packaged Dairy Products (spoiled and broken product containers).	• Inspect area around aged/spoiled dairy products. • Store aged/spoiled dairy products in enclosed area. • Train employees on proper disposal methods for all aged/spoiled dairy products. • Ensure that all aged/spoiled product (e.g., bottles, cartons, plastic containers) are disposed of in a proper manner (bagged, covered).
C. Canned Frozen and Preserved Fruits, Vegetables, and Frozen Specialties:	
• Fruit and Vegetable Storage and Disposal.	• Inspect all fruit and vegetable storage areas. • Store all fruits and vegetables in appropriate containers (e.g., bins, bushels, baskets, buckets) and in enclosed/covered areas. • Store empty fruit and vegetable containers in an enclosed/covered area. • Train employees on proper handling/disposal methods for fresh/rotten fruits and vegetables. • Consider air emission control systems for all cooking processes to reduce particulate matter. • Minimize fruit and vegetable storage time outdoors.
D. Grain Mills	
• Grain Handling, Storage and Mixing	• Inspect the general area around the grain storage. • Store all grain in appropriate containers (e.g., silos, hoppers) in an enclosed/covered area. • Train employees on grain handling procedures. • Consider a vacuum control system in all grain mixing areas.
E. Bakery Products:	
• Ingredient Storage and Mixing	• Inspect ingredient storage areas. • Store all ingredients (e.g., corn sweeteners, flour, shortening, syrup, vegetable oils) in appropriate containers (e.g., tanks, drums, bags) in an enclosed/covered area.
• Baking Process	• Remove flour/oil dust accumulation around ventilation exhaust systems. • Install an air emission control system for all baking processes to reduce particulate matter.
F. Sugar and Confectionery:	
• Sugar Handling	• Consider a vacuum control system in all granular and powdered processing areas.
G. Fats & Oils:	

TABLE U–13.—SPECIFIC STORM WATER BMPS FOR THE FOOD AND KINDRED PRODUCTS PROCESSING SECTOR[i,ii,iii,iv]—Continued

Activity	BMPs
• Fats and Oils Storage and Disposal	• Inspect all Fats and Oils storage areas. • Store all fats and oils, (e.g., butcher shop materials, hair, hide, tallow, bone meal, and offal) in enclosed/covered areas. • Ensure all fats and oils are physically contained.
H. Beverages:	
Material Storage and Mixing	• Ensure grain is stored in enclosed/covered area. • Consider an air emission control system for all grain handling and brewing processes. • Protect reusable beverage containers that are stored outdoors from storm water contact.

[i] "Standard Handbook of Environmental Engineering," Corbitt, Robert A., McGraw-Hill, Inc., 1990.
[ii] Air Pollution Engineering Manual, Air and Waste Management Association, Edited by Anthony J. Buonicore and Wayne T. Davis, Van Nostrand Reinhold, New York, 1992.
[iii] "Environmental Engineering and Sanitation," Fourth Edition, Salvato, Joseph A., John Wiley & Sons, Inc., 1992.
[iv] Storm Water Management for Industrial Activities: Developing Pollution Prevention Plans and Best Management Practices (EPA 832–R–92–006), EPA, Office of Water, September 1992.

5. Storm Water Pollution Prevention Plan Requirements

All facilities included in this section of today's permit must prepare and implement a storm water pollution prevention plan. The establishment of a pollution prevention plan requirement reflects EPA's decision to allow operators of food and kindred products processing facilities to utilize BMPs as the BAT/BCT level of control for the storm water discharges covered by this section. The requirements included in pollution prevention plans provides a flexible framework for the development and implementation of site-specific controls to minimize pollution in storm water discharges. This approach is consistent with the approach used in the baseline general permits finalized on September 9, 1992 (57 FR 41236).

EPA believes that pollution prevention is the most effective approach for controlling contaminated storm water discharges from food and kindred products processing facilities. Pollution prevention plans allow the operator of a facility to select BMPs based on site-specific considerations such as: facility size; climate; geographic location; hydrogeology; the environmental setting of each facility; and volume and type of discharge generated. This flexibility is necessary because each facility will be unique in that the source, type and volume of contaminated surface water discharges will differ from site to site.

There are two major objectives to a pollution prevention plan: (1) To identify sources of pollution potentially affecting the quality of storm water discharges associated with industrial activity from a facility, and (2) to describe and ensure implementation of practices to minimize and control pollutants in storm water discharges associated with industrial activity from a facility.

Specific requirements for a pollution prevention plan for food and kindred products processing facilities are described below. These requirements must be implemented in addition to the baseline pollution prevention plan provisions discussed previously.

a. Contents of the Plan. Storm water pollution prevention plans are intended to aid operators of food and kindred products processing facilities to evaluate all potential pollution prevention sources at a site, and assist in the selection and implementation of appropriate measures designed to prevent, or control, the discharge of pollutants in storm water runoff. EPA has developed guidance entitled "Storm Water Management for Industrial Activities: Developing Pollution Prevention Plans and Best Management Practices," EPA, 1992 (EPA 832–R–92–006), to assist permittees in developing and implementing pollution prevention measures.

(1) Pollution Prevention Team. As a first step in the process of developing and implementing a storm water pollution prevention plan, permittees must identify a qualified individual or team of individuals to be responsible for developing the plan and assisting the facility or plant manager in its implementation. When selecting members of the team, the plant manager should draw on the expertise of all relevant departments within the plant to ensure that all aspects of plant operations are considered when the plan is developed. The plan must clearly describe the responsibilities of each team member as they relate to specific components of the plan. In addition to enhancing the quality of communication between team members and other personnel, clear delineation of responsibilities will ensure that every aspect of the plan is addressed by a specified individual of group of individuals. Pollution Prevention Teams may consist of one individual where appropriate (e.g., in certain small businesses with limited storm water pollution potential).

(2) Description of Potential Pollutant Sources. Each storm water pollution prevention plan must describe activities, materials, and physical features of the facility that may contribute to storm water runoff or, during periods of dry weather, result in dry weather flows. This assessment of storm water pollution prevention will support subsequent efforts to identify and set priorities for necessary changes in materials, materials management practices, or site features, as well as aid in the selection of appropriate structural and nonstructural control techniques. Plans must describe the following elements:

(a) Drainage—The plan must contain a map of the site that shows the pattern of storm water drainage, structural and nonstructural features that control pollutants in storm water runoff, and process wastewater discharges, surface water bodies (including wetlands), places where significant materials are exposed to rainfall and runoff, and locations of major spills and leaks that occurred in the 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit. The map must also show areas where the following general activities take place: loading/unloading areas; vehicle fueling; vehicle and equipment maintenance and/or cleaning areas; waste treatment, storage, and disposal locations; and liquid storage tanks. In addition, as identified in the Part 1 Storm Water Group Applications, the following areas are also potential sources of pollutants in storm water from food and kindred products processing facilities: vents and stacks from cooking and drying operations and

dry product vacuum transfer lines; animal holding pens; spoiled product and broken product container storage areas; and significant dust or particulate generating areas. The site map must identify all monitoring locations that must be sampled as part of the monitoring requirements of the permit. (Monitoring and Reporting Requirements). This will allow for a direct comparison of the industrial activities exposed to storm water with the analytical data for storm water discharges from these areas. The site map must also indicate the outfall locations and the types of discharges contained in the drainage areas of the outfalls (e.g. storm water and air conditioner condensate). In order to increase the readability of the map, the inventory of the types of discharges contained in each outfall may be kept as an attachment to the site map.

(b) Inventory of Exposed Materials—Facility operators are required to carefully conduct an inspection of the site and related records to identify significant materials that are or may be exposed to storm water. The inventory must address materials that within 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit have been handled, stored, processed, treated, or disposed of in a manner to allow exposure to storm water. Findings of the inventory must be documented in detail in the pollution prevention plan. At a minimum, the plan must describe the method and location of onsite storage or disposal; practices used to minimize contact of materials with rainfall and runoff; existing structural and nonstructural controls that reduce pollutants in storm water runoff; existing structural controls that limit process wastewater discharges; and any treatment that the runoff receives before it is discharged to surface waters or a separate storm sewer system. The description must be updated whenever there is a significant change in the types or amounts of materials, or material management practices, that may affect the exposure of materials to storm water.

(c) Significant Spills and Leaks—The plan must include a list of any significant spills and leaks of toxic or hazardous pollutants that occurred in the 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit. Significant spills include, but are not limited to, releases of oil or hazardous substances in excess of quantities that are reportable under Section 311 of CWA (see 40 CFR 110.10 and 117.21) or Section 102 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (see 40 CFR 302.4). Significant spills may also include releases of oil or hazardous substances that are not in excess of reporting requirements and releases of materials that are not classified as oil or a hazardous substance.

(d) Non-storm Water Discharges—Each pollution prevention plan must include a certification, signed by an authorized individual, that discharges from the site have been tested or evaluated for the presence of non-storm water discharges. The certification must describe possible significant sources of non-storm water, the results of any test and/or evaluation conducted to detect such discharges, the test method or evaluation criteria used, the dates on which tests or evaluations were performed; and the onsite drainage points directly observed during the test or evaluation. Pollution prevention plans must identify and ensure the implementation of appropriate pollution prevention measures for the non-storm water discharge.

(e) Sampling Data—Any existing data on the quality or quantity of storm water discharges from the facility must be described in the plan. The description should include a discussion of the methods used to collect and analyze the data. Sample collection points should be identified in the plan and shown on the site map. Also, the plan should identify the types of storm water discharges (i.e., applicable sectors) being sampled at each outfall.

(f) Summary of Potential Pollutant Sources—The description of potential pollutant sources culminates in a narrative assessment of the risk potential that the industrial activities, materials, and physical features of the site pose to storm water quality. Any such activities, materials, or features must be addressed by the measures and controls subsequently described in the plan. In conducting the assessment, the facility operator must consider the following activities: loading/unloading areas; vehicle fueling; vehicle and equipment maintenance and/or cleaning areas; waste treatment, storage, and disposal locations; liquid storage tanks; vents and stacks from cooking and drying operations and dry product vacuum transfer lines; animal holding pens; out-of-date/spoiled product storage areas; and significant dust or particulate generating areas. The assessment must list any significant pollution sources at the site and identify the pollutant parameter or parameters (e.g., biochemical oxygen demand, oil and grease, etc.) associated with each source.

In addition to food and kindred products processing related industrial activities, the plan must also describe application and storage of pest control chemicals (e.g., rodenticides, insecticides, fungicides, etc.) used at the facility, including a discussion of application and storage procedures.

(3) Measures and Controls. The permittee must evaluate, select, and describe the pollution prevention measures, BMPs, and other controls that will be implemented at the facility. EPA emphasizes the implementation of pollution prevention measures and BMPs that reduce possible pollutant discharges at the source. Source reduction measures include, among others, preventative maintenance, chemical substitution, spill prevention, good housekeeping, training, and proper materials management. Where source reduction is not appropriate, EPA supports the use of source control measures and BMPs such as material segregation or covering, water diversion, and dust control. If source reduction or source control are not possible, recycling or treatment are the remaining alternatives. Recycling allows the reuse of storm water while treatment lowers pollutant concentrations prior to discharge. Since the majority of food and kindred products processing is conducted indoors, the activities identified above are geared towards only those activities that may contribute pollutants to storm water. Also because of the relatively few activities that are conducted outdoors within this sector, pollution prevention measures, BMPs, and other controls should be relatively few and easy for any given permittee. Also, these measures are the most appropriate means to reduce pollutant loadings to storm water (as opposed to pollutant limitations) because of the relative ease and the significant reductions in pollutant loads that can be realized. The permittee should consider the general storm water BMPs for the food and kindred products processing sector identified in Table U–12 and the subsector specific BMPs provided in Table U–13 when assessing the need for storm water measures and controls.

The pollution prevention plan must discuss the reasons each selected control or practice is appropriate for the facility and how each of the potential pollutant sources will be addressed. The plan must also identify the times during which each control or practice will be implemented. Also, the plan should summarize the effects that the controls or practices will have on storm water discharges from the site. At a minimum, the measures and controls must address the following components:

(a) Good Housekeeping—Permittees must describe protocols established to reduce the possibility of mishandling chemicals or equipment and training employees in good housekeeping techniques. Specifics of this plan must be communicated to appropriate plant personnel.

(b) Preventative Maintenance—Permittees are required to develop a preventative maintenance program that includes regular inspections and maintenance of storm water BMPs. The purpose of the inspections is to assess the effectiveness of the storm water pollution prevention plan. The inspections allow facility personnel to monitor the success or failure of elements of the plan on a regular basis. The use of an inspection checklist should be considered. A checklist ensures that all required areas are inspected, as well as providing documentation for the recordkeeping requirement.

(c) Spill Prevention and Response Procedures—Permittees are required to identify appropriate material handling procedures, storage requirements, containment or diversion equipment, and spill cleanup procedures that will minimize the potential for spills and in the event of a spill enable proper and timely response. Areas and activities that typically pose a high risk for spills at food and kindred products processing facilities include raw material unloading and product loading areas, material storage areas, and waste management areas (e.g., dumpsters, compactors). These activities and areas, and their accompanying drainage points, must be described in the plan.

(d) Inspections—In addition to the comprehensive site evaluation required under XI.U.6.b. (Comprehensive Site Compliance Evaluation) of this section of today's permit, qualified personnel must inspect designated equipment and areas of the facility at appropriate intervals as specified in the plan. Areas that are found to possibly contribute pollutants to storm water are identified in this section of today's permit as requisite areas for periodic scheduled inspections. A set of tracking or follow-up procedures must be used to ensure that appropriate actions are taken in response to the inspections. Records of inspections must be maintained. Inspections shall be carried out by qualified facility personnel at least once each year.

(e) Employee Training—Permittees must describe a program for informing personnel at all levels of responsibility of the components and goals of the storm water pollution prevention plan. Training should address topics such as good housekeeping, materials management, and spill response procedures. A schedule for conducting this training must be provided in the plan. Where appropriate, contractor personnel also must be trained in relevant aspects of storm water pollution prevention. EPA recommends that facilities conduct training annually at a minimum. However, more frequent training may be necessary at facilities with high turnover of employees or where employee participation is essential to the storm water pollution prevention plan.

(f) Recordkeeping and Internal Reporting Procedures—Permittees must describe procedures for developing and retaining records on the status and effectiveness of plan implementation. The plan must address spills, monitoring, and BMP inspection and maintenance activities. Ineffective BMPs must be reported and the date of their corrective action noted.

(g) Sediment and Erosion Control—Permittees must identify areas that, due to topography, activities, soils, cover materials, or other factors have a high potential for significant soil erosion. Measures to limit erosion in these areas must be identified.

(h) Management of Runoff—Permittees must provide a narrative assessment of traditional storm water management practices that divert, infiltrate, reuse, or otherwise manage storm water runoff so as to reduce the discharge of pollutants. Based on the assessment, the permittee must identify practices that are reasonable and appropriate for the facility and must describe the particular pollutant source area or activity to be controlled by each storm water management practice. Reasonable and appropriate practices must be implemented and maintained.

b. *Comprehensive Site Compliance Evaluation*. The storm water pollution prevention plan must describe the scope and content of comprehensive site evaluations that qualified personnel will conduct to (1) confirm the accuracy of the description of potential pollution sources contained in the plan, (2) determine the effectiveness of the plan, and (3) assess compliance with the terms and conditions of this section of today's permit. Comprehensive site compliance evaluations must be conducted at least annually for food and kindred products processing facilities. The individual or individuals who will conduct the evaluation must be identified in the plan and should be members of the pollution prevention team. Evaluation reports must be retained for at least 3 years after the date of the evaluation. Where compliance evaluation schedules overlap with inspections required under XI.V.3.a.(3)(d) of this section, the compliance evaluation may be conducted in place of one such inspection.

Based on the results of each evaluation, the description of potential pollution sources, and measures and controls, the plan must be revised as appropriate within 2 weeks after each inspection. Changes in the measures and controls must be implemented on the site in a timely manner, and never more than 12 weeks after completion of the evaluation.

6. Monitoring and Reporting Requirements

a. *Analytical Monitoring Requirements*. EPA believes that food and kindred products facilities may reduce the level of pollutants in storm water runoff from their sites through the development and proper implementation of the storm water pollution prevention plan requirements discussed in today's permit. In order to provide a tool for evaluating the effectiveness of the pollution prevention plan and to characterize the discharge for potential environmental impacts, the permit requires grain mill products facilities and fats and oils products facilities to collect and analyze samples of their storm water discharges for the pollutants listed in Tables U–14 or U–15. The pollutants listed in Tables U–14 or U–15 were found to be above benchmark levels for a significant portion of facilities in these subsectors that submitted quantitative data in the group application process. Because these pollutants have been reported at benchmark levels from grain mill products and fats and oils products facilities, EPA is requiring monitoring after the pollution prevention plan has been implemented to assess the effectiveness of the pollution prevention plan and to help ensure that a reduction of pollutants is realized.

Under the Storm Water Regulations at 40 CFR 122.26(b)(14), EPA defined "storm water discharge associated with industrial activity". The focus of today's permit is to address the presence of pollutants that are associated with the industrial activities identified in this definition and that might be found in storm water discharges. Under the methodology for determining analytical monitoring requirements, described in section VI.E.1 of this fact sheet, zinc is above the bench mark concentrations for the grain mill and beverage products subsectors. After a review of the nature of industrial activities and the significant materials exposed to storm water described by facilities in these subsectors, EPA has determined that the higher concentrations of zinc are not likely to be caused by the industrial activity, but may be primarily due to non-industrial activities on-site. Today's permit does not require grain mill or beverage products facilities to conduct analytical monitoring for this parameter.

At a minimum, storm water discharges from grain mill product and fats and oils product facilities must be monitored quarterly during the second year of permit coverage. Samples must be collected at least once in each of the following periods: January through March; April through June; July through September; and October through December. At the end of the second year of permit coverage, a facility must calculate the average concentration for each parameter listed in Tables U–14 or U–15, and applicable to that industrial subsector. If the permittee collects more than four samples in this period, then they must calculate an average concentration for each pollutant of concern for all samples analyzed.

TABLE U–14.—GRAIN MILL PRODUCTS MONITORING REQUIREMENTS

Pollutant of concern	Cut-off concentration
Total Suspended Solids (TSS) ...	100 mg/L

TABLE U–15.—FATS AND OILS MONITORING REQUIREMENTS

Pollutants of concern	Cut-off concentration
Biochemical Oxygen Demand (BOD).	30 mg/L
Chemical Oxygen Demand (COD).	120 mg/L
Nitrate Plus Nitrite Nitrogen	0.68 mg/L
Total Suspended Solids	100 mg/L

If the average concentration for a parameter is less than or equal to the value listed in Tables U–14 or U–15, then the permittee is not required to conduct quantitative analysis for that parameter during the fourth year of the permit. If, however, the average concentration for a parameter is greater than the cut-off concentration listed in Table U–14 or U–15, then the permittee is required to conduct quarterly monitoring for that parameter during the fourth year of permit coverage. Monitoring is not required during the first, third, and fifth year of the permit. The exclusion from monitoring in the fourth year of the permit is conditional on the facility maintaining industrial operations and BMPs that will ensure a quality of storm water discharges consistent with the average concentrations recorded during the second year of the permit.

TABLE U–16.—SCHEDULE OF MONITORING

2nd Year of Permit Coverage	• Conduct quarterly monitoring. • Calculate the average concentration for all parameters analyzed during this period. • If average concentration is greater than the value listed in Table U–14 or U–15, then quarterly sampling is required during the fourth year of the permit. • If average concentration is less than or equal to the value listed in Table U–14 or U–15, then no further sampling is required for that parameter.
4th Year of Permit Coverage	• Conduct quarterly monitoring for any parameter where the average concentration in year 2 of the permit is greater than the value listed in Table U–14 or U–15. • If industrial activities or the pollution prevention plan have been altered such that storm water discharges may be adversely affected, quarterly monitoring is required for all parameters of concern.

In cases where the average concentration of a parameter exceeds the cut-off concentration, EPA expects permittees to place special emphasis on methods for reducing the presence of those parameters in storm water discharges. Quarterly monitoring in the fourth year of the permit will reassess the effectiveness of the adjusted pollution prevention plan.

EPA realizes that if a facility is inactive and unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly chemical sampling.

b. Alternative Certification. Throughout today's permit, EPA has included monitoring requirements for facilities which the Agency believes have the potential for contributing significant levels of pollutants to storm water discharges. The alternative described below is necessary to ensure that monitoring requirements are only imposed on those facilities that do, in fact, have storm water discharges containing pollutants at concentrations of concern. EPA has determined that if materials and activities are not exposed to storm water at the site, then the potential for pollutants to contaminate storm water discharges does not warrant monitoring.

Therefore, a discharger is not subject to the monitoring requirements of this Part provided the discharger makes a certification for a given outfall, or a pollutant-by-pollutant basis in lieu of monitoring reports required under paragraph (*c*) below, under penalty of law, signed in accordance with Part VII.G. (Signatory Requirements), that material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, industrial machinery or operations, significant materials from past industrial activity that are located in areas of the facility that are within the drainage area of the outfall are not presently exposed to storm water and will not be exposed to storm water for the certification period. Such certification must be retained in the storm water pollution prevention plan and submitted to EPA in accordance with Part VI.C. of this permit. In the case of certifying that a pollutant is not present, the permittee must submit the certification along with the monitoring reports required under paragraph (*c*) below. If the permittee cannot certify for an entire period, they must submit the date exposure was eliminated and any monitoring required up until that date. This certification option is not applicable to compliance monitoring requirements associated with effluent limitations. EPA does not expect facilities to be able to exercise this certification for indicator parameters, such as TSS and BOD.

c. Reporting Requirements. Permittees are required to submit all monitoring results obtained during the second and fourth year of permit coverage within 3 months of the conclusion of each year. For each outfall, one signed Discharge Monitoring Report form must be submitted to the Director per storm event sampled. Such permittees must submit monitoring results on four separately signed Discharge Monitoring Report Forms to the Director. For facilities conducting monitoring beyond the minimum quarterly requirements an additional Discharge Monitoring Report Form must be filed for each analysis.

d. Sample Type. All discharge data shall be reported for grab samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The required 72-hour storm event interval is waived where the preceding measurable storm event did not result in a measurable discharge from the facility. The required 72-hour storm event interval may also be waived where the permittee documents that less than a 72-hour interval is representative for local storm events during the season when sampling is being conducted. The grab sample shall be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable.

If storm water discharges associated with industrial activity commingle with process or nonprocess water, then where practicable permittees must attempt to sample the storm water discharge before it mixes with the non-storm water discharge.

e. Representative Discharge. When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may test the effluent of one of such outfalls and report that the quantitative data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluent. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

f. Quarterly Visual Examination of Storm Water Quality. All food and kindred products facilities shall perform and document a visual examination of a storm water discharge associated with industrial activity from each outfall, except discharges exempted under paragraph (3) below. The examination(s) must be made at least once in each of the following 3-month periods: January through March, April through June, July through September, and October through December. The examination shall be made during daylight hours unless there is insufficient rainfall or snow melt to produce a runoff event.

(*1*) Examinations shall be made of grab samples collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 1 hour) of when the runoff or snowmelt begins discharging. The examinations shall document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on the samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. Where practicable, the same individual should carry out the collection and examination of discharges for the entire permit term.

(*2*) Visual examination reports must be maintained onsite in the pollution prevention plan. The report shall include the examination date and time, examination personnel, the nature of the discharge (i.e., runoff or snow melt), visual quality of the storm water discharge (including observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution), and probable sources of any observed storm water contamination.

(*3*) When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may collect a sample of effluent of one of such outfalls and report that the examination data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

(*4*) When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the records of the visual examinations. Adverse weather conditions that may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(*5*) EPA realizes that if a facility is inactive and unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly visual examination.

EPA believes that this quick and simple assessment will allow the permittee to approximate the effectiveness of his/her plan on a regular basis at very little cost. Although the visual examination cannot assess the chemical properties of the storm water discharged from the site, the examination will provide meaningful results upon which the facility may act quickly. The frequency of this visual examination will also allow for timely adjustments to be made to the plan. If BMPs are performing ineffectively, corrective action must be implemented. A set of tracking or follow-up procedures must be used to ensure that appropriate actions are taken in response to the examinations. The visual examination is intended to be performed by members of the pollution prevention team. This hands-on examination will enhance the staff's understanding of the storm water problems on that site and effects on the management practices that are included in the plan.

V. Storm Water Discharges Associated With Industrial Activity From Textile Mills, Apparel, and Other Fabric Product Manufacturing Facilities

1. Discharges Covered Under This Section

Special permit conditions have been developed for textile mills, apparel, and other fabric product manufacturing facilities. The conditions in this section apply to storm water discharges from textile related operations located at any of the facilities covered under the storm water application regulations [40 Code of Federal Regulations (CFR) 122.26] and applying for coverage under this permit.

The storm water application regulations define storm water discharges associated with industrial activity at 40 CFR 122.26(b)(14). Category (xi) of this definition includes facilities under Standard Industrial Classifications 22 and 23. The conditions in this section apply to storm water discharges from the Textile Mill Products, of and regarding facilities and establishments engaged in the preparation of fiber and subsequent manufacturing of yarn, thread, braids, twine, and cordage, the manufacturing of broadwoven fabrics, narrow woven fabrics, knit fabrics, and carpets and rugs from yarn; processes involved in the dyeing and finishing of fibers, yarn fabrics, and knit apparel; the integrated manufacturing of knit apparel and other finished articles of yarn; the manufacturing of felt goods (wool), lace goods, nonwoven fabrics, miscellaneous textiles, and other apparel products.

Textile Mill Product facilities (SIC major group 22) typically receive and prepare fibers, transform these materials into fabric or related products, and finish the materials before packaging. Apparel facilities (SIC major group 23) typically receive woven or knitted fabric for cutting, sewing, and packaging. For more information on the industrial activities at textile facilities, consult EPA's "Development Document for Effluent Limitations Guidelines and Standards for the Textile Mills" (Document EPA 440/1–79/0226, October 1979).

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

2. Pollutants in Storm Water Discharges Associated with the Manufacture of Textile Products

Based on group application information and data, and the "Development Document for Effluent Limitation Guidelines and Standards for the Textile Mills," EPA has identified the storm water pollutants and sources resulting from textile manufacturers in Table V–1.

TABLE V–1.

Activity	Pollutant source	Pollutant
Raw material storage and handling	Wool, cotton, synthetics, rayon, other fibers, coal/wood piles, fuels, oil, lubricants.	TSS, pH, oil and grease, COD, BOD_5, lead, chromium, benzene.
Storage and handling of materials for dyeing	Dyes, dye preservatives, pigments	Copper, phenols, lead, chromium, zinc, aluminum, acids.
Storage and handling of materials for scouring and cleaning.	Wool, scouring agents, detergents	BOD_5, COD, TSS, oil and grease, sulfides, phenols, pH, chromium.
Storage and handling of materials for bleaching, printing, finishing, and other activities.	Dyes, bleaches, detergents, finishing agents, printing products.	BOD_5, COD, TSS, oil and grease, sulfides, phenols, pH, chromium, hydrogen peroxide, acids.

Based on the wide variety of industrial activities and significant materials at the facilities included in this sector, EPA believes it is appropriate to divide the textile mills, apparel, and other fabric product manufacturing industry into subsectors to properly analyze sampling data and determine monitoring requirements. As a result, this sector has been divided into the following subsectors: textile mills and apparel and other finished products made from fabrics. Table V–2 below includes data for the eight pollutants that all facilities were required to monitor for under Form 2F. The table also lists those parameters that EPA has determined may merit further monitoring. A table has not been included for the apparel and other finished products made from fabrics subsector because less than 3 facilities submitted data.

TABLE V–2.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY TEXTILE MILL PRODUCTS FACILITIES SUBMITTING PART II SAMPLING DATA[i] (mg/L)

Pollutant sample type	No. of facilities		No. of samples		Mean		Minimum		Maximum		Median		95th percentile		99th percentile	
	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	51	49	96	93	10.4	9.53	0.0	0.0	50.0	50.2	7.0	7.0	29.8	26.02	51.1	43.2
COD	51	49	96	93	61.9	46.25	0.0	0.0	306.0	212.0	41.0	36.0	194.0	132.1	365.0	228.8
Nitrate + Nitrite Nitrogen	51	49	96	93	1.35	1.22	0.00	0.0	71.00	65.0	0.30	0.34	3.17	2.71	6.80	5.74
Total Kjeldahl Nitrogen	51	49	96	93	1.98	1.71	0.00	0.0	7.40	8.30	1.64	1.50	5.54	4.38	9.03	6.76
Oil & Grease	51	N/A	97	N/A	3.2	N/A	0.0	N/A	42.0	N/A	0.0	N/A	17.8	N/A	35.9	N/A
pH	48	N/A	91	N/A	N/A	N/A	4.0	N/A	10.2	N/A	6.9	N/A	9.1	N/A	10.4	N/A
Total Phosphorus	51	49	96	93	0.28	0.29	0.00	0.0	11.00	11.0	0.12	0.11	0.66	0.66	1.29	1.30
Total Suspended Solids	51	49	96	93	126	75	0	0.0	1888	1675	38	20	591	261	1860	694
Zinc, Total	7	6	16	14	0.328	0.296	0.000	0.070	1.060	0.880	0.19	0.21	1.079	0.769	2.062	1.269

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.
[ii] Composite samples.

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3. Options for Controlling Pollutants

Table V–3 lists some BMPs which may be effective in limiting the amount of pollutants in storm water discharges from textile facilities. Many of the BMPs suggested focus on the process aspect of textile manufacturing. Although processes are typically conducted indoors, EPA believes that changes in the manufacturing process, such as a switch to less toxic chemicals, can lessen the amount of contamination in storm water discharges. The BMPs listed are not necessarily required to be implemented. Rather, BMPs should be chosen based on the specific nature of the storm water discharges at each textile facility and implemented as appropriate. Based on part 1 information, several of the BMPs suggested are already in place at many of the facilities. Part 1 submittals indicate that diking or other types of diversion occur at 55 percent of the sampling facilities. Nineteen percent of the sampling facilities noted that they use some form of covering as a BMP, and catch basins are in place at 45 percent. In addition, 64 percent of the facilities designated as samplers in part 1 information reported they had a Spill Prevention Control and Countermeasure Plan in place, while 56 percent used swales, 29 percent had vegetation strips, and 12 percent utilized ponds to collect storm water.

TABLE V–3.—COMMON BEST MANAGEMENT PRACTICES FOR TEXTILE FACILITIES

Activity	BMPs
Preparation (e.g., Desizing and Scouring)	Waste stream reuse for typical bleach unit processing; recycle J-box or kier drain wastes to saturator.
	Make use of countercurrent washing.
	Use washer waste from scour operation for batch scouring.
Dyeing	Perform analysis of spent dye baths for residual materials.
	Where feasible, obtain background information and data necessary before making product substitutions. This includes OSHA form 20 data and technical data.
	Be aware of potential problem chemicals, such as aryl phenol ethoxylates, chlorinated aromatics, chlorinated aromatics, and metals.
	Employ pad batch dyeing to eliminate the need for salts and chemical specialties from the dyebath, with associated reduction in cost and pollution source reduction.
Finishing	Reuse residual portions of finish mixes as much as possible by adding back to them the required components to make up the next mix.
	Return noncontact cooling water and stream condensates to either a hot water holding tank or a clear well. If neither is available, segregate waste streams from sources which do not generally require treatment from other waste streams that do require treatment.
General Water Conservation Techniques	Use "low liquor ratio" dyeing machines where practicable.
	Use of foam processing (mercerizing, bleaching, dyeing, finishing) where practicable as a water conservation process.
Chemical Screening and Inventory Control	Employ prescreening practices to evaluate and consider chemicals on a wide range of environmental and health impact criteria.
	Develop and perform a routine raw material quality control program.
	Review and develop procedures for source reduction of metals.
	Promptly transfer used fluids to the proper container; do not leave full drip pans or other open containers around the shop. Empty and clean drip pans and containers.
	Do not pour liquid waste down floor drains, sinks, or outdoor storm drain inlets.
	Plug floor drains that are connected to the storm or sanitary sewer; if necessary, install a sump that is pumped regularly.
	Inspect the maintenance area regularly for proper implementation of control measures.
	Train employees on proper waste control and disposal procedures
Material Handling: Bulk Liquid Storage and Containment.	Store permanent tanks in a paved area surrounded by a dike system which provides sufficient containment for the larger of either 10 percent of the volume of all containers or 110 percent of the volume of the largest tank.
	Maintain good integrity of all storage tanks.
	Inspect storage tanks to detect potential leaks and perform preventive maintenance.
	Inspect piping systems (pipes, pumps, flanges, couplings, hoses, valves) for failures or leaks.
	Train employees on proper filling and transfer procedures.
Material Handling: Containerized Material Storage.	Store containerized materials (fuels, paints, solvents, etc.) in a protected, secure location and away from drains.
	Store reactive, ignitable, or flammable liquids in compliance with the local fire code.
	Label all materials clearly.
	Identify potentially hazardous materials, their characteristics, and use.
	Control excessive purchasing, storage, and handling of potentially hazardous materials.
	Keep records to identify quantity, receipt date, service life, users, and disposal routes.
	Secure and carefully monitor hazardous materials to prevent theft, vandalism, and misuse of materials.
	Educate personnel for proper storage, use, cleanup, and disposal of materials.
	Provide sufficient containment for outdoor storage areas for the larger of either 10 percent of the volume of all containers or 110 percent of the volume of the largest tank.
	Use temporary containment where required by portable drip pans.
	Use spill troughs for drums with taps.
Material Handling: Designated Material Mixing Areas.	Mix solvents in designated areas away from drains, ditches, and surface waters.
	If spills occur, • Stop the source of the spill immediately • Contain the liquid until cleanup is complete • Deploy oil containment booms if the spill may reach the water

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TABLE V-3.—COMMON BEST MANAGEMENT PRACTICES FOR TEXTILE FACILITIES—Continued

Activity	BMPs
	• Cover the spill with absorbent material • Keep the area well ventilated • Dispose of cleanup materials properly • Do not use emulsifier or dispersant.

Sources: Smith, Brent, "Identification and Reduction of Pollution Sources in Textile Wet Processing." Department of Textile Chemistry, North Carolina State University, Raleigh, NC, 1986.
Smith, Brent, "Identification and Reduction of Toxic Pollutants in Textile Mill Effluent." Department of Textile Chemistry, North Carolina State University, Raleigh, NC, 1992.
NPDES Storm Water Group Applications—Part 1. Received by EPA March 18, 1991 through December 31, 1992.

4. Special Conditions

There are no additional requirements beyond those described in Part VI.B of this fact sheet.

5. Storm Water Pollution Prevention Plan Requirements

The permit conditions that apply to storm water discharges from textile mills, apparel and other fabric product manufacturing facilities are, in part, established upon the basic requirements in the front of this fact sheet. The following discussion addresses only those conditions that may differ from the common pollution prevention plan provisions discussed previously.

a. Contents of the Plan

(1) Description of Potential Pollutant Sources. Under the description of potential pollutant sources in the storm water pollution prevention plan requirements, permittees are required to include processing areas, loading/unloading areas, treatment, storage, and waste disposal areas, liquid storage tanks, fueling areas, on a site facility map. EPA believes that this is appropriate since these areas may potentially be a significant source of pollutants to storm water.

(2) Measures and Controls. Under the description of measures and controls in the storm water pollution prevention plan requirements, this section requires that all areas that may contribute pollutants to storm water discharges shall be maintained in a clean, orderly manner. This section also requires that the following areas must be specifically addressed:

(a) Material Storage Areas—All stored and containerized materials (fuels, petroleum products, solvents, dyes, etc.) must be stored in a protected area, away from drains and clearly labeled. The plan must describe measures that prevent or minimize contamination of storm water runoff from such storage areas. The facility should specify which materials are stored indoors and must provide a description of the contaminant area or enclosure for those materials which are stored outdoors. Above ground storage tanks, drums, and barrels permanently stored outside must be delineated on the site map with a description of the appropriated containment measures in place to prevent leaks and spills. The facility may consider an inventory control plan to prevent excessive purchasing, storage, and handling of potentially hazardous substances. In the case of storage of empty chemical drums and containers, facilities should employ such practices as triple-rinsing containers. The discharge waters from such washings must be collected, contained, or treated, and facilities should identify where the discharge will be released.

(b) Material Handling Area—The plan must describe measures that prevent or minimize contamination of the storm water runoff from materials handling operations and areas. The facility may consider the use of spill and overflow protection; covering fuel areas; covering and enclosing areas where the transfer of materials may occur. Where applicable, the plan must address the replacement or repair of leaking connections, valves, transfer lines and pipes that may carry chemicals, dyes, or wastewater.

(c) Fueling Areas—The plan must describe measures that prevent or minimize contamination of the storm water runoff from fueling areas. The facility may consider covering the fueling area, using spill and overflow protection, minimizing runon of storm water to the fueling area, using dry cleanup methods, and/or collecting the storm water runoff and providing treatment or recycling.

(d) Above Ground Storage Tank Areas—The plan must describe measures that prevent or minimize contamination of the storm water runoff from above ground storage tank areas. The facility must consider storage tanks and their associated piping and valves. The facility may consider regular cleanup of these areas, preparation of a spill prevention control and countermeasure program, providing spill and overflow protection, minimizing runon of storm water from adjacent facilities and properties, restricting access to the area, inserting filters in adjacent catch basins, providing absorbent booms in unbermed fueling areas, using dry cleanup methods, and permanently sealing drains within critical areas that may discharge to a storm drain.

EPA believes that the incorporation of management practices such as those suggested will substantially reduce the potential for these activities and areas to significantly contribute pollutants to storm water discharges. In addition, EPA believes that these requirements continue to provide the necessary flexibility to address the variable risk for pollutants in storm water discharges associated with different facilities. Further, many facilities will find that management measures that have already been incorporated into the facility's operation, such as the installation of overfill protection equipment and labelling and maintenance of used oil storage units, are already required under existing EPA programs and will meet the requirements of this section.

Under the preventive maintenance requirements, the plan specifically includes the routine inspection of sediment traps to ensure that solids will be intercepted and retained prior to entering the storm drainage system. Because of the nature of operations which occur at textile facilities, specific routine attention needs to be placed on the collection of solids.

Under the inspection requirements this section requires that, in addition to the comprehensive site evaluation required under Part IV of today's permit, qualified facility personnel shall be identified to inspect designated equipment and areas of the facility, at a minimum, on a monthly basis.

The purpose of the inspections is to check on the implementation and effectiveness of the storm water pollution prevention plan. The inspections allow facility personnel to monitor the success or failure of elements of the plan on a regular basis. The use of an inspection checklist is highly encouraged. The checklist will ensure that all required areas are inspected, as well as help to meet the record keeping requirements.

The permittee is required to identify at least annual dates for employee training. EPA requires that facilities conduct training annually at a minimum. However, more frequent training may be necessary at facilities with high turnover of employees or where employee participation is essential to the storm water pollution prevention plan. Employee training must, at a minimum, address the following areas when applicable to a facility: use of reused/recycled waters; solvents management; proper disposal of dyes; proper disposal of petroleum products and spent lubricants; spill prevention and control; fueling procedures; and general good housekeeping practices. Employees, independent contractors, and customers must be informed about BMPs and be required to perform in accordance with these practices. Copies of BMPs and any specific management plans, including emergency phone numbers, shall be posted in the work areas. EPA, therefore, is requiring that employee training take place at least once a year to serve as: (1) Training for new employees; (2) a refresher course for existing employees; and (3) training for all employees on any storm water pollution prevention techniques recently incorporated into the plan.

6. Monitoring and Reporting Requirements

a. Monitoring Requirements. The regulatory modifications at 40 CFR 122.44 (i)(2) established on April 2, 1992, grant permit writers the flexibility to reduce monitoring requirements in storm water discharge permits. EPA has determined that the potential for storm water discharges to contain pollutants above benchmark levels, because of the industrial activities and materials exposed to precipitation, does not support sampling at facilities covered by this section of today's permit. Under the Storm Water Regulations at 40 CFR 122.26(b)(14), EPA defined "storm water discharge associated with industrial activity". The focus of today's permit is to address the presence of pollutants that are associated with the industrial activities identified in this definition and that might be found in storm water discharges. Under the methodology for determining analytical monitoring requirements, described in section VI.E.1 of this fact sheet, zinc is above the bench mark concentrations for the textile mills subsector. After a review of the nature of industrial activities and the significant materials exposed to storm water described by facilities in this subsector, EPA has determined that the higher concentrations of zinc are not likely to be caused by the industrial activity, but may be primarily due to non-industrial activities on-site. Today's permit does not require textile mills facilities to conduct analytical monitoring for this parameter. Based on a consideration of the BMPs typically used at these facilities, and generally low pollutant values from the application data, EPA believes that the pollution prevention plan with visual examinations of storm water discharges (see below) will help to ensure storm water contamination is minimized. Because permittees are not required to conduct analytical monitoring, they will be able to focus their resources on developing and implementing the pollution prevention plan.

b. Quarterly Visual Examination of Storm Water Quality. Textile mills, apparel, and other fabric product facilities shall perform and document a visual examination of a storm water discharge associated with industrial activity from each outfall, except discharges exempted under paragraph (3) below. The examination(s) must be made at least once in each of the following 3-month periods: January through March, April through June, July through September, and October through December. The examination shall be made during daylight hours unless there is insufficient rainfall or snow melt to produce a runoff event.

(1) Examinations shall be made of grab samples collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 1 hour) of when the runoff or snowmelt begins discharging. The examinations shall document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on the samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. Where practicable, the same individual should carry out the collection and examination of discharges for entire permit term.

(2) Visual examination reports must be maintained onsite in the pollution prevention plan. The report shall include the examination date and time, examination personnel, the nature of the discharge (i.e., runoff or snow melt), visual quality of the storm water discharge (including observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution), and probable sources of any observed storm water contamination.

(3) When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may collect a sample of effluent of one of such outfalls and report that the observation data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

(4) When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the records of the visual examinations. Adverse weather conditions that may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(5) EPA realizes that if a facility is inactive and unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly visual examination.

EPA believes that this quick and simple assessment will help the permittee to determine the effectiveness of his/her plan on a regular basis at very little cost. Although the visual examination cannot assess the chemical properties of the storm water discharged from the site, the examination will provide meaningful results upon which the facility may act quickly. The frequency of this visual examination will also allow for timely adjustments to be made to the plan. If BMPs are performing ineffectively, corrective action must be implemented. A set of tracking or follow-up procedures must be used to ensure that appropriate actions are taken in response to the examinations. The visual examination is intended to be performed by members of the pollution prevention team. This hands-on examination will enhance the staff's understanding of the storm water problems on that site and the effects of the management practices that are included in the plan.

As discussed above, EPA does not believe that analytical monitoring is necessary for textile mills, apparel, and other fabric product manufacturing facilities. EPA believes that between quarterly visual examinations and site compliance evaluations potential sources of contaminants can be recognized, addressed, and then controlled with BMPs. In determining the monitoring requirements, EPA considered the nature of the industrial activities and significant materials exposed at these sites, and performed a review of data provided in Part 2 group applications.

W. Storm Water Discharges Associated With Industrial Activity From Wood and Metal Furniture and Fixture Manufacturing Facilities

1. Discharges Covered Under This Section

On November 16, 1990 (55 FR 47990), the U.S. Environmental Protection Agency (EPA) promulgated the regulatory definition of "storm water discharges associated with an industrial activity." This definition included point source discharges of storm water from eleven major categories of facilities, including facilities under Standard Industrial Classification (SIC) codes 2434 and 25. Part XI.W. of today's permit only covers storm water discharges associated with industrial activities from furniture and fixture manufacturing facilities. Furniture and fixture manufacturing facilities eligible for coverage under this section include facilities identified by the following SIC codes: wood kitchen cabinets (generally described by SIC code 2434); household furniture (generally described by SIC code 251); office furniture (generally described by SIC code 252); public buildings and related furniture (generally described by SIC code 253); partitions, shelving, lockers, and office and store fixtures (generally described by SIC code 254); and miscellaneous furniture and fixtures (generally described by SIC code 259).

Storm water discharges covered by this section include all discharges where material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, or industrial machinery are exposed to precipitation and storm water runon. Storm water that does not come into contact with an industrial activity or a significant material are not subject to permitting according to 40 CFR 122.26. This section is not applicable to any discharge subject to effluent limitation guidelines. However, the storm water component of the unpermitted discharge may be included under this section.

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

2. Industry Profile

The manufacturing processes for furniture and fixture manufacturing facilities are not typically exposed to storm water. However, unloading operations and the storage of some raw materials, and waste products, may be exposed to precipitation. Because of the lack of industrial activities occurring outdoors and the necessity of keeping many of the raw materials dry, the primary sources of storm water pollutants originate from materials handling and waste management or disposal activities. Table W–1 lists potential pollutant source activities, and related pollutants associated with furniture and fixture manufacturing facilities. There are two primary types of furniture and fixture manufacturing facilities. The distinction is based on the primary raw material, wood or metal. The manufacturing processes and significant materials to produce wood and metal furniture or fixtures are not similar. However, these manufacturing activities and wood resources are not typically exposed to precipitation.

TABLE W–1.—Activities, Pollutant Sources, and Pollutants

Activity	Pollutant source	Pollutant
Wood Drying	Coal	TSS, pH, cadmium, arsenic.
	Saw Dust	TSS, COD, BOD_5, pH.
	Ash	TSS, pH.
Furniture Manufacturing	Sizing Operations	TSS, BOD_5, pH.
	Painting Operations	Lead, cadmium, COD.
	Gluing Operations	Solvents, COD, oil & grease.
	Used Rags	Solvents, COD, oil & grease.
	Processing materials unloading	Diesel fuel, gasoline, oil, TSS.
	Waste Material Transportation	TSS, BOD_5, pH.
	Treatment Facilities	Solvents, COD, oil & grease.
	Open Dumps	TSS, BOD_5, oil & grease, COD.
Other Activities	Air Emission Control Cleaning	TSS, pH, cadmium, lead, copper, zinc.

Source: Storm Water Group Applications, Parts 1 and 2.

Industrial activities occurring at furniture and fixture manufacturing facilities that pertain to the storm water rule include, "* * * but [are] not limited to, storm water discharges from industrial plant yards; material handling sites; refuse sites; sites used for the application or disposal of process wastewaters (as defined at 40 CFR Part

401); sites used for the storage and maintenance of material handling equipment; sites used for residual treatment, storage, or disposal; shipping and receiving areas; manufacturing buildings; storage areas (including tank farms) for raw materials and intermediate and finished materials; and areas where industrial activity has taken place in the past and significant materials remain and are exposed to storm water" (40 CFR 122.26(b)(14)). The most common industrial activities at furniture and fixture manufacturing facilities include material handling sites and raw material storage areas.

Significant materials include, "* * * but [are] not limited to: raw materials; fuels; materials such as solvents, detergents, and plastic pellets; finished materials such as metallic products; * * * hazardous substances designated under Section 101(14) of CERCLA; any chemical facilities required to report pursuant to Section 313 of Title III of SARA; fertilizers; pesticides; and waste products such as ashes, slag, and sludge that have the potential to be released with storm water discharges" (40 CFR 122.26(b)(12)). Significant materials commonly found at furniture and fixture manufacturing facilities include: wood; saw dust; metals; petroleum-based products; solvents; detergents; and waste materials.

Manufacturers of furniture and fixtures are separated by the primary raw material (i.e., wood and metal). The primary raw materials, industrial processes, waste and by-products, and final products differ for the production of wood furniture and metal furniture. Within each subsector the number of industrial activities and corresponding significant materials and waste products may also vary. Presented below are brief descriptions of the industrial activities and significant materials associated with the manufacturing of wood and metal furniture and fixtures. Due to similarities in the production of furniture and fixtures within subsectors, industrial activities and significant materials are fairly uniform across this sector. Unique practices are noted.

a. Manufacturing of Wood Furniture and Fixtures. The process of manufacturing wood furniture begins with the delivery and storage of wood. There are three different raw wood materials; lumber, veneer, and particle board. Since the manufacturing processes are not typically exposed to storm water for this industry, some of the "industrial activities" described below may not be susceptible to storm water exposure. Significant materials and materials management practices do refer to those materials exposed to storm water, and to the subsequent management practices used to control storm water. Variations on exposure to industrial activities and significant materials are site-specific.

(1) Industrial Activities. Once delivered, raw lumber is allowed to air dry up to 1 year. After the lumber is sufficiently air dried it is then transported to a dry kiln for further drying. The lumber is kiln dried anywhere from 7 to 150 days. Once the lumber has been dried to a desired moisture content, the dried lumber is taken to the processing area. The remaining furniture manufacturing processes are all completed indoors. Manufacturers may also receive lumber that is already dried. Therefore, the manufacturers may not need to air or kiln dry the wood and proceed directly into the processing stage.

The dried lumber is run through planers, to create a smooth, preliminary working surface, and then cut to specified dimensions depending on the end use. The sized lumber is then taken through sanding and machining operations. Sanding produces a smooth, fine working surface. Machining can include boring, routing, lathe operations, mitre cutting, and finish cuts. From this point, each piece of wood is dedicated to a specific product.

Veneer is another raw material used in the production of furniture. In this process logs are placed in a steam vat to increase the moisture content of a log. The logs are turned on a lathe to peel off the veneer. The resulting veneer sheets are layered into stacks or "hacks." Moisture is removed from the hacks by kiln drying. After a desired moisture content has been achieved the hacks are disassembled. Veneer is frequently hot or cold pressed onto particle board or solid wood by utilizing adhesives.

Particle board is the third raw material incorporated into the manufacturing of wood furniture. The board is received, cut to size, and banded on all four edges with solid wood. The banding is accomplished in continuous, steam heated units utilizing adhesives. The panels are allowed to cool and then they are sanded. Particle board is frequently coated with veneer.

The products from the three raw materials may be combined during the machining and sanding step or during the final assembly of a furniture piece. The machining and sanding step may include: initial sizing of particle board, veneer, and lumber; laminating operations; and surface printing. Once all the pieces of a particular furniture item are manufactured and sized, assembly can begin. This process generally involves an assembly line routing with many different individuals and machines working together to build the unit.

The final step in creating an un-upholstered piece of furniture involves surface finishing. This process may involve many separate coats of stains, lacquers, sealers, and finishes to a single unit. This is the step where a uniform wood color and texture are given to each piece of furniture or furniture grouping.

Facilities that manufacture upholstered furniture may have all of the previously mentioned activities, or may purchase dried or sized materials from a manufacturer. Upholstered furniture manufacturers will transport, handle, store, and process natural and synthetic fibers used for the upholstery. After the wood component of an upholstered piece of furniture is assembled, the upholstery materials are cut, sized, stretched, and then attached to the frame. After the final inspection of a furniture piece, the unit is packaged and either stored temporarily onsite or immediately shipped to an offsite location.

(2) Significant Materials. The significant materials identified, in part 1 of the group applications, as exposed to storm water at wood furniture and fixture manufacturing facilities include: raw wood; sawdust; coal; kiln ash; solvent-based finishing materials and waste products; used rags; raw glue and waste materials; and petroleum-based products. While most of the raw wood material is stored outside, more valuable wood products (e.g., sheets of veneer, mahogany, etc.) and some composite wood products (e.g., particle board) may be stored inside or under cover.

b. Manufacturing of Metal Furniture and Fixtures. Many furniture and fixture manufacturing facilities build their furniture with metal as the primary raw material. However, some manufacturers combine wood and upholstered materials with a metal frame. Metal furniture manufacturing facilities may purchase wood pieces ready for assembly or they may have all the industrial activities of wood manufacturing facilities in addition to the metal manufacturing facilities. The industrial activities at metal furniture manufacturing facilities will be site-specific and depend upon the level of work necessary to shape and treat the delivered metal into a furniture piece.

(1) Industrial Activities. Facilities that manufacture metal household furniture conduct operations that include: machining and assembly, finishing, and temporary storage of finished products within an enclosed building. Cold roll steel is initially received and

temporarily stored within the manufacturing building. However, steel may be stored outside prior to use. The steel is cut to size, bent, and welded to design specifications to fabricate raw metal household furniture. Final grinding, sanding, finishing, spot welding, and painting are then completed. After the final inspection of a furniture piece, the unit is packaged and either stored temporarily onsite or immediately shipped to an offsite location.

(2) Significant Materials. The significant materials identified as exposed to storm water, in part 1 of the group applications, at metal furniture and fixture facilities include: metals; sawdust; solvent-based finishing materials and waste products; electroplating solutions and sludges; used rags; raw glue and waste materials; and petroleum-based products. Prior to manufacturing rolls of steel may be stored outdoors but will be brought indoors for manufacturing.

3. Pollutants in Storm Water Discharges Associated with Furniture and Fixtures Manufacturing Facilities

Few pollutants are expected in storm water discharges from the manufacturing of wood and metal furniture and fixtures because the majority of the industrial activities occur indoors. Pollutants may be present in storm water as a result of outdoor activities associated with the manufacturing of wood and metal furniture and fixture such as: material handling operations; waste disposal; raw material storage; and deposition of airborne particulate matter. In addition, sources of pollutants other than storm water, such as illicit connections, spills, and other improperly dumped materials, may increase the pollutant loadings discharged into waters of the United States.

Many of the part 2 group application data submittals did not identify individual site characteristics or sources of storm water pollutants which may be responsible for pollutant loadings.

Based on the similarities of the facilities included in this sector in terms of industrial activities and significant materials, EPA believes it is appropriate to discuss the potential pollutants at Wood and Metal Furniture and Fixture Manufacturing facilities as a whole and not subdivide this sector. Therefore, Table W–2 lists data for selected parameters from facilities in the Wood and Metal Furniture and Fixture Manufacturing sector. These data include the eight pollutants that all facilities were required to monitor for under Form 2F, as well as the pollutants that EPA has determined may merit further monitoring.

TABLE W–2.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY FURNITURE AND FIXTURES FACILITIES SUBMITTING PART II SAMPLING DATA[i] (mg/L)

Pollutant sample type	No. of Facilities		No. of Samples		Mean		Minimum		Maximum		Median		95th Percentile		99th Percentile	
	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	16	15	25	24	12.2	8.80	0.0	0.0	46.0	32.0	9.0	5.95	38.8	27.0	72.2	47.0
COD	16	15	25	24	96.0	76.3	0.0	0.0	300.0	240.0	83.0	72.5	231.9	187.6	358.4	288.0
Nitrate + Nitrite Nitrogen	16	15	25	24	1.73	1.51	0.00	0.0	12.00	10.0	0.90	0.88	6.11	5.1	12.97	11.1
Total Kjeldahl Nitrogen	16	15	25	24	4.37	4.40	0.00	0.60	46.00	55.0	1.70	1.35	10.70	9.57	20.39	18.88
Oil & Grease	16	N/A	25	N/A	3.8	N/A	0.0	N/A	33.0	N/A	0.0	N/A	19.1	N/A	45.0	N/A
pH	15	N/A	23	N/A	N/A	N/A	4.2	N/A	9.3	N/A	7.5	N/A	9.7	N/A	10.8	N/A
Total Phosphorus	16	15	25	24	0.27	0.26	0.00	0.0	1.10	1.30	0.20	0.19	0.76	0.76	1.30	1.35
Total Suspended Solids	16	15	25	24	188	143	3	2	891	900	130	91	1008	791	2740	2290
Zinc, Total	3	3	4	4	2.973	0.594	0.340	0.074	10.000	1.500	0.78	0.40	14.907	3.056	44.006	7.758

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.

[ii] Composite samples.

4. Options for Controlling Storm Water Pollutants.

Certain BMPs are implemented to prevent and/or minimize exposure of pollutants from industrial activities to storm water discharges. EPA believes the most effective BMPs for reducing pollutants in storm water discharges are exposure minimization practices. Exposure minimization practices lessen the potential for storm water to come into contact with pollutants. Good housekeeping practices ensure that facilities are sensitive to routine and nonroutine activities which may increase pollutants in storm water discharges. The BMPs which address good housekeeping and exposure minimization are easily implemented, inexpensive, and require little, if any, maintenance. BMP expenses may include construction of roofs for storage areas or other forms of permanent cover and the installation of berms/dikes. Other BMPs such as detention/retention ponds and filtering devices may be needed at these facilities because of the contaminant level in the storm water discharges.

Part 1 group application data indicate that few BMPs have been implemented at wood and metal furniture and fixture manufacturing facilities. The only BMPs identified in the part 1 applications include: closed tanks, drums, and metal boxes; and partial covering. The part 1 data submissions did not indicate the presence of any traditional BMPs, such as sedimentation and retention ponds, or diversion dikes. However, the group application process did not require a description, or identification, of traditional BMPs, only the identification of material management practices that limit the contact between storm water and significant materials.

Because BMPs described in the part 1 data are limited, EPA is providing an overview of supplementary BMPs for use at furniture and fixture manufacturing facilities. However, inclusion of a BMP cited does not preclude the use of other viable BMP options. Table W–3 summarizes BMP options as they apply to wood and metal furniture and fixture manufacturing facilities.

TABLE W–3.—STORM WATER BMPS FOR FURNITURE AND FIXTURE MANUFACTURING FACILITIES

Activity	Best management practices (BMPs)
Outdoor Unloading and Loading	Confine loading/unloading activities to a designated area. Perform all loading/unloading activities in a covered or enclosed area. Close storm drains during loading/unloading activities in surrounding areas.

TABLE W–3.—STORM WATER BMPS FOR FURNITURE AND FIXTURE MANUFACTURING FACILITIES—Continued

Activity	Best management practices (BMPs)
	Avoid loading/unloading materials in the rain.
	Inspect all containers prior to loading/unloading of any raw or spent materials.
	Berm, curb, or dike loading/unloading areas.
	Use dry clean-up methods instead of washing the areas down.
	Train employees on proper loading/unloading techniques.
Outdoor Material Storage (including waste and particulate emission management).	Confine storage of raw materials, parts, and equipment to designated areas.
	Train employees on proper waste control and disposal.
	Berm, curb, or dike any areas around tanks.
	Ensure that all containers are properly sealed and valves closed.
	Inventory all raw and spent materials.
	Inspect air emission control systems regularly, and repair or replace when necessary.
	Store wastes in covered, leak proof containers (e.g., dumpsters, drums).
	Store wastes in enclosed and/or covered areas.
	Ensure hazardous and solid waste disposal practices are performed in accordance with applicable Federal, State, and local requirements.
	Ship all wastes to offsite landfills or treatment facilities.

Sources: NPDES Storm Water Group Applications—Part 1. Received by EPA, March 18, 1991, through December 31, 1992, and EPA, Office of Water. September 1992. "Storm Water Management for Industrial Activities: Developing Pollution Prevention Plans and Best Management Practices." EPA 832–R–92–006.

Many of the BMPs identified in Table W–3 are reminders of good or preferred operating procedures that are intended to limit the exposure of significant materials and industrial activities to storm water. Facility operators should review their current operations and consider implementing these BMPs if they are applicable to the site in order to reduce storm water contamination.

Since none of the facilities within the wood and metal furniture and fixture manufacturing sector indicated the presence of traditional storm water management practices, EPA is requiring the participants in this sector to consider the implementation of storm water diversions and sediment control and collection structures.

Discharge diversions provide the first line of defense in preventing the contamination of discharges, and subsequent contamination of receiving waters of the United States. Discharge diversions are temporary or permanent structures installed to divert flow, store flow, or limit storm water runon and runoff.

These diversion practices have several objectives. First, diversion structures can be designed to prevent otherwise uncontaminated (or less contaminated) water from crossing disturbed areas or areas containing significant amounts of contaminated materials, where contact may occur between runon and significant materials. These source reduction measures may be particularly effective for preventing uncontaminated discharges from contacting exposed materials and/or reduce the flow across disturbed areas, thereby lessening the potential for erosion. Second, diversion structures can be used to collect or divert waters for later treatment, if necessary. The usefulness of these control measures are limited by such factors as the size of the area to be controlled and the type and nature of materials exposed and precipitation events.

Diversion dikes, curbs, and berms are temporary or permanent diversion structures that prevent runoff from passing beyond a certain point, and divert runoff away from its intended path. Dikes, curbs or berms may be used to surround and isolate areas of concern at wood and metal furniture manufacturing facilities, and divert flow around piles of significant materials in order to minimize or limit offsite discharges of contaminated storm water.

Sediment control and collection limits movement and retains sediments from being transported offsite. Several structural collection devices have been developed to remove sediment from runoff before it leaves the site. Several methods of removing sediment from site runoff involve diversion mechanisms previously discussed, supplemented by a trapping or storage device. Structural practices typically involve filtering diffuse storm water flows through temporary structures such as straw bale dikes, silt fences, brush barriers or vegetated areas.

However, structural practices require periodic removal of sediment to remain functional, for both temporary and permanent structures. As such, they serve as more active-type practices which may not be appropriate for permanent use at inactive mines. However, these practices may be effectively used as temporary measures during active operation and/or prior to the final implementation of permanent measures. Temporary structures include: plastic matting, plastic netting, and erosion control blankets; mulch-straw or wood chips; and compaction. Permanent sediment control and collection structures include: sediment/settling ponds; sediment traps or catch basins; and vegetated buffer strips.

5. Storm Water Pollution Prevention Plan Requirements

All facilities subject to this section must prepare and implement a storm water pollution prevention plan. The establishment of a pollution prevention plan requirement reflects EPA's decision to allow operators of furniture and fixture manufacturing facilities to utilize BMPs as the BAT/BCT level of control for the storm water discharges covered by this section. The requirements included in pollution prevention plans provide a flexible framework for the development and implementation of site-specific controls to minimize pollutants in storm water discharges. EPA believes that pollution prevention is the most effective approach for controlling contaminated storm water discharges from furniture and fixture manufacturing facilities. Pollution prevention plans allow the operator of a facility to select BMPs based on site-specific considerations such as: facility size; climate; geographic location; hydrogeology; the environmental setting of each facility; volume and type of discharge generated, and current BMPs. This flexibility is necessary because each facility will be unique in that the source, type, and volume of contaminated surface water discharges will differ from site to site.

There are two major objectives to a pollution prevention plan: (1) To identify sources of pollution potentially affecting the quality of storm water discharges associated with an industrial activity from a facility; and (2) to describe and ensure implementation of practices to minimize and control pollutants in storm water discharges associated with industrial activity. Specific requirements for a pollution prevention plan for furniture and fixture manufacturing facilities are described below. These requirements must be implemented in addition to the pollution prevention plan provisions discussed previously, or any other industry-specific requirements to which the facility is subject. For example, facilities with coal piles must comply with the provisions for coal pile runoff, as well as the pollution prevention requirements for the furniture and fixture manufacturing industry.

a. Description of Potential Pollution Sources. Under the drainage requirements, the site map must show areas where the following activities take place, if applicable: fueling; vehicle and equipment maintenance and/or cleaning; loading and unloading; material storage (including tanks or other vessels used for liquid or waste storage); outdoor material processing; waste treatment, storage, or disposal; haul roads; access roads; and rail spurs. The site map must also indicate the outfall locations and the types of discharges contained in the drainage areas of the outfalls (e.g. storm water and air conditioner condensate). In order to increase the readability of the map, the inventory of the types of discharges contained in each outfall may be kept as an attachment to the site map.

b. Measures and Controls. Following completion of the source identification and assessment phase, the permittee must evaluate, select, and describe the pollution prevention measures, BMPs, and other controls that will be implemented at the facility. The permittee must assess the applicability of the following categories of BMPs for their site: discharge diversions, drainage/storm water conveyance systems, runoff dispersions, and good housekeeping measures. In addition, BMPs include processes, procedures, schedules of activities, prohibitions on practices, and other management practices that prevent or reduce the discharge of pollutants in storm water runoff.

The pollution prevention plan must discuss the reasons each selected structural control or BMP is appropriate for the facility and how each will address the potential sources of storm water pollution. The plan also must include a schedule specifying the time or times during which each control or practice will be implemented. In addition, the plan should discuss ways in which the controls and practices relate to one another and, when taken as a whole, produce an integrated and consistent approach for preventing or controlling potential storm water contamination problems.

Permittees are also required to develop a preventive maintenance program that includes regular inspections and maintenance of storm water BMPs. The maintenance program requires periodic removal of debris from discharge diversions and conveyance systems. These activities should be conducted particularly during wet seasons. Permittees already controlling their storm water runoff with impoundments or sedimentation ponds must include the maintenance schedules for these ponds in the pollution prevention plan.

Under the inspection requirements of the pollution prevention plan, operators of furniture and fixture manufacturing facilities are required to conduct quarterly inspections. The inspections shall include: (1) An assessment of the integrity of storm water discharge diversions, conveyance systems, sediment control and collection systems, and containment structures; (2) visual inspections of vegetative BMPs to determine if soil erosion has occurred; and (3) visual inspections of material handling and storage areas and other potential sources of pollution for evidence of actual or potential pollutant discharges of contaminated storm water.

EPA believes that this quick and simple description will allow the permittee to assess the effectiveness of his/her plan on a regular basis at very little cost. The inspection will provide meaningful results upon which the facility may act quickly. The frequency of this inspection will also allow for timely adjustments to be made to the pollution prevention plan. If a BMP is found to be ineffective, corrective action must be implemented. A set of tracking or follow-up procedures must be used to ensure that appropriate actions are taken in response to the inspections. The inspection is intended to be performed by facility staff. This hands on inspection will also enhance the staff's understanding of the storm water problems on that site and effects on the management practices that are included in the plan.

Under employee training, the permit does not specify the frequency, however, EPA recommends that facilities conduct training annually at a minimum. However, more frequent training may be necessary at facilities with high turnover of employees or where employee participation is essential to the storm water pollution prevention plan.

Under the recordkeeping and internal reporting procedures of the pollution prevention plan, the permittee must describe procedures for developing and retaining records on the status and effectiveness of plan implementation. The plan must address spills, monitoring (if applicable), and BMP inspection and maintenance activities. Ineffective BMPs must be recorded and the date of their corrective action noted. According to the pollution prevention plan requirements, the permittee must evaluate the appropriateness of each storm water BMP that diverts, infiltrates, reuses, or otherwise reduces the discharge of contaminated storm water. In addition, the permittee must describe the storm water pollutant source area or activity (i.e., loading and unloading operations, raw material storage piles etc.) to be controlled by each storm water management practice.

6. Monitoring and Reporting Requirements

a. Monitoring Requirements. The regulatory modifications at 40 *CFR* 122.44 (i)(2) established on April 2, 1992, grant permit writers the flexibility to reduce monitoring requirements in storm water discharge permits. EPA has determined that the potential for storm water discharges to contain pollutants above benchmark levels, because of the industrial activities and materials exposed to precipitation, does not support sampling at facilities covered by this section of today's permit. Under the Storm Water Regulations at 40 CFR 122.26(b)(14), EPA defined "storm water discharge associated with industrial activity". The focus of today's permit is to address the presence of pollutants that are associated with the industrial activities identified in this definition and that might be found in storm water discharges. Under the methodology for determining analytical monitoring requirements, described in section VI.E.1 of this fact sheet, nitrate plus nitrite nitrogen and zinc are above the bench mark concentrations for the furniture and fixtures sector. After a review of the nature of industrial activities and the significant materials exposed to storm water described by facilities in this sector, EPA has determined that the higher concentrations of nitrate plus nitrite nitrogen and zinc are not likely to be caused by the industrial activity, but may be primarily due to non-industrial activities on-site. Today's permit does not require furniture and fixtures facilities to conduct analytical monitoring for these parameters.

Based on a consideration of the nature of BMPs typically used at these facilities, and generally low pollutant values from the application data, EPA believes that the pollution prevention plan with visual examinations of storm water discharges (see below) will help to ensure storm water contamination is minimized. Because permittees are not required to conduct analytical monitoring, they will be able to focus their resources on developing and implementing the pollution prevention plan.

b. *Quarterly Visual Examination of Storm Water Quality.* Wood and metal furniture and fixture manufacturing facilities shall perform and document a visual examination of a storm water discharge associated with industrial activity from each outfall, except discharges exempted under paragraph (3) below. The examination(s) must be made at least once in each of the following 3-month periods: January through March, April through June, July through September, and October through December. The examination shall be made during daylight hours unless there is insufficient rainfall or snow melt to produce a runoff event.

(1) Examinations shall be made of grab samples collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 1 hour) of when the runoff or snowmelt begins discharging. The examinations shall document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on the samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. Where practicable, the same individual should carry out the collection and examination of discharges for entire permit term.

(2) Visual examination reports must be maintained onsite in the pollution prevention plan. The report shall include the examination date and time, examination personnel, the nature of the discharge (i.e., runoff or snow melt), visual quality of the storm water discharge (including observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution), and probable sources of any observed storm water contamination.

(3) When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may collect a sample of effluent of one of such outfalls and report that the observation data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

(4) When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the records of the visual examinations. Adverse weather conditions that may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(5) EPA realizes that if a facility is inactive and unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly visual examination.

EPA believes that this quick and simple assessment will help the permittee to determine the effectiveness of his/her plan on a regular basis at very little cost. Although the visual examination cannot assess the chemical properties of the storm water discharged from the site, the examination will provide meaningful results upon which the facility may act quickly. The frequency of this visual examination will also allow for timely adjustments to be made to the plan. If BMPs are performing ineffectively, corrective action must be implemented. A set of tracking or follow-up procedures must be used to ensure that appropriate actions are taken in response to the examinations. The visual examination is intended to be performed by members of the pollution prevention team. This hands on examination will enhance the staff's understanding of the storm water problems on that site and effects of the management practices that are included in the plan.

As discussed above, EPA does not believe that analytical monitoring is necessary for wood and metal furniture and fixture manufacturing facilities. EPA believes that between quarterly visual examinations and site compliance evaluations potential sources of contaminants can be recognized, addressed and then controlled with BMPs. In determining the monitoring requirements, EPA considered the nature of the industrial activities and significant materials exposed at these sites, and performed a review of data provided in Part 2 group applications.

X. Storm Water Discharges Associated With Industrial Activity From Printing and Publishing Facilities

1. Industry Profile

On November 16, 1990 (55 FR 47990) EPA promulgated the regulatory definition of "storm water discharge associated with industrial activity." This definition includes point source discharges of storm water from eleven categories of facilities, including "—category (xi) facilities classified as Standard Industrial Classification (SIC) code—27." Facilities eligible for coverage under this section include: book printing (SIC Code 2732); commercial printing, lithographic (SIC Code 2752); commercial printing, gravure (SIC Code 2754); commercial printing, not elsewhere classified (SIC Code 2759); and platemaking and related services (SIC Code 2796).

This section establishes special condition for storm water discharges associated with industrial activities at printing and publishing facilities. The SIC codes of these facilities are in category (xi) of the definition of storm water discharges associated with industrial activity. Storm water discharges from facilities in this category are only regulated where precipitation and storm water runon come into contact with areas associated with industrial activities, and significant materials. Significant materials include, but are not limited to, raw materials, waste products, finished products, intermediate products, by-products, and other materials associated with industrial activities.

When an industrial facility, described by the above eligibility provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

The printing and publishing industry is composed of a heterogeneous collection of over 38,000 companies that range in size from a few employees to several thousand.[98] Some companies are involved in both printing and publishing, while others are exclusively one or the other. The industrial activities of these facilities are similar, but the finished products vary. The finished products include magazines, newspapers, books, and labels. The printing activities covered under this section occur strictly indoors, and are separated into distinct operations. They include book printing, commercial printing (lithographic and gravure), and platemaking for printing purposes. The lithographic printing operation, which is based on the premise that grease and water do not mix, consists of a printing plate or cylinder, ink, a blanket and paper. Areas on the printing plate which will be transferred are coated with grease, and the rest of the plate is kept moist with water. The ink adheres to the grease and is repelled by the water. The printing image is then transferred to a blanket, which is transferred to paper. The gravure printing process uses printing plates or cylinders, ink, and paper. In the gravure process, the image is engraved on the printing plate or cylinder, the ink is then picked up by the engraved cells and directly transferred to paper. Other printing methods include screen, letter press, and flexographic printing. In the platemaking process, plates are cut from metal (usually steel), formed, engraved with the image, and coated with copper sulfate or chromic acid. The plates are later used in the printing processes described above.

Aside from the specific printing activities, other types of industrial activities are shared by facilities covered under this section. For example, the majority of these facilities have outdoor material handling and storage activities, and share the same types of raw and waste materials.

The primary raw materials utilized by this industry group include paper (including wax paper and card stock at some facilities), printing inks (hydrocarbon based, solvent based), and solvents. Other raw materials include steel (for facilities which manufacture printing plates), toner, paints, lubricating fluids, fuels, coating materials, and adhesives/glues. The paper products are stored indoors because exposure to precipitation would destroy the quality. The other raw materials arrive at the facilities in drums and either remain in the drums or are stored in aboveground or underground tanks, depending on the facilities' space and primary activity. The outdoor storage areas for drums are sometimes covered, but when the drums are directly exposed to precipitation, the storage areas are diked. Within the facilities, drums are stored on wooden pallets or skids, which may become contaminated from spills of the stored materials. After use the pallets and skids are stored outside for disposal and have the potential to contaminate storm water discharges.

Both nonhazardous and hazardous wastes are produced from the printing process. Hazardous wastes including ink wastes, solvent wastes, and waste chromic and sulfuric acid. These wastes are generated in small quantities at some of the facilities within this industrial group. Solvent wastes result from cleaning of printing plates and metal cutting operations. Ink wastes are generated from the cleaning of printing plates and from excess ink used in printing. Chromic and sulfuric acid wastes are generated from facilities which manufacture and coat rotogravure printing plates.

Nonhazardous wastes from this industry group include waste paper, paper dust, scrap steel, and used wooden pallets. All of these waste materials have the potential to pollute storm water discharges.

Significant materials exposed to storm water at these facilities may include raw materials and waste materials. They include solvents (toluene, xylene, acetone, 1,1,1-trichloroethane), fuels (gasoline and diesel), inks, metal, lubricating oils, pallets, copper, chromium, acids (sulfuric and chromic), oil and grease, and waste paper. Some of these materials may be directly exposed to storm water, while others may be covered. Pollutants that may be associated with these materials include TSS, pH, heavy metals, oil and grease, and COD.

Material handling activities such as loading and unloading areas, and liquid transfer (solvents from outdoor storage tanks to facility) may be exposed to storm water discharges. Exposure of these areas to storm water may be minimized by covering of the shipping/receiving and liquid transfer areas.

For those facilities engaged in fueling and vehicle maintenance, gasoline and diesel fuel are frequently stored outdoors in aboveground storage tanks and drums. Most vehicles and equipment require oil, hydraulic fluids, antifreeze, and other fluids that may leak and contaminate storm water discharges.

2. Pollutants Found in Storm Water Discharges From Printing and Publishing Facilities

The impact of industrial activities on storm water discharges at printing and publishing facilities will vary. Factors at a site which influence the water quality include geographic location, hydrogeology, the industrial activities exposed to storm water discharges, the facility's size, the types of pollution prevention measures/best management practices in place, and the type, duration, and intensity of storm events. Taken together or separately, these factors determine how polluted the storm water discharges will be at a given facility. Additionally, pollutant sources other than storm water, such as illicit connections,[99] spills, and other improperly dumped materials, may increase the pollutant loading discharged into Waters of the United States. Table X–1 lists industrial activities that commonly occur at printing and publishing facilities, the pollutant sources at these facilities, and the pollutants associated with these activities. Table X–1 identifies heavy metals, oil and other parameters as potential pollutants associated with printing and publishing facilities.

[98] "Economic Analysis of Proposed Effluent Guidelines, Printing Industry." Office of Planning and Evaluation, EPA. August 1974.

[99] Illicit connections are contributions of unpermitted non-storm water discharges to storm sewers from any number of sources including improper connections, dumping or spills from industrial facilities, commercial establishments, or residential dwellings. The probability of illicit connections at facilities manufacturing transportation equipment, industrial or commercial machinery is low but it may be applicable at some operations.

TABLE X-1.—DESCRIPTION OF INDUSTRIAL ACTIVITIES, POTENTIAL POLLUTANT SOURCES, AND ASSOCIATED POLLUTANTS [i,ii,iii]

Activity	Pollutant source	Pollutant
Plate Preparation	using ink (lithography, letterpress, screen printing, flexography), etch baths, applying lacquer.	solvent, heavy metal, toxic waste ink with solvents chromium, lead.
Printing	using ink (lithography, letterpress, screen printing, flexography), gravure.	heavy metal waste (dust and sludge), ink—sludges with chromium or lead, ink—toxic wastes with metals, solvents.
Clean up	used plates: type, die, press blankets and rollers.	ink—toxic wastes with metals, solvents.
Stencil Preparation for Screen Printing	lacquer stencil film, photoemulsion, blockout (screen filler).	solvents, photographic processing wastes.
Material Handling: Transfer, Storage, Disposal	spills and leaks from material handling equipment.	fuel, oil, heavy metals.
	spills and leaks from aboveground tanks	fuel, oil, heavy metals, material being stored.
	solvents; trash; petroleum products	heavy metals, spent solvents, oil.
Photoprocessing	developing negatives and prints	heavy metals, spent solvents.

[i] EPA, Pollution Prevention Programs, Opportunities in Printing. Philadelphia, PA. October 1990.
[ii] University of Pittsburgh Trust, Center for Hazardous Materials Research Fact Sheet, Pollution Prevention: Strategies for the Printing Industry.
[iii] EPA, Resource Conservation and Recovery Act (RCRA) document, Does Your Business Produce Hazardous Waste as Many Small Businesses Do. Printing and Allied Industries, EPA/530-SW-90-027g, April 15, 1990.

Based on the similarities of the facilities included in this sector in terms of industrial activities and significant materials, EPA believes it is appropriate to discuss the potential pollutants at printing and publishing facilities as a whole and not subdivide this sector. Therefore, Table X-2 lists data for selected parameters from facilities in the printing and publishing sector. These data include the eight pollutants that all facilities were required to monitor for under Form 2F, as well as the pollutants that EPA has determined may merit further monitoring.

TABLE X-2.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY PRINTING AND PUBLISHING FACILITIES SUBMITTING PART II SAMPLING DATA[i] (mg/L)

Pollutant Sample type	No. of Facilities		No. of Samples		Mean		Minimum		Maximum		Median		95th Percentile		99th Percentile	
	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	15	15	33	33	12.8	7.7	0.0	0.0	61.8	27.0	9.0	6.40	45.9	24.05	94.1	1.9
COD	15	15	33	33	64.5	45.97	0.0	0.0	239.0	171.0	49.0	40.0	241.5	203.0	492.9	432.1
Nitrate + Nitrite Nitrogen	15	14	27	26	1.18	1.22	0.00	0.0	5.80	5.30	0.73	0.82	3.46	3.25	6.14	5.40
Total Kjeldahl Nitrogen	15	15	33	33	3.01	1.78	0.00	0.0	10.00	6.70	1.50	0.98	11.61	5.64	25.09	10.65
Oil & Grease	15	N/A	33	N/A	10.7	N/A	0.0	N/A	98.0	N/A	1.0	N/A	51.1	N/A	149.7	N/A
pH	14	N/A	26	N/A	N/A	N/A	5.4	N/A	8.6	N/A	7.0	N/A	8.3	N/A	8.9	N/A
Total Phosphorus	15	15	33	33	0.34	0.33	0.00	0.0	1.80	2.10	0.16	0.13	1.34	1.25	3.03	2.84
Total Suspended Solids	15	15	33	33	88	29	0	0	660	104	30	26	445	121	1383	263

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.
[ii] Composite samples.

3. Options for Controlling Pollutants

In evaluating options for controlling pollutants in storm water discharges, EPA must achieve compliance with the technology-based standards of the Clean Water Act [Best Available Technology (BAT) and Best Conventional Technology)]. The Agency does not believe that it is appropriate to establish specific numeric effluent limitations or a specific design or performance standard in this section for storm water discharges associated with industrial activity from printing and publishing facilities to meet BAT/BCT standards of the Clean Water Act. Instead, this section establishes requirements for the development and implementation of site-specific storm water pollution prevention plans consisting of a set of Best Management Practices (BMPs) that are sufficiently flexible to address different sources of pollutants at different sites.

Certain BMPs are implemented to prevent and/or minimize exposure of pollutants from industrial activities to storm water discharges. EPA believes the most effective BMPs for reducing pollutants in storm water discharges are exposure minimization practices. Exposure minimization practices lessen the potential for storm water to come into contact with pollutants. Good housekeeping practices ensure that facilities are sensitive to routine and nonroutine activities which may increase pollutants in storm water discharges. The BMPs which address good housekeeping and exposure minimization are easily implemented, inexpensive, and require little, if any, maintenance. BMP expenses may include construction of roofs for storage areas or other forms of permanent cover and the installation of berms/dikes. Other BMPs such as detention/retention ponds and filtering devices may be needed at these facilities because of the contaminant level in the storm water discharges. The types of BMPs implemented will depend on the type of discharge, types and concentrations of contaminants, and the volume of the flow.

The selection of the most effective BMPs will be based on site-specific considerations such as: facility size, climate, geographic location, geology/hydrology and the environmental setting of each facility, and volume and type of discharge generated. Each facility will be unique in that the source, type, and volume of contaminated storm water discharges will differ. In addition, the fate and transport of pollutants in these discharges will vary. EPA believes that the management practices discussed herein are well suited mechanisms to prevent or control the contamination of storm water discharges associated with printing and publishing facilities.

Part 1 group application data indicate that BMPs have not been widely implemented at the representative sampling facilities. Less than 10 percent of the sampling subgroup reported that they store some materials indoors; less than 10 percent store hazardous wastes under roof; and less than 5 percent cover drums or have sealed drums. However, 45 percent of the subgroup utilize some type of covering; 45 percent implement good housekeeping practices; and over 40 percent have training on pollution prevention.

The measures commonly used to reduce pollutants in storm water discharges associated with printing and publishing facilities are generally simple and easy to implement. Table X–3 identifies best management practices (BMPs) associated with different activities that routinely occur at printing and publishing facilities.

TABLE X–3.—GENERAL STORM WATER BMPS FOR PRINTING AND PUBLISHING FACILITIES[i,ii,iii,iv]

Activity	Best management practices (BMPs)
Plate Preparation	use aqueous-developed lithographic plates or wipe-on plates.
Printing	use press wipes as long as possible before discarding or laundering; dirty ones for the first pass, clean ones for the second pass.
	squeeze or centrifuge solvent out of dirty rags.
	set up an in-house dirty rag cleaning operation if warranted or send to approved industrial laundries, if available.
	dedicated press for inks with hazardous pigments/solvents.
	segregate used oil from solvents or other materials.
	use water-based inks in gravure and flexographic printing process.
Clean up	label sinks as to proper disposal of liquids.
	keep equipment in good condition.
	use doctor blades and squeegees to remove as much ink as possible prior to cleaning with solvent and rags.
	control solvent use during equipment cleaning, use only what you need.
	designate special areas for draining or replacing fluids.
	substitute nontoxic or less toxic cleaning solvents.
	recover waste solvents onsite with batch distillation if warranted or utilize professional solvent recyclers.
	centralize liquid solvent cleaning in one location.
	have refresher courses in operating and safety procedures.
Stencil Preparation for Screen Printing	recapture excess ink from silkscreen process before washing the screen to decrease amount of ink used and cleaning emulsion used
Material Handling and Storage Areas	store containerized materials (fuels, paints, inks, solvents, etc.) in a protected, secure location and away from drains.
	store reactive, ignitable, or flammable liquids in compliance with the local fire code.
	identify potentially hazardous materials, their characteristics, and use.
	eliminate/reduce exposure to storm water.
	control excessive purchasing, storage, and handling of potentially hazardous materials.
	keep records to identify quantity, receipt date, service life, users, and disposal routessecure and carefully monitor hazardous materials to prevent theft, vandalism, and misuse of materials.
	educate personnel for proper storage, use, cleanup, and disposal of materials.
	maintain good integrity of all storage tanks.
	inspect storage tanks to detect potential leaks and perform preventive maintenance.
	provide sufficient containment for outdoor storage areas for the larger of either 10 percent of the volume of all containers or 110 percent of the volume of the largest tank.
	use temporary containment where required by portable drip pans.
	use spill troughs for drums with taps
	train employees on proper filling and transfer procedures
	inspect piping systems (pipes, pumps, flanges, couplings, hoses, valves) for failures or leaks.
	handle solvents in designated areas away from drains, ditches, and surface waters. Locate designated areas preferably indoors or under a shed.
	if spills occur,
	stop the source of the spill immediately.
	contain the liquid until cleanup is complete.
	deploy oil containment booms if the spill may reach the water.
	cover the spill with absorbent material.
	keep the area well ventilated.
	dispose of cleanup materials properly.
	do not use emulsifier or dispersant.

[i] EPA, Pollution Prevention Programs. Opportunities in Printing. Philadelphia, PA. October 1990.
[ii] University of Pittsburgh Trust, Center for Hazardous Materials Research Fact Sheet, Pollution Prevention: Strategies for the Printing Industry.
[iii] EPA, Resource Conservation and Recovery Act (RCRA) document, Does Your Business Produce Hazardous Waste as Many Small Businesses Do. Printing and Allied Industries, EPA/530–SW–90–027g, April 15, 1990.
[iv] NPDES Storm Water Group Applications—Part 1. Received by EPA March 18, 1991 through December 31, 1992.

4. Storm Water Pollution Prevention Plan Requirements.

EPA believes that pollution prevention is the most effective approach for controlling contaminated storm water discharges from printing and publishing facilities. The requirements included in the pollution prevention plan provide a flexible framework for the development and implementation of site-specific controls to minimize the pollutants in storm water discharges. This flexibility is necessary because each facility is unique in that the source, type, and volume of contaminated storm water discharge will vary from site to site.

Under today's permit, all facilities must prepare and implement a storm water pollution prevention plan. The pollution prevention plan requirement reflects EPA's decision to allow operators of printing and publishing facilities to utilize BMPs as the BAT/BCT level of control for the storm water discharges covered by this section. The pollution prevention plan requirements in this section are consistent with the general requirements presented in the front of this fact sheet, which are based on EPA's storm water general permits finalized on September 9, 1992 (57 FR 41236), and September 25, 1992 (57 FR 44438), for discharges in nonauthorized NPDES States.

There are two major objectives to a pollution prevention plan: 1) to identify sources of pollution potentially affecting the quality of storm water discharges associated with industrial activity from a facility; and 2) to describe and ensure implementation of practices to minimize and control pollutants in storm water discharges associated with industrial activity from a facility.

Specific requirements for a pollution prevention plan for printing and publishing facilities are described below.

a. Contents of the Plan. Storm water pollution prevention plans are intended to aid operators of printing and publishing facilities to evaluate all potential prevention sources at a site, and assist in the selection and implementation of appropriate measures designed to prevent, or control, the discharge of pollutants in storm water runoff. EPA has developed guidance entitled Storm Water Management for Industrial Activities: "Developing Pollution Prevention Plans and Best Management Practices," EPA, 1992, (EPA 832–R–92–006) to assist permittees in developing and implementing pollution prevention measures.

(1) Description of Potential Pollutant Sources. Each storm water pollution prevention plan must describe activities, materials, and physical features of the facility that may contribute pollutants to storm water runoff or, during periods of dry weather, result in dry weather flows. This assessment of potential storm water pollutant source will support subsequent efforts to identify and set priorities for necessary changes in materials, materials management practices, or site features, as well as aid in the selection of appropriate structural and nonstructural control techniques. Plans must describe the following elements:

(a) Site Map—The plan must contain a map of the site that shows the pattern of storm water drainage, structural and nonstructural features that control pollutants in storm water runoff and process wastewater discharges, surface water bodies (including wetlands), places where significant materials [100] are exposed to rainfall and runoff, and locations of major spills and leaks that occurred in the 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit. The map must also indicate the direction of storm water flow. An outline of the drainage area for each outfall must be provided; the location of each outfall and monitoring points must be indicated; and the types of discharges contained in the drainage areas of the outfalls (e.g., storm water and air conditioner condensate) must be identified. An estimation of the total site acreage utilized for each industrial activity (e.g., storage of raw materials, waste materials, and used equipment) must be provided. These areas include liquid storage tanks, stockpiles, holding bins, used equipment, and empty drum storage. These areas are considered to be significant potential sources of pollutants at printing and publishing facilities.

(b) Inventory of Exposed Materials—Facility operators are required to carefully conduct an inspection of the site to identify significant materials that are or may be exposed to storm water discharges. The inventory must address materials that within 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit have been handled, stored, processed, treated, or disposed of in a manner to allow exposure to storm water. Findings of the inventory must be documented in detail in the pollution prevention plan. At a minimum, the plan must describe the method and location of onsite storage or disposal; practices used to minimize contact of materials with precipitation and runoff; existing structural and nonstructural controls that reduce pollutants in storm water; existing structural controls that limit process wastewater discharges; and any treatment the runoff receives before it is discharged to surface waters or through a separate storm sewer system. The description must be updated whenever there is a significant change in the type or amounts of materials, or material management practices, that may affect the exposure of materials to storm water.

(c) Significant Spills and Leaks—The plan must include a list of any significant spills and leaks of toxic or hazardous pollutants that occurred in the 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit. Significant spills include, but are not limited to, releases of oil or hazardous substances in excess of reportable quantities under Section 311 of CWA (see 40 CFR 110.10 and 117.21) or Section 102 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (see 40 CFR 302.4). Significant spills may also include releases of oil or hazardous substances that are not in excess of reporting requirements and releases of materials that are not classified as oil or a hazardous substance.

(d) Non-storm Water Discharges—Each pollution prevention plan must include a certification, signed by an authorized individual, that discharges from the site have been tested or evaluated for the presence of non-storm water, the results of any test and/or evaluation conducted to detect such discharges, the test method or evaluation criteria used, the dates on which tests or evaluations were performed, and the onsite drainage points directly observed during the test or evaluation. Pollution prevention plans must identify and ensure the implementation of appropriate pollution prevention measures for any non-storm water discharges.

[100] Significant materials include, "* * * but [are] not limited to: raw materials, fuels, materials such as solvents, detergents, and plastic pellets; finished materials such as metallic products; * * * hazardous substances designated under section 101(14) of CERCLA; any chemical facilities are required to report pursuant to section 313 of Title III of SARA; fertilizers; pesticides; and waste products such as ashes, slag, and sludge that have the potential to be released with storm water discharge." (40 CFR 122.26(b)(12)). Significant materials commonly found at transportation equipment, industrial or commercial machinery manufacturing facilities include raw and scrap metals; solvents; used equipment; petroleum based products; waste materials or by-products used or created by the facility.

(e) Sampling Data—Any existing data describing the quality or quantity of storm water discharges from the facility must be summarized in the plan. The description should include a discussion of the methods used to collect and analyze the data. Sample collection points should be identified in the plan and shown on the site map.

(f) Summary of Potential Pollutant Sources—The description of potential pollutant sources should clearly point to activities, materials, and physical features of the facility that have a reasonable potential to contribute significant amounts of pollutants to storm water. Any such activities, materials, or features must be addressed by the measures and controls subsequently described in the plan. In conducting the assessment, the facility operator must consider the following activities: raw materials (liquid storage tanks, stockpiles, holding bins), waste materials (empty drum storage), and used equipment storage areas. The assessment must list any significant pollutant parameter(s) (i.e., total suspended solids, oil and grease, etc.) associated with each source.

(2) Measures and Controls. Permittees must select, describe, and evaluate the pollution prevention measures, BMPs, and other controls that will be implemented at the facility. Source reduction measures include preventive maintenance, spill prevention, good housekeeping, training, and proper materials management. If source reduction is not an option, EPA supports the use of source control measures. These include BMPs such as material covering, water diversion, and dust control. If source reduction or source control are not available, then recycling or waste treatment are other alternatives. Recycling allows the reuse of storm water, while treatment lowers pollutant concentrations prior to discharge. Since the majority of printing and publishing activities occur indoors, the BMPs identified above are geared towards only those activities that occur outdoors or that otherwise have a potential to contribute pollutants to storm water discharges.

Pollution prevention plans must discuss the reasons each selected control or practice is appropriate for the facility and how each of the potential pollutant sources will be addressed. Plans must identify the time during which controls or practices will be implemented, as well the effect the controls or practices will have on storm water discharges from the site. At a minimum, the measures and controls must address the following components:

(a) Good Housekeeping—Permittees must describe protocols established to reduce the possibility of mishandling chemicals or equipment and training employees in good housekeeping techniques. Specifics of this plan must be communicated to appropriate plant personnel.

(b) Preventive Maintenance—Permittees are required to develop a preventive maintenance program that includes regular inspections and maintenance of storm water BMPs. Inspections should assess the effectiveness of the storm water pollution prevention plan. They allow facility personnel to monitor the components of the plan on a regular basis. The use of a checklist is encouraged, as it will ensure that all of the appropriate areas are inspected and provide documentation for recordkeeping purposes.

(c) Spill Prevention and Response Procedures—Permittees are required to identify proper material handling procedures, storage requirements, containment or diversion equipment, and spill removal procedures to reduce exposure of spills to storm water discharges. Areas and activities which are high risks for spills at printing and publishing facilities include raw material unloading and product loading areas, material storage areas, and waste management areas. These activities and areas and their drainage points must be described in the plan.

(d) Inspections—Qualified personnel must inspect designated equipment and areas of the facility at the proper intervals specified in the plan. The plan should identify areas which have the potential to pollute storm water for periodic inspections. Records of inspections must be maintained onsite.

(e) Employee Training—Permittees must describe a program for informing and educating personnel at all levels of responsibility of the components and goals of the storm water pollution prevention plan. A schedule for conducting this training should be provided in the plan. Where appropriate, contractor personnel must also be trained in relevant aspects of storm water pollution prevention. Topics for employee training should include good housekeeping, materials management, and spill response procedures. EPA recommends that facilities conduct training annually at a minimum. However, more frequent training may be necessary at facilities with high turnover of employees or where employee participation is essential to the storm water pollution prevention plan.

(f) Recordkeeping and Internal Reporting Procedures—Permittees must describe procedures for developing and retaining records on the status and effectiveness of plan implementation. This includes the success and failure of BMPs implemented at the facility.

(g) Sediment and Erosion Control—Permittees must identify areas, due to topography, activities, soils, cover materials, or other factors that have a high potential for soil erosion. Measures to eliminate erosion must be identified in the plan.

(h) Management of Runoff—Permittees must provide an assessment of traditional storm water management practices that divert, infiltrate, reuse, or otherwise manage storm water so as to reduce the discharge of pollutants. Based on this assessment, practices to control runoff from these areas must be identified and implemented as required by the plan.

(3) Comprehensive Site Compliance Evaluation. The storm water pollution prevention plan must describe the scope and content of comprehensive site evaluations that qualified personnel will conduct to: (1) Confirm the accuracy of the description of potential sources contained in the plan, (2) determine the effectiveness of the plan, and (3) assess compliance with the terms and conditions of this section. Comprehensive site compliance evaluations must be conducted once a year for printing and publishing facilities. The individual(s) who will conduct the evaluations must be identified in the plan and should be members of the pollution prevention team. Evaluation reports must be retained for at least 3 years after the date of the evaluation.

Based on the results of each evaluation, the description of potential pollution sources, and measures and controls, the plan must be revised as appropriate within 2 weeks after each evaluation. Changes in the measures and controls must be implemented on the site in a timely manner, never more than 12 weeks after completion of the evaluation.

5. Monitoring and Reporting Requirements

a. Monitoring Requirements. The regulatory modifications at 40 CFR 122.44 (i)(2) established on April 2, 1992, grant permit writers the flexibility to reduce monitoring requirements in storm water discharge permits. EPA has determined that the potential for storm water discharges to contain pollutants above benchmark levels, because of the industrial activities and materials exposed to precipitation, does not support sampling at printing and publishing facilities. Under the Storm Water Regulations at 40 CFR 122.26(b)(14), EPA defined "storm water discharge associated with industrial activity". The focus of today's permit is to address the presence of pollutants that are associated with the industrial activities identified in this definition and that might be found in storm water discharges. Under the methodology for determining analytical monitoring requirements, described in section VI.E.1 of this fact sheet, nitrate plus nitrite nitrogen is above the bench mark concentrations for the printing and publishing sector. After a review of the nature of industrial activities and the significant materials exposed to storm water described by facilities in this sector, EPA has determined that the higher concentrations of nitrate plus nitrite nitrogen are not likely to be caused by the industrial activity, but may be primarily due to non-industrial activities on-site. Today's permit does not require printing and publishing facilities to conduct analytical monitoring for this parameter. Based on a consideration of the BMPs typically used at these facilities, and generally low pollutant values from the application data, EPA believes that the pollution prevention plan with visual examinations of storm water discharges will help to ensure storm water contamination is minimized. Because permittees are not required to conduct sampling, they will be able to focus their resources on developing and implementing the pollution prevention plan.

Quarterly visual examinations of a storm water discharge from each outfall are required. The inspection must be of a grab sample collected from each storm water outfall. The examination of storm water grab samples shall include any observations of color, odor, turbidity, floating solids, foam, oil sheen, or other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on these samples.

The examination must be made at least once in each designated period during daylight hours unless there is insufficient rainfall or snow-melt to runoff. Where practicable, the same individual should carry out the collection and examination of discharges throughout the life of the permit to ensure the greatest degree of consistency possible. Examinations shall be conducted in each of the following periods for the purposes of inspecting storm water quality associated with storm water runoff and snow melt: January through March; April through June; July through September; October through December. Grab samples shall be collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 1 hour) of when the runoff begins discharging. Reports of the visual examination include: the examination date and time, examination personnel, visual quality of the storm water discharge, and probable sources of any observed storm water contamination. The visual examination reports must be maintained onsite with the pollution prevention plan.

EPA realizes that if a facility is inactive and unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly visual examination.

EPA believes that this quick and simple assessment will help permittees to determine the effectiveness of their plan on a regular basis at very little cost. Although the visual examination cannot assess the chemical properties of the storm water discharged from the site, the examination will provide meaningful results upon which the facility may act quickly. The frequency of this visual examination will also allow for timely adjustments to be made to the plan. If BMPs are performing ineffectively, corrective action must be implemented. A set of tracking or follow-up procedures must be used to ensure that appropriate actions are taken in response to the examinations. The visual examination is intended to be performed by members of the pollution prevention team. This hands-on examination will enhance the staff's understanding of the storm water problems on that site and the effects of the management practices that are included in the plan.

When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the records of the visual examination. Adverse weather conditions which may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

As discussed above, EPA does not believe that chemical monitoring is necessary for printing and publishing facilities. EPA believes that between quarterly visual examinations and site compliance evaluations potential sources of contaminants can be recognized, addressed, and then controlled with BMPs. In determining the monitoring requirements, EPA considered the nature of the industrial activities and significant materials exposed at these sites, and performed a review of data provided in Part 2 group applications.

Y. Storm Water Discharges Associated With Industrial Activity From Rubber, Miscellaneous Plastic Products, and Miscellaneous Manufacturing Industries

1. Discharges Covered Under This Section

This section covers storm water discharges associated with industrial activity from rubber and miscellaneous plastic products facilities (commonly identified by Standard Industrial Classification (SIC) major group 30) and miscellaneous manufacturing industries, except jewelry, silverware, and plateware (commonly identified by SIC major group 39, except 391).

Rubber and miscellaneous plastic products manufacturing facilities specifically include manufacturers of tires and inner tubes, rubber and plastic footwear, rubber and plastic hose and belting, gaskets, packing and sealing devices, and miscellaneous fabricated rubber products. This group also includes miscellaneous plastic products such as unsupported plastic film, sheet, rods and tubes, laminated plastic plate, sheet and profile shapes, plastic pipe and bottles, plastic foam products such as cups, ice chests and packaging materials, plastic plumbing fixtures, and miscellaneous plastic products.

Miscellaneous manufacturing industries specifically include manufacturers of musical instruments, games, toys and athletic goods, pens, pencils and artists' supplies, buttons, pins and needles, and a wide variety of products not classified elsewhere.

The SIC codes of the facilities covered by this section are in category (xi) of the definition of storm water discharges associated with industrial activity. Storm water discharges from facilities in this category are only regulated where precipitation and storm water runon come into contact with areas associated with industrial activities, and significant materials. Significant materials include, but are not limited to, raw materials, waste products, fuels, finished products, intermediate products, by-products, and other materials associated with industrial activities.

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

2. Pollutants Found in Storm Water Discharges

a. Sources of Pollutants. As discussed above, the SICs of the facilities in this sector fall into category (xi) of the definition of "storm water associated with industrial activity" found at 40 Code of Federal Regulations (CFR) 122.26(b)(14). As noted in the preamble to the final storm water regulations of November 16, 1990, most of the actual manufacturing and processing activity at these types of facilities normally occurs indoors (55 FR 48008).

Additional information concerning these manufacturing processes and the industrial sector itself can be found in the following documents: "Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Tire and Synthetic Rubber Processing Point Source Category," EPA 440/1–74–013a; "Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Fabricated and Reclaimed Rubber Segment of the Rubber Processing Point Source Category," EPA 440/1–74/030a; and "Development Document and Effluent Limitations Guidelines and Standards for the Plastics Molding and Forming Point Source Category," EPA 440/1–84/069.

The types of activities at these facilities where exposure to storm water may occur consist primarily of loading/unloading activities, and the storage and handling of raw materials, by-products, final products or waste products. A wide variety of materials are used at the facilities including solvents, acids and caustic, carbon black, plasticizers, paint, processing oils, resins, rubber compounds and solutions, fuels such as diesel or gasoline, adhesives, zinc and miscellaneous chemicals. However, it should also be noted that this is a cumulative list gathered from all the types of facilities in this sector and that individual facilities do not necessarily use all the materials on the list. Tanks, drums or bags of these materials may be exposed to storm water during loading/unloading operations, or through outdoor storage or handling at some facilities.

Other items which may be exposed to storm water include surplus processing machinery, scrap metal, scrap plastic and rubber, plastic pellets, PVC pipe and rags. Table Y-1 lists potential pollutant sources from activities that commonly take place at rubber, miscellaneous plastic products, and miscellaneous manufacturing industries.

TABLE Y–1.—COMMON POLLUTANT SOURCES

Activity	Pollutant source	Pollutants
Outdoor Material Loading/Unloading	Wooden pallets, spills/leaks from material handling equipment, solvents, resins.	TSS, oil and grease, organics.
Outdoor Material and Equipment Storage	Solvents, acids and caustic, plasticizers, paint, lubricating oils, processing oils, resins, rubber compounds, mineral spirits, zinc, scrap metal, scrap plastic and rubber, plastic pellets, PVC pipe, and rags.	Organics, zinc, hydrocarbons, oil and grease, acids, alkalinity.

Based on the wide variety of industrial activities and significant materials at the facilities included in this sector, EPA believes it is appropriate to divide the rubber and plastic product and miscellaneous manufacturing industry into subsectors to properly analyze sampling data and determine monitoring requirements. As a result, this sector has been divided into the following subsectors: rubber and miscellaneous plastic products manufacturing and miscellaneous manufacturing. Tables Y–2 and Y–3 below include data for the eight pollutants that all facilities were required to monitor for under Form 2F. The tables also list those parameters that EPA has determined merit further monitoring.

TABLE Y–2.—Statistics for Selected Pollutants Reported by Tires and Inner Tubes, Rubber and Plastics Footwear, Gaskets, Packing, and Sealing Devices and Rubber and Plastics Hose and Belting, Fabricated Rubber Products, Not Elsewhere Classified Manufacturing Facilities Submitting Part II Sampling Data[i] (mg/L)

Pollutant Samples type	No. of Facilities		No. of Sample		Mean		Minimum		Maximum		Median		95th Percentile		99th Percentile	
	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	18	17	32	31	14.7	14.47	0.0	0.0	160.0	144.0	6.4	7.90	43.0	43.18	86.1	86.3
COD	18	17	32	31	105.2	77.7	13.0	0.0	812.0	321.0	52.0	63.0	271.5	335.7	499.0	737.6
Nitrate + Nitrite Nitrogen	18	17	32	31	0.72	1.69	0.04	0.05	2.49	32.0	0.58	0.65	2.61	4.12	5.30	9.63
Total Kjeldahl Nitrogen	18	17	32	31	1.98	1.44	0.37	0.0	8.55	6.48	1.38	1.11	5.55	4.07	9.87	7.20
Oil & Grease	18	N/A	32	N/A	5.3	N/A	0.0	N/A	76.0	N/A	1.5	N/A	16.5	N/A	37.5	N/A
pH	17	N/A	30	N/A	N/A	N/A	4.8	N/A	9.2	N/A	7.0	N/A	8.7	N/A	9.5	N/A
Total Phosphorus	18	17	32	31	0.35	0.51	0.00	0.0	1.65	8.65	0.22	0.17	1.17	1.38	2.31	3.19
Total Suspended Solids	18	17	32	31	185	129	0	0.0	1420	760	63	44	783	584	2143	1585
Zinc, Total	15	15	28	28	1.103	0.904	0.027	0.011	7.600	7.490	0.21	0.25	4.617	4.179	14.012	12.660

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.

[ii] Composite samples.

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TABLE Y–3.—Statistics for Selected Pollutants Reported by Miscellaneous Plastics Products, Musical Instruments, Dolls, Toys, Games, and Sporting and Athletic Goods, Pens, Pencils, and Other Artists' Materials, Costume Jewelry, Costume Novelties, Buttons, and Miscellaneous Notions, Except Precious Metal, and Miscellaneous Manufacturing Facilities Submitting Part II Sampling Data[i] (mg/L)

Pollutant Samples type	No. of Facilities		No. of Sample		Mean		Minimum		Maximum		Median		95th Percentile		99th Percentile	
	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	35	36	56	58	13.3	9.37	0.0	0.0	71.0	70.0	8.1	7.0	41.8	28.8	77.1	51.5
COD	35	35	56	56	100.6	69.0	0.0	0.0	600.0	640.0	57.0	36.5	789.2	201.2	2377.6	380.8
Nitrate + Nitrite Nitrogen	35	34	56	55	1.01	1.02	0.00	0.0	5.23	7.40	0.75	0.62	5.49	3.21	13.98	6.25
Total Kjeldahl Nitrogen	34	33	55	54	2.16	1.58	0.00	0.0	11.00	6.54	1.40	1.20	12.46	5.22	31.95	10.02
Oil & Grease	38	N/A	60	N/A	3.9	N/A	0.0	N/A	91.0	N/A	0.0	N/A	15.4	N/A	35.5	N/A
pH	32	N/A	54	N/A	N/A	N/A	2.6	N/A	10.1	N/A	7.3	N/A	9.6	N/A	10.9	N/A
Total Phosphorus	35	34	55	54	0.33	0.24	0.00	0.0	2.90	1.25	0.18	0.15	1.90	0.72	5.35	1.31
Total Suspended Solids	35	35	56	56	202	116	0	0	2008	2100	34	25	1777	433	8369	1235

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.

[ii] Composite samples.

3. Options for Controlling Pollutants

In evaluating options for controlling pollutants in storm water discharges, EPA must achieve compliance with the technology-based standards of the Clean Water Act [Best Available Technology (BAT) and Best Conventional Technology)]. The Agency does not believe that it is appropriate to establish specific numeric effluent limitations or a specific design or performance standard in this section for storm water discharges associated with industrial activity from rubber, miscellaneous plastic products and miscellaneous manufacturing industries to meet BAT/BCT standards of the Clean Water Act. Instead, this section establishes requirements for the development and implementation of site-specific storm water pollution prevention plans consisting of a set of Best Management Practices (BMPs) that are sufficiently flexible to address different sources of pollutants at different sites.

Certain BMPs are implemented to prevent and/or minimize exposure of pollutants from industrial activities to storm water discharges. EPA believes the most effective BMPs for reducing pollutants in storm water discharges are exposure minimization practices. Exposure minimization practices lessen the potential for storm water to come into contact with pollutants. Good housekeeping practices ensure that facilities are sensitive to routine and nonroutine activities which may increase pollutants in storm water discharges. The BMPs which address good housekeeping and exposure minimization are easily implemented, inexpensive, and require little, if any, maintenance. BMP expenses may include construction of roofs for storage areas or other forms of permanent cover and the installation of berms/dikes. Other BMPs such as detention/retention ponds and filtering devices may be needed at these facilities because of the contaminant level in the storm water discharges. The types of BMPs implemented will depend on the type of discharge, types and concentrations of contaminants, and the volume of the flow.

The selection of the most effective BMPs will be based on site-specific considerations such as: facility size, climate, geographic location, geology/hydrology and the environmental setting of each facility, and volume and type of discharge generated. Each facility will be unique in that the source, type, and volume of contaminated storm water discharges will differ. In addition, the fate and transport of pollutants in these discharges will vary. EPA believes that the management practices discussed herein are well suited mechanisms to prevent or control the contamination of storm water discharges associated with rubber, miscellaneous plastic products and miscellaneous manufacturing industries.

Part 1 group application data indicated that the most widely implemented BMP, used by approximately 36 percent of the sampling facilities, is dikes. Less than 10 percent of the sampling subgroup reported that they cover their storage or loading areas; approximately 12 percent have roofs over their raw materials; and less than 5 percent store raw materials indoors. Because BMPs described in part 1 data are limited, the Table Y–4 is provided to identify BMPs associated with activities that routinely occur at rubber, miscellaneous plastic products and miscellaneous manufacturing industries.

TABLE Y–4.—GENERAL STORM WATER BMPS FOR RUBBER, MISCELLANEOUS PLASTIC PRODUCTS, AND MISCELLANEOUS MANUFACTURING INDUSTRIES

Activity	Best management practices (BMPs)
Outdoor Unloading and Loading	Confine loading/unloading activities to a designated area.
	Consider performing loading/unloading activities indoors or in a covered area.
	Consider covering loading/unloading area with permanent cover (e.g., roofs) or temporary cover (e.g., tarps).
	Close storm drains during loading/unloading activities in surrounding areas.
	Avoid loading/unloading materials in the rain.
	Inspect the unloading/loading areas to detect problems before they occur.
	Inspect all containers prior to loading/unloading of any raw or spent materials.
	Consider berming, curbing, or diking loading/unloading areas.
	Dead-end sump where spilled materials could be directed.
	Drip pans under hoses.
	Use dry clean-up methods instead of washing the areas down.
	Train employees on proper loading/unloading techniques and spill prevention and response.
Outdoor Material Storage (including waste, and particulate emission management).	Confine storage of materials, parts, and equipment to designated areas.

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TABLE Y–4.—GENERAL STORM WATER BMPS FOR RUBBER, MISCELLANEOUS PLASTIC PRODUCTS, AND MISCELLANEOUS MANUFACTURING INDUSTRIES—Continued

Activity	Best management practices (BMPs)
	Consider secondary containment using curbing, berming, or diking all liquid storage areas. Train employees on proper waste control and disposal. Train employees in spill prevention and response. Consider covering tanks. Ensure that all containers are closed (e.g., valves shut, lids sealed, caps closed). Wash and rinse containers indoors before storing them outdoors. If outside or in covered areas, minimize runon of storm water by grading the land to divert flow away from containers. Leak detection and container integrity testing. Direct runoff to onsite retention pond. Inventory all raw and spent materials. Clean around vents and stacks. Place tubs around vents and stacks to collect particulate. Inspect air emission control systems (e.g., baghouses) regularly, and repair or replace when necessary. Store wastes in covered, leak proof containers (e.g., dumpsters, drums). Consider shipping all wastes to offsite landfills or treatment facilities. Ensure hazardous waste disposal practices are performed in accordance with Federal, State, and local requirements.

Sources: NPDES Storm Water Group Applications—Part 1. Received by EPA, March 18, 1991, through December 31, 1992.
EPA, Office of Water. September 1992. "Storm Water Management for Industrial Activities: Developing Pollution Prevention Plans and Best Management Practices." EPA 832–R–92–006.

There are three major types of facilities in this sector: (1) Rubber products manufacturers, (2) manufacturers of miscellaneous plastic products, and (3) miscellaneous industries. In discussions with the rubber industry, the BMPs found in Table Y–5 were identified for rubber manufacturing to control discharges of zinc which was the most frequently reported toxic pollutant in the storm water sampling data:

TABLE Y–5.—BMPS FOR THE CONTROL OF ZINC AT RUBBER PRODUCTS MANUFACTURERS

Zinc source	BMPs
Poor housekeeping, bags of zinc stored outside, zinc spilled from trucks during unloading, spillage during emptying for plant use.	Employee training, spill cleanup, indoor storage, use of special large volume sacks with less potential for releases of zinc.
Zinc containers, rubber products, rags contaminated with zinc stearate discarded in outdoor dumpsters.	Cover the dumpsters, use linked dumpsters which do not leak or move dumpster inside.
Malfunctioning baghouses for dust collection	Repair or replace the baghouse, regular maintenance.
Grinding operations from which zinc dust may be released	Use dust collection system or reduce the amount of dust generated.
Drips of zinc stearate during coating operations	Spill prevention/response, use of alternate compounds.

4. Special Conditions

There are no additional requirements under this section other than those stated in Part III. of the permit.

5. Storm Water Pollution Prevention Plan Requirements

EPA believes that pollution prevention is the most effective approach for controlling contaminated storm water discharges from rubber, miscellaneous plastic products, and miscellaneous manufacturing industries. The requirements included in the pollution prevention plans provide a flexible framework for the development and implementation of site-specific controls to minimize the pollutants in storm water discharges. This flexibility is necessary because each facility is unique in that the source, type, and volume of contaminated storm water discharge will vary from site to site.

Under today's permit, all facilities must prepare and implement a storm water pollution prevention plan. The pollution prevention plan requirement reflects EPA's decision to allow operators of rubber, miscellaneous plastic products, and miscellaneous manufacturing industries to utilize BMPs as the BAT/BCT level of control for the storm water discharges covered by this section.

There are two major objectives to a pollution prevention plan: (1) To identify sources of pollution potentially affecting the quality of storm water discharges associated with industrial activity from a facility; and (2) to describe and ensure implementation of practices to minimize and control pollutants in storm water discharges associated with industrial activity from a facility.

Section 313 of EPCRA requires operators of manufacturing facilities that handle toxic chemicals in amounts exceeding threshold levels (listed at 40 CFR 372.25) to report to EPA on an annual basis. Because these types of facilities handle large amounts of toxic chemicals, EPA concluded that they have the increased potential to degrade the water quality of receiving streams. Consistent with Part VII.B. of this permit, Section 313 reporting facilities must fulfill specific requirements.

Except for the special controls discussed below for rubber products manufacturers, there are no additional Pollution Prevention Plan requirements other than those stated in Part IV of this permit.

a. Special Measures and Controls for Rubber Manufacturing Facilities. For rubber manufacturers, this section also requires permittees to develop specific BMPs to control discharges of zinc in storm water runoff. The principal sources of zinc in storm water runoff at these facilities were identified above in Section 3. EPA believes that sources of zinc merit special attention at rubber products manufacturing facilities due to its prevalence at such facilities and its toxicity in aquatic systems. This section requires that rubber products manufacturers review the possible sources of zinc listed below at their facilities and include as appropriate the accompanying BMPs in their storm water pollution prevention plans:

(1) Inadequate Housekeeping. Permittees are required to review the handling and storage of zinc bags at their facilities. The following BMPs must be considered in developing the storm water pollution prevention plan: employee training regarding the handling and emptying of zinc bags, indoor storage of zinc bags, thorough cleanup of zinc spills without washing the zinc into a storm drain. Facilities must also consider the use of 2,500 pound sacks (from which spills are less likely) rather than 50 to 100 pound sacks.

(2) Zinc in Dumpsters. The following BMPs must be considered to reduce this potential source of zinc: provide a cover for the dumpster or move the dumpster inside; provide a lining for the dumpster.

(3) Malfunctioning Dust Collectors or Baghouses. Permittees must review dust collectors and baghouses as possible sources of zinc. Improperly operating dust collectors or baghouses must be replaced or repaired as appropriate; the plan must also provide for regular maintenance of these facilities.

(4) Grinding Operations. Permittees must review dust generation from rubber grinding operations at their facility and as appropriate, install a dust collection system.

(5) Zinc Stearate Coating Operations. The plan must include measures to prevent and/or clean up drips or spills of zinc stearate slurry which may be released to a storm drain. Alternate compounds to zinc stearate must also be considered.

6. Numeric Effluent Limitations

There are no additional numeric effluent limitations beyond those described in Part V.B of today's permit.

7. Monitoring and Reporting Requirements

a. Analytical Monitoring Requirements. EPA believes that rubber product manufacturing facilities may reduce the level of pollutants in storm water runoff from their sites through the development and proper implementation of the storm water pollution prevention plan requirements discussed in today's permit. Under the revised methodology for determining pollutants of concern for the various industrial sectors, the rubber product manufacturing subsector must monitor its storm water discharges. The monitoring requirements are presented in Table Y–6. The pollutant listed in Table Y–6 was found to be above the benchmark level. Because this pollutant has been reported at benchmark levels from rubber product manufacturing facilities, EPA is requiring monitoring after the pollution prevention plan has been implemented to assess the effectiveness of the pollution prevention plan and to help ensure that a reduction of pollutants is realized.

At a minimum, storm water discharges from rubber product manufacturing facilities must be monitored quarterly during the second year of permit coverage. Samples must be collected at least once in each of the following periods: January through March; April through June; July through September; and October through December. At the end of the second year of permit coverage, a facility must calculate the average concentration for each parameter listed in Table Y–6. If the permittee collects more than four samples in this period, then it must calculate an average concentration for each pollutant of concern for all samples analyzed.

TABLE Y–6

Pollutants of concern	Cut-off concentration
Total Recoverable Zinc	0.117 mg/L

If the average concentration for a parameter is less than or equal to the cut-off concentration, then the permittee is not required to conduct quantitative analysis for that parameter during the fourth year of the permit. If, however, the average concentration for a parameter is greater than the cut-off concentration, then the permittee is required to conduct quarterly monitoring for that parameter during the fourth year of permit coverage. Monitoring is not required during the first, third, and fifth year of the permit. The exclusion from monitoring in the fourth year of the permit is conditional on the facility maintaining industrial operations and BMPs that will ensure a quality of storm water discharges consistent with the average concentrations recorded during the second year of the permit. The schedule for monitoring is presented in Table Y–7.

TABLE Y–7.—SCHEDULE OF MONITORING

2nd Year of Permit Coverage	• Conduct quarterly monitoring. • Calculate the average concentration for all parameters analyzed during this period. • If average concentration is greater than the value listed in Table Y–6, then quarterly sampling is required during the fourth year of the permit. • If average concentration is less than or equal to the value listed in Table Y–6, then no further sampling is required for that parameter.
4th Year of Permit Coverage	• Conduct quarterly monitoring for any parameter where the average concentration in year 2 of the permit is greater than the value listed in Table Y–6. • If industrial activities or the pollution prevention plan have been altered such that storm water discharges may be adversely affected, quarterly monitoring is required for all parameters of concern.

In cases where the average concentration of a parameter exceeds the cut-off concentration, EPA expects permittees to place special emphasis on methods for reducing the presence of those parameters in storm water discharges. Quarterly monitoring in the fourth year of the permit will be used to reassess the effectiveness of the adjusted pollution prevention plan.

EPA realizes that if a facility is inactive and unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly chemical sampling.

b. Alternative Certification. Throughout today's permit, EPA has included monitoring requirements for facilities which the Agency believes have the potential for contributing significant levels of pollutants to storm water discharges. The alternative certification described below is necessary to ensure that monitoring requirements are only imposed on those facilities that do, in fact, have storm water discharges containing pollutants at concentrations of concern. EPA has determined that if materials and activities are not exposed to storm water at the site, then the potential for pollutants to contaminate storm water discharges does not warrant monitoring.

Therefore, a discharger is not subject to the monitoring requirements of this Part, provided the discharger makes a certification for a given outfall or on a pollutant-by-pollutant basis, in lieu of monitoring described in Table Y–6, under penalty of law, signed in accordance with Part VII.G. (Signatory Requirements), that material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, industrial machinery or operations, significant materials from past industrial activity, and that are located in areas of the facility that are within the drainage area of the outfall are not presently exposed to storm water and will not be exposed to storm water for the certification period. Such certification must be retained in the storm water pollution prevention plan and submitted to EPA in lieu of monitoring reports required under paragraph (*c*.) below. The permittee is required to complete any and all sampling until the exposure is eliminated. If the facility is reporting for a partial year, the permittee must specify the date exposure was eliminated. If the permittee is certifying that a pollutant was present for part of the reporting period, nothing relieves the permittee from the responsibility to sample that parameter up until the exposure was eliminated and it was determined that no significant materials remained. This certification option is not applicable to compliance monitoring requirements associated with effluent limitations. EPA does not expect facilities to be able to exercise this certification for indicator parameters, such as TSS and BOD.

c. Reporting Requirements. Permittees are required to submit all monitoring results obtained during the second and fourth year of permit coverage within 3 months of the conclusion of each year. For each outfall, one signed Discharge Monitoring Report Form must be submitted to the Director per storm event sampled. For facilities conducting monitoring beyond the minimum requirements, an additional signed Discharge Monitoring Report Form must be filed for each analysis. The permittee must include a measurement or estimate of the total precipitation, volume of runoff, and peak flow rate of runoff for each storm event sampled.

d. Sample Type. All discharge data shall be reported for grab samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The required 72-hour storm event interval is waived where the preceding measurable storm event did not result in a measurable discharge from the facility. The required 72-hour storm event interval may also be waived where the permittee documents that less than a 72-hour interval is representative for local storm events during the season when sampling is being conducted. The grab sample shall be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable.

If storm water discharges associated with industrial activity commingle with process or nonprocess water, then where practicable, permittees must attempt to sample the storm water discharge before it mixes with the non-storm water discharge.

e. Representative Discharge. When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may test the effluent of one of such outfalls and report that the quantitative data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluent. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

f. Quarterly Visual Examination of Storm Water Quality. Rubber, miscellaneous plastic products, and miscellaneous manufacturing facilities shall perform and document a visual examination of a storm water discharge associated with industrial activity from each outfall, except discharges exempted under paragraph (3) below. The examination(s) must be made at least once in each of the following 3-month periods: January through March, April through June, July through September, and October through December. The examination shall be made during daylight hours unless there is insufficient rainfall or snow melt to produce a runoff event.

(*1*) Examinations shall be made of grab samples collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 1 hour) of when the runoff or snowmelt begins discharging. The examinations shall document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution. The examination must be conducted in a well-lit area. No analytical tests are required to be performed on the samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. Where practicable, the same individual should carry out the collection and examination of discharges for entire permit term.

(*2*) Visual examination reports must be maintained onsite in the pollution prevention plan. The report shall include the examination date and time, examination personnel, the nature of the discharge (i.e., runoff or snow melt), visual quality of the storm water discharge (including observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution), and probable sources of any observed storm water contamination.

(*3*) When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may collect a sample of effluent of one of such outfalls and report that the examination data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

(*4*) When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the records of the visual examinations. Adverse weather conditions that may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(*5*) EPA realizes that if a facility is inactive and unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly visual examination.

EPA believes that this quick and simple assessment will help the permittee to determine the effectiveness of his/her plan on a regular basis at very little cost. Although the visual examination cannot assess the chemical properties of the storm water discharged from the site, the examination will provide meaningful results upon which the facility may act quickly. The frequency of this visual examination will also allow for timely adjustments to be made to the plan. If BMPs are performing ineffectively, corrective action must be implemented. A set of tracking or follow-up procedures must be used to ensure that appropriate actions are taken in response to the examinations. The visual examination is intended to be performed by members of the pollution prevention team. This hands-on examination will enhance the staff's understanding of the storm water problems on that site and the effects of the management practices that are included in the plan.

Z. Storm Water Discharges Associated With Industrial Activity From Leather Tanning and Finishing Facilities

1. Discharges Covered Under This Section

Storm water discharges covered by this section include all discharges from leather tanning (commonly identified by Standard Industrial Classification (SIC) code 3111) and facilities which make fertilizer solely from leather scraps and leather dust where precipitation and storm water runon come into contact with significant materials including, but not limited to, raw materials, waste products, by-products, stored materials, and fuels. This includes storm water discharges from access roads, and rail lines used or traveled by carriers of raw materials, manufactured products, waste materials, or by-products created by the facility. This section does not cover any discharge subject to process wastewater effluent limitation guidelines, including storm water that combines with process wastewater.

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

a. Industry Profile. The storm water permit application regulations define storm water discharge associated with industrial activity at 40 Code of Federal Regulations (CFR) 122.26(b)(14). Category (ii) of this definition includes facilities identified by SIC code 3111, establishments primarily engaged in tanning, currying, and finishing hides and skins into leather. Most tanneries are small family operations, although several are divisions of larger corporations. The leather tanning and finishing industry currently includes approximately one hundred fifty facilities. There are effluent limitations guidelines for the leather tanning industry based on 9 subcategories, as described in the "Development Document for Effluent Limitations Guidelines and Standards for Leather Tanning and Finishing Point Source Category." (The subcategories were based on distinct combinations of raw materials and leather processing operations.)

Leather tanning or finishing is the conversion of animal hides or skins into leather. Leather is made from the inner layer of the animal skin, which consists primarily of the protein collagen. Tanning is the reaction of the collagen fibers with tannins, chromium, alum or other tanning agents. Tanning processes use chromium III, sulfuric acid and detergents and a variety of raw and intermediate materials.

There are three major processes required to make finished leather. These are beamhouse operations, tanyard processes and retanning and finishing processes. In general, most tanneries perform the entire tanning process, from beamhouse to wet finishing operations. A smaller number perform only beamhouse and tanyard operations and sell their unfinished product (wet "blue" stock) to other tanneries. These processes are described below:

Beamhouse Operations—These consist of four activities: side and trim; soak and wash; fleshing and unhairing. Side and trim is the cutting of the hide into two sides and trimming of areas which do not produce good leather. In soak and wash processes, the hides are soaked in water to restore moisture lost during curing. Washing removes dirt, salt, blood, manure, and nonfibrous proteins. Fleshing is a mechanical operation which removes excess flesh. The removed matter is normally recovered and sold for conversion to glue. Unhairing involves using calcium hydroxide, sodium sulfhydrate, and sodium sulfide to destroy the hair (hair pulp process) or remove hair roots. A mechanical unhairing machine can also be used to remove hair loosened by chemicals (hair save process). Beamhouse processes can account for approximately 60 percent of the pollutant load (except trivalent chromium) from a complete tannery. Pollutants that may be produced are proteinaceous organic and inorganic pollutants characterized by a high pH (10–12) and substantial amounts of Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total Suspended Solids (TSS), Total Kjeldahl Nitrogen (TKN), and sulfides.

Tanyard Processes—These consist of bating, pickling, tanning, wringing, splitting, and shaving. Bating involves the addition of salts of ammonium sulfate or ammonium chloride used to convert the residual alkaline chemicals present from the unhairing process into soluble compounds which can be washed from the hides or skins. "Pickling" the hide with sulfuric acid provides the acid environment necessary for chromium tanning. In the tanning process, tanning agents such as trivalent chromium and vegetable tannins convert the hide into a stable product which resists decomposition. Wringing of the "blue hides" (hides tanned with trivalent chromium) removes excess moisture with a machine similar to a clothes wringer. Splitting adjusts the thickness of the tanned hide to the requirements of the finished product and produces a "split" from the flesh side of the hide. The hide is then shaved to remove any remaining fleshy matter. Wastewater from tanyard operations contain inorganic chemical salts, small amounts of proteinaceous hair and waste, and large amounts of ammonia from the bating process. Pickling generates a highly acidic waste (pH of 2.5–3.5) which contains salt. Spent chromium liquors contain high concentrations of trivalent chromium in acid solution with low concentrations of BOD and TSS. Vegetable tanning vat discharges are highly colored, and contain significant amounts of BOD, COD, and dissolved solids.

Retanning and Wet Finishing Processes—These include retanning, bleaching, coloring, fatliquoring, and finishing. The most common retanning agents are chromium, vegetable extracts and syntans (based upon naphthalene and phenol). Sodium bicarbonate and sulfuric acid are sometimes used to bleach leather. Coloring involves the use of dyes (usually aniline based) on the tanned skin. Animal or vegetable fatliquors are added to replace the natural oils lost in the beamhouse and tanyard processes. Finishing includes all operations performed on the hide after fatliquoring, and includes finishing to enhance color and resistance to stains and abrasions, smoothing and stretching of the skin, drying, conditioning, staking, dry milling, buffing and plating. These processes generate wastes with additional quantities of trivalent chromium, tannins, sulfonated oils, and spent dyes, which are low in BOD and TSS, and high in COD.

Table Z–1 lists potential storm water pollutant source activities that may take place at leather tanning facilities.

TABLE Z–1.—POLLUTANTS POTENTIALLY FOUND IN STORM WATER DISCHARGES AT LEATHER TANNING FACILITIES

Activity	Pollutant source	Pollutant
Outdoor storage of fresh and brine cured hides	Fresh & brine cured hides	Salt, organic materials (manure), biochemical oxygen demand.
Beamhouse Processes (trimming, soak & wash, fleshing, unhairing).	Chemical storage (drums or bags)	Depilatory chemicals.
	Empty containers of lime, depilatory chemicals.	Calcium hydroxide, sodium sulfhydrate, or sodium sulfide.
	Trim scraps, hair	BOD, COD, TSS.
Tanyards (bating, pickling, tanning, wringing, splitting, shaving).	Empty chemical containers	Trivalent chromium, vegetable tannins, enzymes, pickling acids (sulfuric acid), alum, syntans, chemical deliming agents, glutaraldehyde, heavy oils.
	"Blue" hides, splits, trimmings, shavings	Trivalent chromium, leather fiber and dust, suspended solids.
Retan and Wet Finishing (retanning, bleaching & coloring, fatliquoring, buffing).	Empty chemical containers	Chromium tanning agents, vegetable extract, dyes, pigments, animal or vegetable based oils, synthetic oils made from modified mineral based oils.
	Leather dust containing chromium.	Leather fiber, trivalent chromium, suspended solids.
Dry finishing (Application of pigment to leather surface with water-based or solvent based finishes).	Emissions from spray booths and spent solvents.	Pigments, solvents-acetone, pylene, glycol ether.
Receiving and unloading areas	Hides	Trivalent chromium, salt.
	Chemical supplies	Depilatory chemicals, trivalent chromium, vegetable tannins, enzymes, pickling acids (sulfuric acid), alum, syntans, chemical deliming agents, glutaraldehyde, heavy oils, dyes, pigments, animal or vegetable based oils, synthetic oils, solvents and biocides.
	Leaking trucks	Oil & grease and waste materials.
	Accidental spills	Chemicals listed for supplies above.
Improper Connections to Storm Sewer	Floor drains-process wastewater, cleaning and washdown of process equipment and process areas.	Dependent on operations.
Outdoor Bulk Chemical Storage	Above ground tanks	Sulfuric acid, ferric chloride, finishing solvents (mineral spirits), hydrated lime, surfactant.
Outdoor Storage of coal	Coal piles	Oil & grease, TSS, copper, nickel, zinc.
Waste Management	Hoppers	Leather dust, scraps.
	Dumpsters	Empty bags & chemical containers.
	Sludge (wastewater treatment sludge stored in containers to diminish storm water contact, awaiting offsite disposal).	Lime, pieces of leather, hair, protein-like substances, floor sweepings, trivalent chromium, biochemical oxygen demand.

Sources: NPDES Storm Water Group Applications—Part 1. Received by EPA May 22, 1991—February 18, 1992.
EPA, Office of Water. November 1982. "Development Document for Effluent Limitations Guidelines and Standards for the Leather Tanning and Finishing Point Source Category." EPA/440/1–82/016.
EPA, Office of Water Regulations and Standards and Office of Water Enforcement and Permits. September 1986. "Guidance Manual for Leather Tanning and Finishing Pretreatment Standards."
EPA, Office of Solid Waste Management Programs, SCS Engineers, Reston, VA. 1976. "Assessment of Industrial Hazardous Waste Practices Leather Tanning and Finishing Industry." EPA–68–01–3261.

2. Pollutants Found in Storm Water Discharges From Leather Tanning Operations

The impacts caused by storm water discharges from leather tanning facilities will depend on the geographic location of the facility, the types of industrial activities occurring onsite (e.g., beamhouse, tanyard, retan and wet finishing, dry finishing); the types of significant materials exposed to storm water (e.g., trivalent chromium tanned leather shavings, chemical containers etc.), the size of the operation; and the type, duration, and intensity of precipitation events. Other factors such as air emissions (i.e., settled dust), materials storage, spills, improperly dumped materials, and illicit conditions may also impact receiving waters. (Illicit connections are contributions of unpermitted non-storm water discharges to storm sewers.)

Part 1 group application information indicates that the industrial activities occurring at leather tanning facilities include leather tanning plant yards; unhairing (76.9 percent of samplers); chromium tanning (69.2 percent of samplers); splitting and shaving (76.9 percent) retanning (69.2 percent); wet hide finishing-buffing (76.9 percent); dry finishing; vegetable tanning (30.8 percent); immediate access roads and rail lines used or traveled by carriers of raw materials (38.5 percent of samplers), manufactured products, waste management (36.8 percent); material handling sites (23.1 percent); refuse sites; sites used for the application or disposal of process wastewaters (as defined at 40 CFR Part 401) sites used for residual treatment, storage or disposal (waste water treatment (30.8 percent)); shipping and receiving areas (69.2 percent of samplers); finished materials; and areas where industrial activity has taken place in the past and significant materials remain and are exposed to storm water. (40 CFR 122.26(b)(14)).

Significant materials include raw materials, brine or salt cured hides and skins (7.7 percent), fuels (15.4 percent), materials such as solvents, detergents, finished materials; hazardous substances designated under Section 101(14) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), any chemical required to be reported pursuant to Section 313 of Title III of the Superfund Amendments and Reauthorization Act; fertilizers; pesticides; and waste products such as sludge (7.7 percent) that have the potential to be released with storm water discharge. (40 CFR 122.26(b)(12)). Other significant materials found at leather tanning facilities include leather shavings and dust (46.2 percent), leather scrap (30.8 percent), blue hides and splits (46.2 percent), empty chemical containers, spent solvents, emissions from spray booths, and wastes in dumpsters. Significant materials produced from various industrial activities occurring at leather tanning facilities are summarized in Table Z–1.

Based on the similarities of the facilities included in this sector in terms of industrial activities and significant materials, EPA believes it is appropriate to discuss the potential pollutants at leather tanning and finishing facilities as a whole and not subdivide this sector. Therefore, Table Z–2 lists data for selected parameters from facilities in the leather tanning and finishing sector. These data include the eight pollutants that all facilities were required to monitor for under Form 2F.

TABLE Z–2.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY LEATHER TANNING AND FINISHING FACILITIES SUBMITTING PART II SAMPLING DATA[i] (mg/L)

Pollutant Sample type	No. of facilities		No. of samples		Mean		Minimum		Maximum		Median		95th percentile		99th percentile	
	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	12	12	31	31	33.1	22.3	0.0	0.0	320.0	92.0	11.0	10.0	105.8	78.05	217.9	145.3
COD	12	12	31	31	205.5	91.94	0.0	0.0	2100.0	460.0	82.0	50.0	597.0	296.0	1247.4	577.2
Nitrate + Nitrite Nitrogen	12	12	31	31	1.86	1.88	0.06	0.30	11.00	9.60	1.20	0.90	6.12	5.01	11.97	9.01
Total Kjeldahl Nitrogen	12	12	31	31	7.70	6.22	0.70	0.90	46.00	38.0	4.30	3.50	26.49	19.7	55.80	39.18
Oil & Grease	12	N/A	31	N/A	13.9	N/A	0.0	N/A	130.0	N/A	0.0	N/A	56.4	N/A	124.5	N/A
pH	12	N/A	31	N/A	N/A	N/A	4.6	N/A	9.0	N/A	7.4	N/A	8.9	N/A	9.8	N/A
Total Phosphorus	12	12	31	31	0.36	0.83	0.00	0.03	3.00	18.0	0.16	0.18	1.11	1.51	2.34	3.66
Total Suspended Solids	12	12	31	31	310	115	0	0	4000	670	49	86	1302	520	4071	1209

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.

[ii] Composite samples.

Table Z-3 lists the potential pollutant sources for common pollutants found at leather tanning and finishing facilities.

TABLE Z–3.—LIST OF POTENTIAL POLLUTANT SOURCES

Parameter	Pollutant sources
Oil and Grease	Degreasing processes, oils used in leather processing (fatliquoring).
COD	Complex organic and inorganic process chemicals, dyes, vegetable tannins, extraneous hide substances.
BOD_5	Carbonaceous organic materials such as dissolved or pulped hair and other extraneous hide substances, nitrites, ammonia from residual bating chemicals and from hydrolytic deamination of proteinaceous hair and hide substances.
pH	Acidic or alkaline materials.
TSS	Leather dust, scraps, hair.
Total phosphorus	Detergents.
Nitrate nitrite nitrogen	Spent bating liquors and breakdown of organic proteins (dissolved hair and dermal matter).
Total Kjeldahl nitrogen	Dissolved or pulped proteinaceous hair.
Chromium	Blue hides, leather scraps and dust, waste materials such as empty containers, sludge.

3. Options for Controlling Pollutants

The measures implemented to reduce pollutants in storm water associated with leather tanning operations are generally uncomplicated practices. The following table identifies Best Management Practices (BMPs) associated with different activities that take place at leather tanning facilities. The most effective BMPs will be selected on the basis of site-specific considerations (e.g., facility size, industrial processes performed geographic location, significant materials, volume and type of discharge generated). Because of the industrial processes involved in leather tanning, BMPs that concentrate on source reduction, recycling and containment/ diversion will be the most helpful for reducing pollution in storm water runoff.

Source reduction BMPs include good housekeeping, materials management practices, preventive maintenance, spill prevention and response activities and employee training. Activities associated with good housekeeping include:

Operation and Maintenance—Keep floors clean and dry, regularly pick up garbage and waste materials, make sure equipment is working properly, routinely inspect for leaks or conditions that could lead to discharges of chemicals or contact of storm water with raw materials, intermediate materials, waste materials etc., reduce chemical spills resulting from carelessness and prepare program to control spills and carry out cleanups. Ensure that spill cleanup procedures are understood by employees. Eliminate unnecessary uses of water such as leaving hoses running.

Materials Storage and Maintenance—Store containers away from direct traffic routes to prevent accidental spills, stack containers according to manufacturers instructions to avoid damaging containers, store containers on pallets to prevent corrosion of containers, assign responsibility of hazardous material inventories to a limited number of people who are trained to handle hazardous materials.

Material Inventory Procedures—Identify all chemical substances present in the work place, label all containers, clearly mark on the inventory hazardous materials that require special handling, storage or use.

Preventive Maintenance—Identify equipment, systems and facility areas that should be inspected, schedule periodic inspections of the equipment and systems, timely adjustments, repair, or replacement of equipment and systems. Maintain complete records on inspections, equipment, and systems. Install automatic monitoring devices to detect abnormal discharge of gases and hazardous substances.

Containment/diversion BMPs involve segregating areas of concern by covering or berming the activity and controlling dust. Diversion dikes, curbs and berms are temporary or permanent diversion structures that prevent runoff from passing beyond a certain point, and divert runoff away from its intended path. Dikes, curbs and berms are already in use at some leather tanning facilities.

Part 1 group application data indicate that BMPs have not been widely implemented at the representative sampling facilities. The most commonly listed material management practice is roofing and covers. Table Z–4 lists BMPs associated with different activities that take place at leather tanning facilities.

TABLE Z–4.—LIST OF BEST MANAGEMENT PRACTICES

Activity	Best management practices
Temporary Outdoor Storage of fresh or brine cured hides.	Store hides indoors if possible.
	Cover the hides with a roof or temporary covering (e.g., polyethylene, tarpaulin etc.).
	Minimize storm water runon by enclosing the area or building a berm around the area.
	Inspect area regularly for proper implementation of good housekeeping and control measures.
Beamhouse Operations	Store chemical drums & bags and empty lime & depilatory chemical containers indoors if possible, preventive maintenance.
	Cover chemical drums & bags, empty lime & depilatory chemical containers and leather scraps with roof or temporary covering (e.g., tarpaulins, polyethylene) and store on elevated impermeable surface.
	Curbing, containment dikes around chemical storage, empty lime & depilatory chemical containers and leather scrap storage area.
	Inspect area regularly for leaking drums, broken bags, proper implementation of good housekeeping and control measures, (broken cracked dikes), material inventory, material storage and operation & maintenance.
	Clean up leaks & spills quickly & completely, use drip pans for leaking equipment.
	Good Housekeeping—all paved areas should be swept regularly, eliminate unnecessary flushing with water and label chemical drums and containers.
	Employee training on good housekeeping, proper handling of chemicals.
Tanyards	BMPs for Tanyards (empty chemical containers and hides, leather dust, shavings) are the same as those listed above for Beamhouse Activities.
Retan and wet finish	Dust reduction through frequent inspection of vacuum, collector (bag & cyclone), and filter systems.
	Dust reduction through enclosure and covering.
	Preventive maintenance/inspection of dust collection systems.
	Good Housekeeping-regular sweeping of paved areas, eliminate unnecessary flushing with water and label chemical drums and containers.
	Employee training on good housekeeping, proper handling of chemicals.
Dry Finish	Preventive maintenance, inspection of spray booths.
	Employee training on proper disposal of spent solvents.
Receiving and shipping	Cover shipping & receiving area.
	Cover trucks.
	Vehicle positioning—locating trucks while transferring materials to prevent spills onto the ground surface.
	Grade berm or curb area to prevent storm water runon contamination, divert rain gutters away from loading area.
	Clean spills immediately.
	Inspect trucks for leaks.
	Employee training in spill prevention.
Liquid Storage in Above Ground Tanks	Clearly tag valves to avoid human error.
	Install overflow protection devices on tank systems to warn operator or to automatically shut down transfer pumps when tanks reach full capacity.
	Secondary containment around tanks.

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TABLE Z-4.—LIST OF BEST MANAGEMENT PRACTICES—Continued

Activity	Best management practices
	Employee training.
	Inspection of tank foundations, connections, coatings, valves and piping systems.
	Comply with existing spill prevention, cleanup and countermeasure plans (SPCC plan) and State and Federal laws.
	Integrity testing by qualified professional.
Improper connections to storm sewers	Plug all floor drains connected to sanitary or storm sewer.
	Perform smoke or dye testing to determine if interconnections exist between sanitary water system and storm sewer system.
	Update facility schematics to accurately reflect all plumbing connections.
	Install a safeguard against washwaters from processing areas entering the storm sewer unless permitted.
	Train employees on proper disposal practices for all materials.
Waste Management	Conduct waste reduction assessment—develop guidelines for the elimination of waste generation emissions.
	Institute industrial waste source reduction and recycling BMPs.
	Move waste management activities indoors (after safety concerns are addressed) and cover waste piles, dumpsters, hoppers, place on impermeable elevated surfaces.
	Prevent storm water runon by curbing, building berms.
	Cover trucks & inspect for leaking wastes.
	Inspection of waste management areas for leaking containers, spills, damaged containers, uncovered waste piles, dumpsters, hoppers.
	Inspection of roof areas & outside equipment.
	Develop and maintain proper erosion control or site stabilization measures.
	Train employees on proper disposal practices for all materials.

Sources: NPDES Storm Water Group Applications—Part 1.
EPA, Office of Water. September 1992. "Storm Water Management for Industrial Activities—Developing Pollution Prevention Plans and Best Management Practices." EPA 832–R–92–006.
EPA, Office of Research and Development. January 1993. "Investigation of Inappropriate Pollutant Entries into Storm Drainage Systems. A User's Guide." EPA/600/R–92/238.

4. Special Conditions

There are no additional requirements beyond those described in Part VI.B. of this fact sheet.

5. Storm Water Pollution Prevention Plan Requirements

All facilities covered by this section must prepare and implement a storm water pollution prevention plan. The establishment of a pollution prevention plan requirement reflects EPA's decision to allow operators of leather tanning facilities to select BMPs as the Best Available Technology/Best Control Technology (BAT/BCT) level of control for the storm water discharges covered by this section. The requirements included in pollution prevention plans provide a flexible framework for the development and implementation of site specific controls to minimize pollutants in storm water discharges.

EPA believes that pollution prevention is the most effective approach for controlling contaminated storm water discharges from leather tanning facilities. Pollution prevention plans allow the operator of a facility to select BMPs based on site-specific considerations such as facility size, climate, geographic location, the environmental setting of the facility, and volume and type of discharge generated. This flexibility is necessary because each facility will be unique in that the source, type, and volume of contaminated surface water discharges will differ from site to site.

There are two major objectives to a pollution prevention plan (1) to identify sources of pollution potentially affecting the quality of storm water discharges associated with industrial activity from a facility; and (2) to describe and ensure implementation of practices to minimize and control pollutants in storm water discharges associated with industrial activity from a facility. Specific requirements for a pollution prevention plan for leather tanning facilities and facilities which make fertilizer solely from leather scraps and dust are described below.

a. Contents of the Plan. Storm water pollution prevention plans are intended to help leather tanners evaluate all potential pollution sources at a site, and assist in the selection and implementation of appropriate measures designed to prevent, or control the discharge of pollutants in storm water runoff. EPA has developed guidance entitled "Storm Water Management for Industrial Activities: Developing Pollution Prevention Plans and Best Management Practices," EPA, 1992 (EPA 832–R–92–006), to assist permittees in developing and implementing pollution prevention measures.

(1) Description of Potential Pollutant Sources. Each storm water pollution prevention plan must describe activities, materials, and physical features of the facility that may contribute to storm water runoff or, during periods of dry weather result in dry weather flows. This assessment of storm water pollution will support subsequent efforts to identify and set priorities for necessary changes in materials, materials management practices, or site features, as well as aid in the selection of appropriate structural and nonstructural control techniques. Plans must describe the following elements:

(a) Drainage—The plan must contain a map of the site that shows the pattern of storm water drainage, structural features that control pollutants in storm water runoff and process wastewater discharges, surface water bodies (including wetlands), places where significant materials are exposed to rainfall and runoff, and locations of major spills and leaks that occurred in the 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit. The map also must show areas where the following activities take place: fueling, vehicle and equipment maintenance and/or cleaning, loading and unloading, material storage (including tanks or other vessels used for liquid or waste

storage), material processing, and waste disposal, haul roads, access roads, and rail spurs. In addition the site map must also identify the location of all outfalls covered under this permit. The facility must prepare an inventory of the types of discharges contained in each outfall. This inventory may be kept as an attachment to the site map.

(b) Inventory of Exposed Materials—Facility operators are required to carefully conduct an inspection of the site and related records to identify significant materials that are or may be exposed to storm water. The inventory must address materials that within 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit have been handled, stored, processed, treated, or disposed of in a manner to allow exposure to storm water. Findings of the inventory must be documented in detail in the pollution prevention plan. At a minimum, the plan must describe the method and location of onsite storage or disposal; practices used to minimize contact of materials with rainfall and runoff; existing structural and nonstructural controls that reduce pollutants in storm water runoff; existing structural controls that limit process wastewater discharges; and any treatment the runoff receives before it is discharged to surface waters or a separate storm sewer system. The description must be updated whenever there is a significant change in the types or amounts of materials, or material management practices, that may effect the exposure of materials to storm water.

(c) Significant Spills and Leaks—The plan must include a list of any significant spills and leaks of toxic or hazardous pollutants that occurred in the 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit. Significant pills include, but are not limited to, releases of oil or hazardous substances in excess of quantities that are reportable under Section 311 of CWA (see 40 CFR 110.0 and 40 CFR 117.21) or Section 102 of CERCLA (see 40 CFR 302.4). Significant spill may also include releases of oil or hazardous substances that are not in excess of reporting requirements and release of materials that are not classified as oil or a hazardous substance. The list shall be updated as appropriate during the term of the permit.

(d) Sampling Data—Any existing data on the quality or quantity of storm water discharges from the facility must described in the plan. The description should include a discussion of the methods used to collect and analyze the data. Sample collection points should be identified in the plan and shown on the site map.

(e) Risk Identification and Summary of Potential Pollutant Sources—The description of potential pollution sources culminates in a narrative assessment of the risk potential that sources of pollution pose to storm water quality. This assessment should clearly point to activities, materials, and physical features of the facility that have a reasonable potential to contribute significant amounts of pollutants to storm water. Any such activities, materials, or features must be addressed by the measures and controls subsequently described in the plan. In conducting the assessment, the operator of the facility must consider the following activities: loading and unloading operations; outdoor storage activities; outdoor processing activities; significant dust or particulate generating processes; and onsite waste disposal practices. The assessment must list any significant pollution sources at the site and identify the pollutant parameter or parameters (i.e., total suspended solids, biochemical oxygen demand, etc.) associated with each source.

(2) Measures and Controls. Under the description of measures and controls in the storm water pollution prevention plan requirements, this section proposes that all areas that may contribute pollutants to storm water discharges shall be maintained in a clean, orderly manner. This section also proposes that the following areas must be specifically addressed:

(a) Areas to be Addressed.

(i) Storage Areas for Raw, Semiprocessed, or Finished Tannery By-products—Pallets and/or bales of raw, semiprocessed, or finished tannery by-products (e.g., splits, trimmings, shavings, etc.) that are stored where there is potential storm water contact, must be stored indoors or protected by polyethylene wrapping, tarpaulins, roofed storage area or other suitable means. Materials should be placed on an impermeable surface, the area should be enclosed or bermed or other equivalent measures should be employed to prevent runon or runoff of storm water.

(ii) Material Storage Areas—Label storage units of all materials (e.g., specific chemicals, hazardous materials, spent solvents, waste materials). Maintain such containers and units in good condition. Describe measures that prevent or minimize contact with storm water. The facility must consider indoor storage and/or installation of berming and diking around the area to prevent runon or runoff of storm water.

(iii) Buffing/Shaving Areas—The plan must describe measures that prevent or minimize contamination of the storm water runoff with leather dust from buffing/shaving areas. The facility may consider dust collection enclosures, preventive inspection/maintenance programs or other appropriate preventive measures.

(iv) Receiving, Loading, and Storage Areas—The plan must describe measures that prevent or minimize contamination of the storm water runoff from receiving, unloading, and storage areas. Exposed receiving, unloading and storage areas for hides and chemical supplies should be protected by a suitable cover, diversion of drainage to the process sewer, directing rain gutters away from loading/receiving areas, grade berming or curbing area to prevent runon of storm water or other appropriate preventive measures.

(v) Outdoor Storage of Contaminated Equipment—The plan must describe measures that minimize contact of storm water with contaminated equipment. Equipment should be protected by suitable cover, diversion of drainage to the process sewer, thorough cleaning prior to storage or other appropriate preventive measures.

(vi) Waste Management—The plan must describe measures that prevent or minimize contamination of the storm water runoff from waste storage areas. The facility may consider inspection/maintenance programs for leaking containers or spills, covering dumpsters, moving waste management activities indoors, covering waste piles with temporary covering material such as tarpaulin or polyethylene, and minimizing storm water runon by enclosing the area or building berms around the area.

(vii) Vehicle Maintenance and Fueling—Permittees must follow all applicable requirements described in Part XI.P. for controlling storm water discharges from vehicle maintenance and refueling areas.

(viii) Improper Connections to Storm Sewers—The plan must describe measures which prevent and prohibit washwaters from processing areas from entering storm sewers. The facility must install safeguards against wash waters entering storm sewers and train employees on proper disposal practices for disposal of all process waste materials.

These areas are sources of pollutants in storm water from leather tanning facilities. EPA believes that the incorporation of BMPs such as those suggested, in conjunction with the pollution prevention plan, will substantially reduce the potential of storm water contamination from these areas. Based upon the information provided in part 1 of the group application process, some of the suggested management processes are being used at leather tanning facilities. In addition, EPA believes that these requirements continue to provide the necessary flexibility to address the variable risk for pollutants in storm water discharges associated with different facilities. Further, many facilities will find that management measures that they have already incorporated into the facilities operation, such as the use of covers and roofing, containers, and berms and dikes will meet the requirements of this section.

(b) Preventive Maintenance—Under the preventive maintenance requirements of the pollution prevention plan, permittees are required to develop a preventive maintenance program that includes regular inspections and maintenance of storm water BMPs. The maintenance program requires periodic removal of debris from discharge diversions. Permittees using ponds to control their effluent limitation frequently use impoundments or sedimentation ponds as their BAT/BCT. Maintenance schedules and maintenance measures for these ponds must be provided in the pollution prevention plan.

The purpose of the inspections is to check on the accuracy of the description of potential pollution sources contained in the plan, determine the effectiveness of the plan and implementation of the storm water pollution prevention plan. The inspections allow facility personnel to monitor the success or failure of elements of the plan on a regular basis. The use of an inspection checklist is recommended. The checklist will ensure that all required areas are inspected, as well as help to meet the record keeping requirements. Based on the results of each inspection, the description of potential pollution sources, and measures and controls, the plan must be revised as appropriate within 2 weeks after each inspection. Changes in the measures and controls must be implemented on the site in a timely manner, and never more than 12 weeks after completion of the inspection.

(c) Inspections—Under the inspection requirements of the storm water pollution prevention plan elements, qualified facility personnel shall be identified to inspect designated areas of the facility, at a minimum of every 3 months. The individual or individuals who will conduct the inspections must be identified in the plan and should be members of the pollution prevention team. The following areas shall be included in all inspections: storage areas for equipment and vehicles awaiting maintenance, facility yard area where outdoor storage occurs, receiving and unloading areas and waste management areas. A set of tracking or follow-up procedures shall be used to ensure that appropriate actions are taken in response to the inspections. Records of inspections shall be maintained and the pollution prevention plan modified where necessary.

In addition, qualified personnel must conduct quarterly visual inspections of all BMPs. The inspections shall include an assessment of the effectiveness and need for maintenance of storm water roofing and covers, dikes and curbs, discharge diversions, sediment control and collection systems and all other BMPs.

Quarterly visual inspections must be made at least once in each of the following designated periods during daylight hours. January–March (storm water runoff or snow melt), April–June (storm water runoff), July–September (storm water runoff), and October–December (snow melt runoff). Records shall be maintained as part of the pollution prevention plan.

(d) Employee Training—Under the employee training component of the storm water pollution prevention plan requirements, the permittee is required to identify annual (once per year) dates for training. Employee training must, at a minimum, address the following areas when applicable to a facility: general good housekeeping practices, spill prevention and control, waste management, inspections, preventive maintenance, detection of non-storm water discharges and other areas. EPA requires that facilities conduct training annually at a minimum. However, more frequent training may be necessary at facilities with high turnover of employees or where employee participation is essential to the storm water pollution prevention plan.

(e) Recordkeeping and Internal Reporting—Permittees must describe procedures for developing and retaining records on the status and effectiveness of plan implementation. The plan must address spills, monitoring, and BMP inspection and maintenance activities. Ineffective BMPs must be reported and the date of their corrective action recorded. Employees must report incidents of leaking fluids to facility management and these reports must be incorporated into the plan.

(f) Storm Water Management—The permittee must evaluate the appropriateness of each storm water BMP that diverts, infiltrates, reuses, or otherwise reduces the discharge of contaminated storm water. In addition, the permittee must describe the storm water pollutant source or activity (i.e., loading and unloading operations, raw material storage piles, waste piles, etc.) to be controlled by each storm water management practice.

(3) Comprehensive Site Compliance Evaluation. The storm water pollution prevention plan must describe the scope and content of comprehensive site evaluation that qualified personnel will conduct to: 1) confirm the accuracy of the description of potential pollution sources contained in the plan; 2) determine the effectiveness of the plan; and 3) assess compliance with the terms and conditions of this section. Comprehensive site compliance evaluations must be conducted once a year for leather tanning facilities. These evaluations are intended to be more in depth than the quarterly visual inspections. The individual or individuals who will conduct the evaluation must be identified in the plan and should be members of the pollution prevention team. Evaluation reports must be retained for at least 3 years after the date of the evaluation. Based on the results of each evaluation, the description of potential pollution sources, and measures and controls, the plan must be revised as appropriate within 2 weeks after each inspection. Changes in the measures and controls must be implemented on the site in a timely manner, and never more than 12 weeks after completion of the evaluation.

6. Numeric Effluent Limitations

There are no numeric effluent limitations for storm water discharges from leather tanning facilities beyond those described in Part VI.E. of the fact sheet.

7. Monitoring and Reporting Requirements

a. Analytical Monitoring Requirements. The regulatory modifications at 40 CFR 122.44 (i)(2) established on April 2, 1992, grant permit writers the flexibility to reduce monitoring requirements in storm water discharge permits. EPA has determined that the potential for storm water discharges to contain pollutants above benchmark levels, because of the industrial activities and materials exposed to precipitation, does not support sampling at leather tanning and finishing facilities. Under the Storm Water Regulations at 40 CFR 122.26(b)(14), EPA defined "storm water discharge associated with industrial activity". The focus of today's permit is to address the presence of pollutants that are associated with the industrial activities identified in this definition and that might be found in storm water discharges. Under the methodology for determining analytical monitoring requirements, described in section VI.E.1 of this fact sheet, nitrate plus nitrite nitrogen is above the bench mark concentrations for the leather tanning and finishing sector. After a review of the nature of industrial activities and the significant materials exposed to storm water described by facilities in this sector, EPA has determined that the higher concentrations of nitrate plus nitrite nitrogen are not likely to be caused by the industrial activity, but may be primarily due to non-industrial activities on-site. Today's permit does not require leather tanning and finishing facilities to conduct analytical monitoring for this parameter. Based on a consideration of the BMPs typically used at these facilities, and generally low pollutant values from the application data, EPA believes that the pollution prevention plan with visual examinations of storm water discharges will help to ensure storm water contamination is minimized. Because permittees are not required to conduct sampling, they will be able to focus their resources on developing and implementing the pollution prevention plan.

b. Quarterly Visual Examination of Storm Water Quality. Quarterly visual examinations of a storm water discharge from each outfall are required for leather tanning and finishing facilities. The examination must be of a grab sample collected from each storm water outfall. The examination of storm water grab samples shall include any observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, or other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on these samples.

The examination must be made at least once in each of the following three-month periods: January through March; April through June; July through September; and October through December during daylight unless there is insufficient rainfall or snow-melt to runoff. EPA expects that, whenever practicable, the same individual should carry out the collection and examination of discharges throughout the life of the permit to ensure the greatest degree of consistency possible. Grab samples shall be collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 1 hour) of when the runoff begins discharging. Reports of the visual examination include: the examination date and time, examination personnel, visual quality of the storm water discharge, and probable sources of any observed storm water contamination. The visual examination reports must be maintained onsite with the pollution prevention plan.

When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination. Adverse weather conditions which may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

EPA realizes that if a facility is inactive and unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly visual examination.

EPA believes that this quick and simple assessment will allow the permittee to approximate the effectiveness of his/her plan on a regular basis at very little cost. Although the visual examination cannot assess the chemical properties of the storm water discharged from the site, the examination will provide meaningful results upon which the facility may act quickly. The frequency of this visual examination will also allow for timely adjustments to be made to the plan. If BMPs are performing ineffectively, corrective action must be implemented. A set of tracking or follow-up procedures must be used to ensure that appropriate actions are taken in response to the examinations. The visual examination is intended to be performed by members of the pollution prevention team. This hands-on examination will enhance the staff's understanding of the storm water problems on that site and the effects of the management practices that are included in the plan.

AA. Storm Water Discharges Associated With Industrial Activity From Fabricated Metal Products Industry

1. Discharges Covered Under this Section

On November 16, 1990 [55 **Federal Register** (FR) 47990], the U.S. Environmental Protection Agency (EPA) promulgated the regulatory definition of "storm water discharges associated with industrial activity." This section of today's final permit covers storm water discharges associated with industrial activities from metal fabrication processes and operations. Fabricated metal and processing facilities eligible for coverage under this section include the following types of operations: fabricated metal products, except machinery and transportation equipment (Standard Industrial Classification (SIC) codes 3429, 3441, 3442, 3443, 3444, 3451, 3452, 3462, 3471, 3479, 3494, 3496 and 3449); and jewelry, silverware, and plated ware (SIC code 391).

This section covers establishments engaged in fabricating ferrous and nonferrous metal products, such as metal cans, tinware, general hardware, automotive parts, tanks, road mesh, structural metal products, nonelectrical equipment, and a variety of metal and wire products from purchased iron or steel rods, bars, or wire materials. This section does not cover discharges from establishments engaged in manufacturing and rolling of ferrous and nonferrous metals, forgings or stampings, electrolytic or other processes for refining copper from ore. These establishments are addressed in a separate section of today's final permit.

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

Impacts caused by storm water discharges from fabricating operations will vary from one facility to the next. Several factors influence to what extent significant materials from fabricators will affect water quality. Specifically, the use of indoor operations as opposed to outdoor storage facilities; discharges to Publicly Owned Treatment Works (POTWs); recycling programs; product choice in the various operations; and the number of operations that take place at a given facility based on customer needs; and use of storm water controls.

This section does not cover any discharge subject to process wastewater effluent limitation guidelines.

2. Industrial Profile

There are two major subcategories of facilities covered by this sector: fabricated metal products excluding coating and fabricated metal coating and engraving. These facilities are engaged in the manufacturing of a variety of products that are constructed primarily by using metals. The operations performed usually begin with materials in the form of raw rods, bars, sheet, castings, forgings, and other related materials and can progress to the most sophisticated surface finishing operations. There are typically several operations that take place at a fabrication facility: machining operations, grinding, cleaning and stripping, surface treatment and plating, painting, and assembly. The machining operation involves turning, drilling, milling, reaming, threading, broaching, grinding, polishing, cutting and shaping, and planing. Grinding is the process using abrasive grains such as aluminum oxide, silicon carbide, and diamond to remove stock from a workpiece. Cleaning and stripping is a preparatory process involving solvents for the removal of oil, grease and dirt. Both alkaline and acid cleaning are employed. Surface treatment and plating is a major component that involves batching operations to increase corrosion or abrasion resistance. This is generally in the form of galvanizing. Painting is generally practiced at most facilities to provide decoration and protection to the product or item. Assembly is the fitting together of previously manufactured parts into a complete unit or structure.

Industrial activities and storm water management practices vary among the fabricating industry, mostly in the type of chemicals used in the processes and the final product. Some industries involve only dry operations and others include wet operations. Examples of products being fabricated in this industry include: aircraft engines, screws, nuts, bolts, automotive parts (drive shafts, struts, gears, rods), tanks, hand tools, doors, and bridge grates.

Many of the operations in this industry take place indoors. The major activities evaluated for purposes of storm water contamination and control measures include: waste storage, outside product storage, use of pickling acids, storage of cutoff scrap metal, aluminum scraps, hazardous materials, galvanized steel components, solvent storage, waste paper storage, machinery storage, used absorbent materials, wood materials dunnage/pallets, and maintenance of existing Best Management Practices (BMPs). The table below lists the most likely wastes to be generated at a steel fabricating facility.

TABLE AA–1.—WASTES GENERATED FROM FABRICATED METALS INDUSTRIES

Activity	Pollutant source	Pollutant
Tool workpiece interface/shaving, chipping	Used metal working fluid with fine metal dust	TSS, COD, oil and grease.
Parts/tools cleaning, sand blasting, metal surface cleaning, removal of applied chemicals.	Solvent cleaners abrasive cleaners, alkaline cleaners, acid cleaners, rinse waters.	Spent solvents, TSS, acid/alkaline waste, oil.
Making structural components	Cuttings, scraps, turnings, fines	Metals.
Painting operations	Paint and paint thinner spills, sanding, spray painting.	Paints, spent solvents, heavy metals, TSS.
Cleanup of spills and drips	Used absorbent materials	TSS, spilled material.
Transportation or storage of materials	Wood dunnage/pallets	BOD, TSS.

3. Storm Water Sampling Results

Based on the wide variety of industrial activities and significant materials at the facilities included in this sector, EPA believes it is appropriate to divide the fabricated metal industry into subsectors to properly analyze sampling data and determine monitoring requirements. As a result, this sector has been divided into the following subsectors: fabricated metal products except coating and fabricated metal coating and engraving. Tables AA–2 and AA–3 below include data for the eight pollutants that all facilities were required to monitor for under Form 2F. The tables also list those parameters that EPA has determined merit further monitoring.

TABLE AA–2.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY CUTLERY, HANDTOOLS, AND GENERAL HARDWARE, FABRICATED STRUCTURAL METAL PRODUCTS, SCREW MACHINE PRODUCTS, AND BOLTS, NUTS, SCREWS, RIVETS, AND WASHERS, METAL FORGINGS AND STAMPINGS, ELECTROPLATING, PLATING, POLISHING, ANODIZING, AND COLORING, MISCELLANEOUS FABRICATED METAL PRODUCTS, JEWELRY, SILVERWARE, AND PLATED WARE MANUFACTURING FACILITIES SUBMITTING PART II SAMPLING DATA[i] (mg/L)

Pollutant Sample type	No. of facilities		No. of samples		Mean		Minimum		Maximum		Median		95th percentile		99th percentile	
	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	51	49	70	69	19.6	11.6	0.0	0.0	380.0	57.0	8.4	8.0	53.5	32.6	106.2	55.8
COD	51	48	70	68	143.2	115.2	0.0	0.0	1380.0	962.0	63.0	63.0	435.4	358.5	885.1	713.7
Nitrate + Nitrate Nitrogen	51	49	70	69	1.66	1.31	0.00	0.0	14.90	9.17	0.94	0.87	5.85	4.58	12.74	9.22
Total Kjeldahl Nitrogen	51	49	70	69	3.24	2.05	0.00	0.0	29.30	9.12	1.76	1.40	9.77	5.99	19.16	10.52
Oil & Grease	50	N/A	69	N/A	9.2	N/A	0.0	N/A	86.0	N/A	6.0	N/A	31.3	N/A	62.1	N/A
pH	45	N/A	63	N/A	N/A	N/A	3.3	N/A	9.0	N/A	7.1	N/A	9.4	N/1	10.7	N/A
Total Phosphorus	50	49	69	69	1.13	1.03	0.00	0.0	10.50	10.8	0.22	0.2	3.39	3.36	8.96	9.12
Total Suspended Solids	51	49	70	69	214	169	0	0	2340	3235	104	53	1014	650	2832	1801
Aluminum, Total	15	15	16	16	89.68	10.37	0.00	0.00	1400.0	130.00	0.96	0.92	74.83	24.71	365.47	80.82
Iron, Total	25	23	32	29	4.9	3.1	0.0	0.0	25.1	26.0	1.5	0.9	28.3	13.2	92.2	35.5
Zinc, Total	27	25	38	35	6.407	3.451	0.000	0.007	157.00	22.80	0.72	0.44	18.234	20.001	64.196	79.412

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.

[ii] Composite samples.

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TABLE AA-3.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY COATING, ENGRAVING, AND ALLIED SERVICES FACILITIES SUBMITTING PART II SAMPLING DATA[i] (mg/L)

Pollutant Sample type	No. of facilities		No. of samples		Mean		Minimum		Maximum		Median		95th percentile		99th percentile	
	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	13	13	16	16	12.0	6.06	0.0	0.0	81.0	17.0	7.5	6.0	39.3	15.8	74.4	24.58
COD	13	13	16	17	68.8	56.9	12.0	0.0	320.0	160.0	45.0	49.0	194.4	262.7	349.4	559.3
Nitrate + Nitrate Nitrogen	13	13	16	17	1.82	1.60	0.21	0.0	7.70	12.5	0.96	0.80	5.64	4.44	10.91	8.67
Total Kjeldahl Nitrogen	13	13	16	17	2.36	1.52	0.00	0.0	7.20	5.2	1.35	0.80	6.87	4.41	12.12	7.68
Oil & Grease	13	N/A	16	N/A	1.7	N/A	0.0	N/A	9.0	N/A	0.0	N/A	9.4	N/A	18.2	N/A
pH	11	N/A	14	N/A	N/A	N/A	5.5	N/A	8.2	N/A	6.6	N/A	8.0	N/A	8.7	N/A
Total Phosphorus	13	13	16	17	1.91	0.90	0.00	0.0	16.00	12.0	0.16	0.15	6.30	2.77	23.91	9.37
Total Suspended Solids	13	13	16	17	112	88	0	0	461	990	26	21	474	272	1215	764
Zinc, Total	10	10	13	14	0.489	0.218	0.050	0.000	2.100	0.830	0.32	0.15	1.481	0.800	2.758	1.632

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.

[ii] Composite samples.

4. Options for Controlling Pollutants

The measures to control pollutants at metal fabricating operations should focus primarily on the storage of waste and raw materials; chemical storage areas; and equipment storage and service areas. Since most of the operations occur indoors, procedures are necessary in the handling and transporting of materials to minimize exposure of pollutants to storm water runoff. Of primary importance is the control of activities and use of chemicals that have been identified as potential sources of pollutants. The most effective discharge controls for these facilities are BMPs targeted toward source control. This includes utilizing inside storage as much as possible; and implementing programs for recycling scrap materials. Many of these practices require the use of covers, indoor storage, and indoor operations. Some structural measures would provide an additional control to reduce the potential for exposure at these facilities. These include source reduction diversion dikes, grass swales, vegetative covers, and sedimentation ponds. Preventive controls are typically low in cost and relatively easy to implement, as the majority of the facilities in this industry already employ these practices. In addition, directing flows to privately owned treatment works or retention ponds will be the most effective measure. The industry also must give consideration to the non-storm water discharges associated with improper disposal of materials from the indoor processes due to the extensive use of chemicals in the preparation and finishing phases of metal preparation and fabrication. The industry also involves grinding, welding, and sanding operations that will require special consideration to control potential pollutants that could accumulate and be subject to storm water runoff. Most of the measures commonly implemented to reduce pollutants in storm water associated with the fabricated metals industry are generally uncomplicated practices. Some of the practices may be predicated on the size of the operation, the types of processes that are exercised from a full-scale plant operation to a more specialized company that conducts only a portion of the operations usually found in the fabricating industry. Table AA–4 below is an outline of the most common activities and sources that may produce pollutants associated with different activities that routinely take place at fabricated metal industries. Following the table is a brief list of BMPs that EPA believes will help reduce and control the potential pollutant sources at fabricating facilities from contaminating storm water.

TABLE AA–4.—POLLUTANTS POTENTIALLY FOUND IN STORM WATER DISCHARGES ASSOCIATED WITH THE FABRICATED METAL INDUSTRY

Activity	Pollutant source	Pollutant
Metal preparation	Grinding, welding, sawing, shaving, brazing, bending, cutting, etching.	Steel scraps, aluminum scraps, brass, copper, dust, chips and borings, steel scale, teflon, manganese.
Parts cleaning	Solvents, cold and hot dips, cleaning parts, degreasing.	Acid, coolants, clean composition, degreaser, mineral spirits, pickle liquor, spent caustic, sludge.
Surface Treatment	Finishing, plating, case hardening, chemical coating, coating, polishing, rinsing, abrasive cleaning, electroplating.	Acid, aromatic solvent, corn cob, lubricants, sand, oil, pH, nitrates, nitrites, carbon, phosphates, borates, nitrogen, oily sludge, nickel, chromium, hydrofluoric acid.
Galvanizing	Spills, leaks, transporting materials	Acid solution, phosphates, zinc chromate, hexavalent chromium, nickel.
Painting	Empty containers, paint application wastes, spills, over spraying, storage areas.	Paint wastes, thinner, varnish, heavy metals, spent chlorinated solvents
Heavy equipment use and storage	Leaking fluids, fluids replacement, washing equipment, use on poor surface area, soil disturbance.	Oil, heavy metals, organics, fuels, TSS, hydraulic oil, diesel fuel, gasoline
Equipment maintenance	Leaking fluids, fluids replacement, washing equipment.	Oil, grease
Storage of uncoated structural steel	Stored on porous pavement	Aluminum, lead, zinc, copper, iron, oxide, oil, nickel, manganese.
Storing galvanized steel directly on the ground	Galvanizing material drippage or leaching	Metals: zinc, nickel, cadmium, chromium.
Vehicle/equipment traffic	Soil disturbance and erosion	TSS from erosion, hydraulic fluid loss/spillage
Cleaning equipment/vehicles	Chemicals disposed improperly, spillage	Oil, grease, surfactants, chromates, acid, hydroxide, nitric acid.

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TABLE AA-4.—POLLUTANTS POTENTIALLY FOUND IN STORM WATER DISCHARGES ASSOCIATED WITH THE FABRICATED METAL INDUSTRY—Continued

Activity	Pollutant source	Pollutant
Storage areas	Unidentifiable drums, extended exposure to weather conditions, tank corrosion, open containers.	Benzene, toluene, xylene, pyrene, and other volatile organics, solvents.
Equipment usage	Malfunctioning equipment, stockpiled obsolete equipment.	Oil, grease, lead
Above ground storage tanks	Installation problems, spills, external corrosion and structural failure.	Fuel oil and various chemicals.

Table AA-4 above shows the potential pollutants that could end up in storm water runoff if the activities typically found at a fabricating facility are not handled properly. Many of the fabricating facilities in the group application indicated several of the activities listed as a part of the normal operations carried out at the facility. Many of the pollutants involved in these activities are potentially of concern if exposed to precipitation and storm water runoff. Consideration of control measures is needed to assure that the activities minimize exposure to the potential pollutants of concern as it relates to each activity identified and control the potential sources that may generate pollutants as part of the management practices used.

5. Special Conditions

The permit conditions that apply to the fabricated metals industry build upon the base permit requirements set forth in the front of today's permit. The discussion that follows, therefore, only addresses conditions that differ from those base requirements.

Due to the concern that many non-storm water discharges may be present at metal fabricators, EPA is requiring that all facilities provide proof that these discharges are not commingled and are appropriately controlled so as to protect all receiving waters.

Today's permit clarifies in Part XI.AA.2. (Prohibition of Non-storm Water Discharges) that non-storm water discharges, including metal fabricator operations, are not authorized by this section. The operators of such non-storm water discharges must obtain coverage under a separate National Pollutant Discharge Elimination System (NPDES) permit if discharged to waters of the United States or through a municipal separate storm sewer system. In a related requirement under the storm water pollution prevention plan requirements, the permittee is required to attach a copy of the NPDES permit issued for metal acid baths, sludge disposal, scrap disposal or recycling or, if an NPDES permit has not yet been issued, a copy of the pending application plan. Facilities that pretreat and discharge the waste water into a POTW system must notify the operator and a copy of the notification must be attached to the plan. With regard to all the acid baths, wash waters, and any other non-storm water discharges must be considered in the plan. Some facilities may use retention ponds, recycling, collecting and hauling as methods of disposal. Other facilities discharge into separate storm sewer systems. In these instances, the facility is required to attach the disposal plans and operations to the plan.

6. Storm Water Pollution Prevention Plan Requirements

Each storm water pollution prevention plan must stipulate activities, materials, and physical features of the facility that may contribute pollutants to storm water runoff or, during periods of dry weather, result in dry weather flows. The metals fabricating industry plan focuses primarily on storage areas, unloading and loading areas, and any other areas where outside operations occur.

Under the description of measures and controls in the storm water pollution prevention plan requirements, facilities are required to address the identified pollutant sources by identifying and implementing appropriate storm water pollution management controls. Such controls much address the areas listed below, as appropriate.

a. Facility Areas to be Addressed in the Storm Water Pollution Prevention Plan.

(1) Metal Fabricating Areas. These areas should be kept clean by frequent sweeping to avoid heavy accumulation of steel ingots, fines, and scrap. Dust is a byproduct of many processes in the fabricating areas and therefore should be absorbed through a vacuum system to avoid accumulation on roof tops and onto the ground. Tracking of metal dusts and metal fines outdoors may be minimized by employing these management practices: sweep on a regular basis all accessible paved areas; maintain floors in a clean and dry condition; remove waste and dispose of regularly; remove obsolete equipment expeditiously; sweep fabrication areas; and train employees on good housekeeping measures.

(2) Storage Areas for Raw Metal. The storage of raw materials should be under a covered area whenever possible and protected from contact with the ground. The amount of material stored should be minimized to avoid corrosive activity from long-term exposed materials. Diking or berming the area to prevent or minimize runon may be considered. Long-term exposure to weather conditions results in oxidation of the metals. Also, dirt, oil, and grease buildup on the metal are potential sources of pollutants. The following measures should be considered: check raw metals for corrosion; keep area neat and orderly, stack neatly on pallets or off the ground; and cover exposed materials.

(3) Receiving, Unloading, and Loading Areas. These areas should be enclosed where feasible using either curbing, berming, diking or other accepted containment systems in case of spills during delivery of chemicals such as lubricants, coolants, rust preventatives, solvents, oil, sodium hydroxide, hydrochloric acid, calcium chloride, polymers, sulfuric acid, and other chemicals used in the metal fabricating processes. Directing roof down spouts away from loading sites and equipment and onto grassy or vegetated areas should help prevent storm water contamination by pollutants that have accumulated in these areas. The following measures should be considered: clean up spills immediately; check for leaks and remedy problems regularly; and unload under covered areas when possible.

(4) Storage of Heavy Equipment. Vehicles should be stored indoors when possible. If stored outdoors the use of gravel, concrete or other porous surfaces should be considered to minimize or prevent heavy equipment from creating ditches or other conveyances that would

cause sedimentation runoff and increase TSS loadings. Also directing the flow toward the area by the use of grass swales or filter strips will reduce the runoff of materials. Directing drainage systems away from high traffic areas into collection systems will help to reduce the TSS loadings caused by exposed and eroding open areas. The following measures should be considered: clean prior to storage or store under cover; store indoors; and divert drainage to the grass swales, filter strips, retention ponds, or holding tanks.

(5) Metal Working Fluid Areas. Due to the toxicity of metal working fluids as well as the contamination of fluids by metal fines and dusts, spillage and loss of metal working fluids used to cleanse or prepare the steel components should be controlled throughout the process. Collection systems and storage areas need special consideration. The following measures should be considered: store used metal working fluid with fine metal dust indoors; use tight sealing lids on all fluid containers; use straw, clay absorbents, sawdust, or synthetic absorbents to confine or contain any spills, or other absorbent material; and establish recycling programs for used fluids when possible.

(6) Unprotected Liquid Storage Tanks. Storing these tanks (this does not include products that are gaseous at atmospheric pressure) indoors will reduce potential waste or spills from contaminating storm water. Berming outdoor areas when unable to store inside will contain potential pollutants. Cleaning up spills is essential to minimizing buildup in these areas. EPA believes that this will significantly reduce the potential for major discharges into the water of the United States during storm runoff. The following measures should be considered: cover all tanks whenever possible; berm tanks whenever possible; dike area or install grass filters to contain spills; keep area clean; and check piping, valves and other related equipment on a regular basis.

(7) Chemical Cleaners and Rinse Water. Proper disposal and use of cleaners in various activities will minimize the amount of liquid exposed to storm water by reducing the need to store contaminated liquids for an extended period of time. Controlling potential contamination of pollutants by employing simple control devices during the activity will prevent potential contamination in storm water runoff. Recycling or reuse of these materials whenever possible serves as a source reduction by reducing the necessary amount of new materials. The following measures should be considered: use drip pans and other spill devices to collect spills or solvents and other liquid cleaners; recycle waste water; store recyclable waste indoors or in covered containers; and substitute nontoxic cleaning agents when possible.

(8) Raw Steel Collection Areas. The collection areas must be kept clean. Materials should be kept in a covered storage bin or kept inside until pickup. The use of pitched-structures should be considered. The following measures should be considered: collect scrap metals, fines, iron dust and store under cover and recycle.

(9) Paints and Painting Equipment. Facilities using tarps, drip pans, or other spill collection devices to contain and collect spills of paints, solvents or other liquid material. Blasting in windy weather increases the potential for runoff. Enclosing outdoor sanding areas with tarps or plastic sheeting contains the metal fines. Immediate collection of any waste and proper disposal may significantly contribute to the reduction of storm water runoff. Training employees to use the spray equipment properly may reduce waste and decrease the likelihood of accidents, as well as, reduce the amount of solvents needed to complete the job. The following measures should be considered: paint and sand indoors when possible; avoid painting and sandblasting operations outdoors in windy weather conditions; if done outside, enclose sanding and painting areas with tarps or plastic sheeting; and use water-based paints when possible.

(10) Vehicle and Equipment Maintenance Areas. Changing fluids or parts should be done indoors when possible. If maintenance is performed outdoors, fluids used in maintaining these vehicles should be contained in the area by using drip pans, large plastic sheets, canvas or other similar controls under the vehicles, or berming the area. Hydraulic fluids should be properly stored to prevent leakage and storm water contamination. The following measures should be considered: berm area or use other containment device to control spills; use drip pans, plastic sheeting and other similar controls; and discard fluids properly or recycle if possible.

(11) Hazardous Waste Storage Areas. All hazardous waste must be stored in sealed drums. Establishing centralized drum-storage satellite areas throughout the complex to store these materials will decrease the potential for mishandling drums. Berming the enclosed structures is added protection in case of spills. Spills or leaks that are contained within an area are easier to contain and prevent storm water contamination or runoff. Checks for corrosion and leakage of storage containers is important. Proper labeling for proper handling should be considered. All other applicable Federal, State, and local regulations must be followed. The following measures should be considered: store indoors; label materials clearly; check for corrosion and leaking; properly dispose of outdated materials; dike or use grass swales, ditches or other containment to prevent runon or runoff in case of spills; post notices prohibiting dumping of materials into storm drains; store containers, drums, and bags away from direct traffic routes; do not stack containers in such a way as to cause leaks or damage to the containers; use pallets to store containers when possible; store materials with adequate space for traffic without disturbing drums; maintain low inventory level of chemicals based on need.

(12) Transporting Chemicals to Storage Areas. Proper handling of drums is needed to avoid damaging drums causing leaks. Storage areas should be as close as possible to operational buildings. The following measures should be considered: forklift operators should be trained to avoid puncturing drums; store drums as close to operational building as possible; and label all drums with proper warning and handling instructions.

(13) Finished Products (Galvanized) Storage. Improper storage of finished products can contribute pollutants to storm water discharges. Materials should be stored in such a way to minimize contact with precipitation and runoff. The following measures should be considered: store finished products indoors, on a wooden pallets concrete pad, gravel surface, or other impervious surface.

(14) Wooden Pallets and Empty Drums. The following measures should be considered: clean contaminated wooden pallets; cover empty drums; cover contaminated wooden pallets; store drums and pallets indoors; clean empty drums; and store pallets and drums on concrete pads.

(15) Retention Ponds (Lagoon). Creating and maintaining retention ponds as a treatment system for settling out TSS would help to reduce the concentrations of these pollutants in storm water runoff. The following measures should be considered: provide routine maintenance; remove excess sludge periodically; and aerate periodically to maintain pond's aerobic character and ecological balance.

b. Comprehensive Site Compliance Evaluation. The storm water pollution prevention plan must describe the scope and content of comprehensive site evaluations that qualified personnel will conduct to (1) confirm the accuracy of the description of potential pollution sources contained in the plan, (2) determine the effectiveness of the plan, and (3) assess compliance with the terms and conditions of this section. Comprehensive site compliance evaluations should be conducted at least once a year. The individual or individuals that will conduct the evaluations must be identified in the plan and should be members of the pollution prevention team. Evaluation reports must be retained for at least 3 years after the date of the evaluation.

Based on the results of each evaluation, the description of potential pollution sources, and measures and controls, the plan must be revised as appropriate within 2 weeks after each evaluation. Changes in the measures and controls must be implemented on the site in a timely manner, and never more than 12 weeks after completion of the evaluation.

7. Numeric Effluent Limitations

There are no additional numeric effluent limitations beyond those described in Part V.B. of today's permit.

8. Monitoring and Reporting Requirements

a. Analytical Monitoring Requirements. EPA believes that fabricated metal and processing facilities may reduce the level of pollutants in storm water runoff from their sites through the development and proper implementation of the storm water pollution prevention plan requirements discussed in today's final permit. In order to provide a tool for evaluating the effectiveness of the pollution prevention plan and to characterize the discharge for potential environmental impacts, Tables AA-5 and AA-6 list the pollutants that fabricated metal products except coating and fabricated metal coating and engraving facilities are required to analyze for in their storm water discharges in accordance with the activities onsite. The pollutants listed in Tables AA-5 and AA-6 were found to be above levels of concern for a significant portion of fabricating facilities that submitted quantitative data in the group application process. Because these pollutants have been reported at levels of concern from fabricated metal and processing facilities, EPA is requiring monitoring after the pollution prevention plan has been implemented to assess the effectiveness of the pollution prevention plan and to help ensure that a reduction of pollutants is realized.

Permittees can exercise the alternative certification on a pollutant-by-pollutant basis as described under Section 8.b. If there are any pollutant(s) for which the facility is unable to certify to no exposure the facility must, at a minimum, monitor storm water discharges on a quarterly basis during the second year of permit coverage. Samples must be collected at least once in each of the following periods: January through March; April through June; July through September; and October through December. At the end of the second year of permit coverage, a facility must calculate the average concentration for each parameter listed in the applicable table (Table AA-5 or Table AA-6). If the permittee collects more than four samples in this period, then they must calculate an average concentration for each pollutant of concern for all samples analyzed.

TABLE AA-5.—MONITORING REQUIREMENTS FOR FABRICATED METAL PRODUCTS EXCEPT COATING

Pollutants of concern	Monitoring cut-off concentration
Total Recoverable Iron	1.0 mg/L.
Total Recoverable Zinc	0.117 mg/L
Total Recoverable Aluminum	0.75 mg/L.
Nitrate plus Nitrite Nitrogen	0.68 mg/L.

TABLE AA-6.—MONITORING REQUIREMENTS FOR FABRICATED METAL COATING AND ENGRAVING

Pollutants of concern	Monitoring cut-off concentration
Total Recoverable Zinc	0.117 mg/L
Nitrate plus Nitrite Nitrogen	0.68 mg/L.

If the average concentration for a parameter is less than or equal to the appropriate cut-off concentration, then the permittee is not required to conduct quantitative analysis for that parameter during the fourth year of the permit. If, however, the average concentration for a parameter is greater than the cut-off concentration listed in Table AA-5 or Table AA-6, then the permittee is required to conduct quarterly monitoring for that parameter during the fourth year of permit coverage. Monitoring is not required during the first, third, and fifth year of the permit. The exclusion from monitoring in the fourth year of the permit is conditional on the facility maintaining industrial operations and BMPs that will ensure a quality of storm water discharges consistent with the average concentrations recorded during the second year of the permit.

TABLE AA-7.—SCHEDULE OF MONITORING

2nd Year of Permit Coverage.	• Conduct quarterly monitoring. • Calculate the average concentration for all parameters analyzed during this period. • If average concentration is greater than the value listed in Tables AA-5 or AA-6, then quarterly sampling is required during the fourth year of the permit. • If average concentration is less than or equal to the value listed in Tables AA-5 or AA-6, then no further sampling is required for that parameter.
4th Year of Permit Coverage.	• Conduct quarterly monitoring for any parameter where the average concentration in year 2 of the permit is greater than the value listed in Tables AA-5 or AA-6. • If industrial activities or the pollution prevention plan have been altered such that storm water discharges may be adversely affected, quarterly monitoring is required for all parameters of concern.

In cases where the average concentration of a parameter exceeds the cut-off concentration, EPA expects permittees to place special emphasis on methods for reducing the presence of those parameters in storm water discharges. Quarterly monitoring in the fourth year of the permit will reassess the effectiveness of the adjusted pollution prevention plan.

The monitoring cut off concentrations listed in Tables AA-5and AA-6 are not numerical effluent limitations. These values represent a level of pollutant discharge which facilities may achieve through the implementation of pollution prevention plans. At least half of the facilities which submitted Part 2 data, reported concentrations greater than or equal to the values listed in the applicable table (Tables AA–5 or AA–6). Facilities that achieve average discharge concentrations which are less than or equal to the appropriate cut-off concentration values are not relieved from the pollution prevention plan requirements or any other requirements of the permit.

EPA realizes that if a facility is inactive and unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly chemical sampling.

b. Alternative Certification. Throughout today's permit, EPA has included monitoring requirements for facilities which the Agency believes have the potential for contributing significant levels of pollutants to storm water discharges. The alternative described below is necessary to ensure that monitoring requirements are only imposed on those facilities that do, in fact, have storm water discharges containing pollutants at concentrations of concern. EPA has determined that if materials and activities are not exposed to storm water at the site, then the potential for pollutants to contaminate storm water discharges does not warrant monitoring.

Therefore, a discharger is not subject to the monitoring requirements of this Part provided the discharger makes a certification for a given outfall, or on a pollutant-by-pollutant basis in lieu of monitoring described in Tables AA–5 and AA–6, under penalty of law, signed in accordance with Part VII.G. (Signatory Requirements), that material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, industrial machinery or operations, significant materials from past industrial activity that are located in areas of the facility that are within the drainage area of the outfall are not presently exposed to storm water and will not be exposed to storm water for the certification period. Such certification must be retained in the storm water pollution prevention plan and submitted to EPA. In the case of certifying that a pollutant is not present, the permittee must submit the certification along with the monitoring reports required under paragraph *c* below. If the permittee cannot certify for an entire period, they must submit the date exposure was eliminated and any monitoring required up until that date. This certification option is not applicable to compliance monitoring requirements associated with effluent limitations. EPA does not expect facilities to be able to exercise this certification for indicator parameters, such as TSS and BOD.

c. Reporting Requirements. Permittees are required to submit all monitoring results obtained during the second and fourth year of permit coverage within 3 months of the conclusion of each year. For each outfall, one signed Discharge Monitoring Report Form must be submitted per storm event sampled. For facilities conducting monitoring beyond the minimum quarterly requirements an additional Discharge Monitoring Report Form must be filed for each analysis.

d. Sample Type. All discharge data shall be reported for grab samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The required 72-hour storm event interval is waived where the preceding measurable storm event did not result in a measurable discharge from the facility. The required 72-hour storm event interval may also be waived where the permittee documents that less than a 72-hour interval is representative for local storm events during the season when sampling is being conducted. The grab sample shall be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable.

If storm water discharges associated with industrial activity commingle with process or non-process water, then where practicable permittees must attempt to sample the storm water discharge before it mixes with the non-storm water discharge.

e. Representative Discharge. When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may test the effluent of one of such outfalls and report that the quantitative data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluent. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

f. Quarterly Visual Examination of Storm Water Quality. Quarterly visual examinations of storm water discharges from each outfall are required at fabricated metal products facilities. The examinations must be of a grab sample collected from each storm water outfall. The examination of storm water grab samples shall include any observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, or other obvious indicators of storm water pollution. The examinations must be conducted in a well lit area. No analytical tests are required to be performed on these samples.

The examination must be made at least once in each of the following periods during daylight, unless there is insufficient rainfall or snow-melt to runoff: January through March; April through June; July through September; and October through December. Where practicable, the same individual should carry out the collection and examination of discharges throughout the life of the permit to ensure the greatest degree of consistency possible. Grab samples shall be collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 60 minutes) of when the runoff begins discharging. Reports of the visual examination include: the examination date and time, examination personnel, visual quality of the storm water discharge, and probable sources of any observed storm water contamination. The visual examination reports must be maintained onsite with the pollution prevention plan.

When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the records of the visual examination. Adverse weather conditions which may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

EPA realizes that if a facility is inactive and unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly visual examination.

EPA believes that this quick and simple assessment will allow the permittee to approximate the effectiveness of his/her plan on a regular basis at very little cost. Although the visual examination cannot assess the chemical properties of the storm water discharged from the site, the examination will provide meaningful results upon which the facility may act quickly. The frequency of this visual examination will also allow for timely adjustments to be made to the plan. If BMPs are performing ineffectively, corrective action must be implemented. A set of tracking or follow-up procedures must be used to ensure that appropriate actions are taken in response to the examinations. The visual examination is intended to be performed by members of the pollution prevention team. This hands-on examination will enhance the staff's understanding of the storm water problems on that site and the effects of the management practices that are included in the plan.

AB. Storm Water Discharges Associated With Industrial Activity From Facilities That Manufacture Transportation Equipment, Industrial, or Commercial Machinery

1. Industry Profile

On November 16, 1990 (55 FR 47990), EPA promulgated the regulatory definition of "storm water discharge associated with industrial activity." This definition includes point source discharges of storm water from eleven categories of facilities, including "* * * (xi) facilities classified as Standard Industrial Classification (SIC) codes * * * 35 (except SIC 357), 37 (except SIC 373), * * *" Facilities eligible for coverage under this section of today's permit include the following manufacturing facilities: engines and turbines (SIC Code 351); farm and garden machinery and equipment (SIC Code 352); construction, mining, and materials handling machinery and equipment (SIC Code 353); metalworking machinery and equipment (SIC Code 354); special industry machinery, except metalworking machinery (SIC Code 355); general industrial machinery and equipment (SIC Code 356); refrigeration and service industry machinery (SIC Code 358); miscellaneous industrial and commercial machinery and equipment (SIC Code 359); motor vehicles and motor vehicle equipment (SIC Code 371); aircraft and parts (SIC Code 372); motorcycles, bicycles, and parts (SIC Code 375); guided missiles and space vehicles and parts (SIC Code 376); and miscellaneous transportation equipment (SIC Code 379).

This section establishes special conditions for storm water discharges associated with industrial activities at facilities which manufacture transportation equipment, industrial or commercial machinery. The SIC codes of these facilities are in category (xi) of the definition of storm water discharges associated with industrial activity. Storm water discharges from facilities in this category are only regulated where precipitation or storm water runon come into contact with areas associated with industrial activities, and significant materials. Significant materials include, but are not limited to, raw materials, waste products, fuels, finished products, intermediate products, by-products, and other materials associated with industrial activities.

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

There are approximately 14,000 facilities which handle and process ferrous and nonferrous metals to manufacture transportation equipment, industrial or commercial machinery. These facilities vary in size, age, number of employees and the types of operations performed. The manufacturing processes for these facilities are similar, although the finished products may vary. The general manufacturing process is conducted indoors, and includes activities such as cutting, shaping, grinding, cleaning, coating, forming, and finishing. Specific processes are referred to as "unit operations," and there are approximately 45 unit operations utilized by facilities that manufacture transportation equipment, industrial, or commercial machinery. Since these operations occur predominately indoors, contamination of storm water discharges from the manufacturing process is unlikely. Unit operations include the following: electroplating, electroless plating, anodizing, chemical conversion coating, etching and chemical milling, cleaning, machining, grinding, polishing, barrel finishing, burnishing, impact deformation, pressure deformation, shearing, heat treating, thermal cutting, welding, brazing, soldering, flame spraying, sand blasting, abrasive jet machining, electrical discharge machining, electrochemical machining, electron beam machining, laser beam machining, plasma arc machining, ultrasonic machining, sintering, laminating, hot dip coating, sputtering, vapor plating, thermal infusion, salt bath descaling, solvent degreasing, paint stripping, painting, electrostatic painting, electropainting, vacuum metalizing, assembly, calibration, testing, and mechanical plating.

Facilities which manufacture transportation equipment, industrial and commercial machinery will utilize many of the same unit operations listed above. Aside from the specific unit operations, other types of industrial activity are shared by facilities covered by this section. For example, the majority of these facilities have outdoor material handling and storage activities, and share the same types of raw, scrap, and waste materials.

The primary raw materials utilized by this industry group include ferrous and nonferrous metals, such as aluminum, copper, iron, steel and alloys of these metals; either in raw form or as intermediate products. These metals are typically received at loading/unloading docks and are taken to outdoor storage areas (e.g., stockpiles, holding bins) before manufacturing.

Besides metals, other raw materials are utilized in the manufacturing process. These materials include paints, solvents (e.g., paint thinners, degreasers), chemicals (e.g., acids, bases, liquid gases), fuels (e.g., gasoline and diesel fuel), lubricating and cutting oils, and plastics. These materials are typically stored in bins, tanks, and/or 55 gallon drums outdoors on wooden pallets or concrete pads. They are used during the unit operations to cool and lubricate the metals (oils), clean metal parts (solvents, acids, bases), and coat metal parts before shipment (plastics, paints). Intermediate products are also sometimes stored outdoors before shipment or further manufacturing.

These products may have residues of oils, solvents and metal particles, which are potential sources of pollutants to storm water discharges. Similarly, scrap metal will have the same residues, and is almost always stored outdoors in bins before being sold to scrap metal recyclers.

The manufacturing process produces several types of hazardous and nonhazardous wastes. Hazardous wastes including paint wastes, solvent wastes, and sludge wastes are generated in small quantities at the facilities within this industrial group. Paint wastes result from painting operations and consist of paints and paint thinners. Solvent wastes result from metal cutting, shaping, and cleaning operations. As the metals are manufactured into different parts and treated with various chemicals, the different assembly parts must be cleaned with solvents to remove any chemical residues and rinsed with water. The metal parts are subject to more cleaning with detergents to remove the solvents and chemical residues and rinsed again with water to remove the detergents. Sludge wastes are generated when wastewater discharges from painting, plating, finishing and parts cleaning operations are treated, and is generally shipped offsite for disposal. Hazardous wastes are stored in 55 gallon drums outdoors before shipment and may be exposed to storm water discharges.

Nonhazardous wastes from this industry group include glass, tires, used wooden pallets, used equipment and machinery, as well as plastics and rubber wastes. All of these waste materials are stored outdoors and have the potential to pollute storm water discharges. Storm water runoff from these materials could include solids, oils, solvents and other pollutants generated in the manufacturing process.

Air emissions from stacks and ventilation systems are potential areas for exposure of materials to storm water discharges. Facilities which have high levels of engine exhaust from the manufacturing equipment, paint residue, and particulates in fumes from metal processing activities such as cutting, grinding, shaping, and welding, are subject to having particulate in the air emissions that may pollute storm water discharges.

Material handling activities such as loading and unloading areas may be exposed to storm water discharges. These are areas where significant materials are received and shipped at the facilities. Exposure of these materials to storm water may be minimized by having shipping/receiving areas under cover.

For those facilities engaged in fueling and vehicle maintenance, gasoline and diesel fuel are frequently stored outdoors in aboveground storage tanks and 55 gallon drums. Most vehicles and equipment also require oil, hydraulic fluids, antifreeze, and other fluids that may leak and contaminate storm water discharges. The discharges from these areas are addressed elsewhere in today's permit.

2. Pollutants Found in Storm Water Discharges From Facilities Which Manufacture Transportation Equipment, Industrial or Commercial Machinery

The impact of industrial activities at facilities which manufacture transportation equipment, industrial or commercial machinery on storm water discharges will vary. Factors at a site which influence the water quality include geographic location, hydrogeology, the industrial activities exposed to storm water discharges, the facility's size, the types of pollution prevention measures/best management practices in place, and the type, duration, and intensity of storm events. Taken together or separately, these factors determine how polluted the storm water discharges will be at a given facility. For example, scrap piles may be a significant source of pollutants at some facilities, while particulate stack emissions may be the primary pollutant source at others. Additionally, pollutant sources other than storm water, such as illicit connections, spills, and other improperly dumped materials, may increase the pollutant loading discharged into Waters of the United States.

Table AB–1 lists industrial activities that commonly occur at transportation equipment, industrial or commercial machinery manufacturers, the pollutant sources at these facilities, and pollutants that are associated with these activities. Table AB–1 identifies oil and grease, TSS, organics, and other parameters as potential pollutants associated with facilities covered by this section.

TABLE AB–1.—DESCRIPTION OF INDUSTRIAL ACTIVITIES, POTENTIAL POLLUTANT SOURCES, AND POSSIBLE POLLUTANTS

Activity	Pollutant source	Pollutants
Outdoor Material Loading/Unloading	Wooden pallets, castings, foundry sand, limestone, spills/leaks from material handling equipment, solvents.	TSS, turbidity, dust, oil and grease, organics.
Outdoor Material and Equipment Storage.	Foundry sand, limestone, used equipment, above ground tanks, scrap metal, oil and grease, raw materials (e.g., aluminum, steel, iron, copper), castings, solvents, acids, and paints.	TSS, turbidity, dust, oil and grease, heavy metals, and organics.

Source: NPDES Storm Water Group Applications—Part 1. Received by EPA, March 18, 1991 through December 31, 1992.

Based on the similarities of the facilities included in this sector in terms of industrial activities and significant materials, EPA believes it is appropriate to discuss the potential pollutants at industrial and commercial machinery and transportation equipment manufacturing facilities as a whole and not subdivide this sector. Therefore, Table AB–2 lists data for selected parameters from facilities in the industrial and commercial machinery and transportation equipment manufacturing sector. These data include the eight pollutants that all facilities were required to monitor for under Form 2F, as well as any additional pollutants with median concentrations higher than the benchmarks.

TABLE AB–2.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY INDUSTRIAL AND COMMERCIAL MACHINERY AND TRANSPORTATION EQUIPMENT MANUFACTURING FACILITIES SUBMITTING PART II SAMPLING DATA[i] (mg/L)

Pollutant Sample type	No. of facilities		No. of samples		Mean		Minimum		Maximum		Median		95th percentile		99th percentile	
	Grab	Comp[ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	118	113	207	199	12.5	7.32	0.0	0.0	513.0	226.0	6.0	5.0	33.3	23.10	63.8	43.90
COD	119	114	204	194	68.2	47.20	0.0	0.0	940.0	610.0	37.6	30.50	228.9	142.4	469.7	261.9
Nitrate + Nitrite Nitrogen	119	113	206	193	1.13	1.20	0.00	0.0	19.20	28.0	0.58	0.46	4.00	3.74	8.79	8.43
Total Kjeldahl Nitrogen	118	113	204	194	2.30	1.68	0.00	0.0	55.00	30.0	1.30	1.00	5.57	4.57	12.68	8.11
Oil & Grease	122	N/A	213	N/A	7.1	N/A	0.0	N/A	223.0	N/A	0.0	N/A	28.1	N/A	92.6	N/A
pH	113	N/A	201	N/A	N/A	N/A	4.1	N/A	9.1	N/A	7.1	N/A	8.6	N/A	9.5	N/A
Total Phosphorus	120	115	206	198	0.50	0.48	0.00	0.00	42.00	19.0	0.15	0.13	1.21	1.17	2.70	2.66
Total Suspended Solids	117	112	203	194	153	97	0	0	6453	3600	30	19	507	339	1501	1022
Zinc, Total	61	57	109	103	0.515	0.354	0.000	0.000	8.800	9.000	0.21	0.14	2.070	1.836	5.443	5.297

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as nondetect or below detection limit were assumed to be 0.
[ii] Composite samples.

3. Options for Controlling Pollutants

In evaluating options for controlling pollutants in storm water discharges, EPA must achieve compliance with the technology-based standards of the Clean Water Act (Best Available Technology (BAT) and Best Conventional Technology). The Agency does not believe that it is appropriate to establish specific numeric effluent limitations or a specific design or performance standard in this sections for storm water discharges associated with industrial activity from facilities which manufacture transportation equipment, industrial or commercial machinery to meet BAT/BCT standards of the Clean Water Act. Instead, this section establishes requirements for the development and implementation of site-specific storm water pollution prevention plans consisting of a set of Best Management Practices (BMPs) that are sufficiently flexible to address different sources of pollutants at different sites.

Certain BMPs are implemented to prevent and/or minimize exposure of pollutants from industrial activities to storm water discharges. EPA believes the most effective BMPs for reducing pollutants in storm water discharges are exposure minimization practices. Exposure minimization practices lessen the potential for storm water to come into contact with pollutants. Good housekeeping practices ensure that facilities are sensitive to routine and nonroutine activities which may increase pollutants in storm water discharges. The BMPs which address good housekeeping and exposure minimization are easily implemented, inexpensive, and require little, if any, maintenance. BMP expenses may include construction of roofs for storage areas or other forms of permanent cover and the installation of berms/dikes. Other BMPs such as detention/retention ponds and filtering devices may be needed at these facilities because of the contaminant level in the storm water discharges. The types of BMPs implemented will depend on the type of discharge, types and concentrations of contaminants, and the volume of the flow.

The selection of the most effective BMPs will be based on site-specific considerations such as: facility size, climate, geographic location, geology/hydrology and the environmental setting of each facility, and volume and type of discharge generated. Each facility will be unique in that the source, type, and volume of contaminated storm water discharges will differ. In addition, the fate and transport of pollutants in these discharges will vary. EPA believes that the management practices discussed herein are well suited mechanisms to prevent or control the contamination of storm water discharges associated with transportation equipment, industrial or commercial machinery manufacturers.

Part 1 group application data indicate that BMPs have not been widely implemented at the representative sampling facilities. Less than 25 percent of the sampling subgroup reported that they store some materials indoors; less than 10 percent cover loading areas, dumpsters, drums, or above ground tanks; less than 5 percent of the representative facilities utilize waste minimization practices (e.g., recycling or reusing materials).[101] Because BMPs described in part 1 data are limited, the following table is provided to identify BMPs that should be considered at facilities which manufacture transportation equipment, industrial or commercial machinery.

TABLE AB–3.—GENERAL STORM WATER BMPS FOR FACILITIES WHICH MANUFACTURE TRANSPORTATION EQUIPMENT, INDUSTRIAL, OR COMMERCIAL MACHINERY

Activity	Best management practices (BMPs)
Outdoor Unloading and Loading	Confine loading/unloading activities to a designated area. Consider performing loading/unloading activities indoors or in a covered area. Consider covering loading/unloading area with permanent cover (e.g., roofs) or temporary cover (e.g., tarps). Close storm drains during loading/unloading activities in surrounding areas. Avoid loading/unloading materials in the rain. Inspect the unloading/loading areas to detect problems before they occur. Inspect all containers prior to loading/unloading of any raw or spent materials. Consider berming, curbing, or diking loading/unloading areas. Use dry clean-up methods instead of washing the areas down. Train employees on proper loading/unloading techniques.
Outdoor Material Storage (including waste, and particulate emission management).	Confine storage of materials, parts, and equipment to designated areas.

[101] These percentages were based on the information reported in the Part 1 group applications. However, some facilities which utilize these BMPs as part of their daily activities may not recognize these practices as BMPs and as a result did not report this information in their applications.

TABLE AB-3.—GENERAL STORM WATER BMPS FOR FACILITIES WHICH MANUFACTURE TRANSPORTATION EQUIPMENT, INDUSTRIAL, OR COMMERCIAL MACHINERY—Continued

Activity	Best management practices (BMPs)
	Consider curbing, berming, or diking all liquid storage areas. Train employees on proper waste control and disposal. Consider covering tanks. Ensure that all containers are closed (e.g., valves shut, lids sealed, caps closed). Wash and rinse containers indoors before storing them outdoors. If outside or in covered areas, minimize runon of storm water by grading the land to divert flow away from containers. Inventory all raw and spent materials. Clean around vents and stacks. Place tubs around vents and stacks to collect particulate. Inspect air emission control systems (e.g., baghouses) regularly, and repair or replace when necessary. Store wastes in covered, leak proof containers (e.g., dumpsters, drums). Consider shipping all wastes to offsite landfills or treatment facilities. Ensure hazardous waste disposal practices are performed in accordance with Federal, State, and local requirements.

Sources: NPDES Storm Water Group Applications—Part 1, Received by EPA, March 18, 1991 through December 31, 1992.
EPA, Office of Water. September 1992. "Storm Water Management for Industrial Activities: Developing Pollution Prevention Plans and Best Management Practices." EPA 832-R-92-006.

4. Special Conditions

There are no additional requirements under this section other than those stated in Part III of today's permit .

5. Storm Water Pollution Prevention Plan Requirements

EPA believes that pollution prevention is the most effective approach for controlling contaminated storm water discharges from facilities which manufacture transportation equipment, industrial or commercial machinery. The requirements included in the pollution prevention plans provide a flexible framework for the development and implementation of site-specific controls to minimize the pollutants in storm water discharges. This flexibility is necessary because each facility is unique in that the source, type, and volume of contaminated storm water discharge will vary from site to site.

Under today's permit, all facilities must prepare and implement a storm water pollution prevention plan. The pollution prevention plan requirement reflects EPA's decision to allow operators of transportation equipment, industrial or commercial machinery manufacturing facilities to utilize BMPs as the BAT/BCT level of control for the storm water discharges covered by this section.

There are two major objectives of a pollution prevention plan: 1) to identify sources of pollution potentially affecting the quality of storm water discharges associated with industrial activity from a facility; and 2) to describe and ensure implementation of practices to minimize and control pollutants in storm water discharges associated with industrial activity from a facility.

Specific requirements for a pollution prevention plan for transportation equipment, industrial or commercial machinery manufacturing facilities are described below. These requirements must be implemented in addition to the common pollution prevention plan provisions discussed in section VI.C. of today's fact sheet.

a. Contents of the Plan. Storm water pollution prevention plans are intended to aid operators of transportation equipment, industrial or commercial machinery manufacturing facilities to evaluate all potential prevention sources at a site, and assist in the selection and implementation of appropriate measures designed to prevent, or control, the discharge of pollutants in storm water runoff. EPA has developed guidance entitled "Storm Water Management for Industrial Activities: Developing Pollution Prevention Plans and Best Management Practices," EPA, 1992, (EPA 832-R-92-006) to assist permittees in developing and implementing pollution prevention measures.

(1) Description of Potential Pollutant Sources. Each storm water pollution prevention plan must describe activities, materials, and physical features of the facility that may contribute pollutants to storm water runoff or, during periods of dry weather, result in dry weather flows. This assessment of potential storm water pollutant source will support subsequent efforts to identify and set priorities for necessary changes in materials, materials management practices, or site features, as well as aid in the selection of appropriate structural and nonstructural control techniques. Plans must describe the following elements:

(a) Site Map—The plan must contain a map of the site that shows the pattern of storm water drainage, structural and nonstructural features that control pollutants in storm water runoff and process wastewater discharges, surface water bodies (including wetlands), places where significant materials [102] are exposed to rainfall and runoff, and locations of major spills and leaks that occurred in the 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit. The map must also indicate the direction of storm water flow. An outline of the drainage area for each outfall must be provided; and the location of each outfall and monitoring points must be indicated. An estimate of the total site acreage utilized for each industrial activity (e.g., storage of raw materials, waste materials, and used equipment) must be provided. These areas include liquid storage tanks, stockpiles, holding bins, used equipment, and empty drum storage.

[102] Significant materials include, "* * * but [are] not limited to: raw materials, fuels, materials such as solvents, detergents, and plastic pellets; finished materials such as metallic products; * * * hazardous substances designated under section 101(14) of CERCLA; any Chemical facilities are required to report pursuant to section 313 of Title III of SARA; fertilizers; pesticides; and waste products such as ashes, slag, and sludge that have the potential to be released with storm water discharge." (40 CFR 122.26(b)(12)). Significant materials commonly found at transportation equipment, industrial or commercial machinery manufacturing facilities include raw and scrap metals; solvents; used equipment; petroleum based products; waste materials or by-products used or created by the facility.

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These areas are considered to be significant potential sources of pollutants at facilities which manufacture transportation equipment, industrial or commercial machinery. The site map must also indicate the outfall locations and the types of discharges contained in the drainage areas of the outfalls (e.g. storm water and air conditioner condensate). In order to increase the readability of the map, the inventory of the types of discharges contained in each outfall may be kept as an attachment to the site map.

(b) Inventory of Exposed Materials—Facility operators are required to carefully conduct an inspection of the site to identify significant materials that are or may be exposed to storm water discharges. The inventory must address materials that within 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit have been handled, stored, processed, treated, or disposed of in a manner to allow exposure to storm water. Findings of the inventory must be documented in detail in the pollution prevention plan. At a minimum, the plan must describe the method and location of onsite storage or disposal; practices used to minimize contact of materials with precipitation and runoff; existing structural and nonstructural controls that reduce pollutants in storm water; existing structural controls that limit process wastewater discharges; and any treatment the runoff receives before it is discharged to surface waters or through a separate storm sewer system. The description must be updated whenever there is a significant change in the type or amounts of materials, or material management practices, that may affect the exposure of materials to storm water.

(c) Significant Spills and Leaks—The plan must include a list of any significant spills and leaks of toxic or hazardous pollutants that occurred in the 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit. Significant spills include, but are not limited to, releases of oil or hazardous substances in excess of reportable quantities under Section 311 of CWA (see 40 CFR Section 110.10 and Section 117.21) or Section 102 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (see 40 CFR Section 302.4). Significant spills may also include releases of oil or hazardous substances that are not in excess of reporting requirements and releases of materials that are not classified as oil or a hazardous substance.

(d) Non-storm Water Discharges—Each pollution prevention plan must include a certification, signed by an authorized individual, that discharges from the site have been tested or evaluated for the presence of non-storm water, the results of any test and/or evaluation conducted to detect such discharges, the test method or evaluation criteria used, the dates on which tests or evaluations were performed, and the onsite drainage points directly observed during the test or evaluation. Pollution prevention plans must identify and ensure the implementation of appropriate pollution prevention measures for any non-storm water discharges.

(e) Sampling Data—Any existing data describing the quality or quantity of storm water discharges from the facility must be summarized in the plan. The description should include a discussion of the methods used to collect and analyze the data. Sample collection points should be identified in the plan and shown on the site map.

(f) Summary of Potential Pollutant Sources—The description of potential pollutant sources should clearly point to activities, materials, and physical features of the facility that have a reasonable potential to contribute significant amounts of pollutants to storm water. Any such activities, materials, or features must be addressed by the measures and controls subsequently described in the plan. In conducting the assessment, the facility operator must consider the following activities: raw materials (liquid storage tanks, stockpiles, holding bins), waste materials (empty drum storage), and used equipment storage areas. The assessment must list any significant pollutant parameter(s) (i.e., total suspended solids, oil and grease, etc.) associated with each source.

(2) Measures and Controls. Permittees must select, describe, and evaluate the pollution prevention measures, BMPs, and other controls that will be implemented at the facility. Source reduction measures include preventive maintenance, spill prevention, good housekeeping, training, and proper materials management. If source reduction is not an option, EPA supports the use of source control measures. These include BMPs such as material covering, water diversion, and dust control. If source reduction or source control are not available, then recycling or waste treatment are other alternatives. Recycling allows the reuse of storm water, while treatment lowers pollutant concentrations prior to discharge. Since the majority of transportation equipment, industrial or commercial machinery manufacturing occurs indoors, the BMPs identified above are geared towards only those activities occurring outdoors or otherwise have a potential to contribute pollutants to storm water discharges.

Pollution prevention plans must discuss the reasons each selected control or practice is appropriate for the facility and how each of the potential pollutant sources will be addressed. Plans must identify the time during which controls or practices will be implemented, as well the effect the controls or practices will have on storm water discharges from the site. At a minimum, the measures and controls must address the following components:

(a) Good Housekeeping—Permittees must describe protocols established to reduce the possibility of mishandling chemicals or equipment and training employees in good housekeeping techniques. Specifics of this plan must be communicated to appropriate plant personnel.

(b) Preventive Maintenance—Permittees are required to develop a preventive maintenance program that includes regular inspections and maintenance of storm water BMPs. Inspections should assess the effectiveness of the storm water pollution prevention plan. They allow facility personnel to monitor the components of the plan on a regular basis. The use of a checklist is encouraged, as it will ensure that all of the appropriate areas are inspected and provide documentation for recordkeeping purposes.

(c) Spill Prevention and Response Procedures—Permittees are required to identify proper material handling procedures, storage requirements, containment or diversion equipment, and spill removal procedures to reduce exposure of spills to storm water discharges. Areas and activities which are high risks for spills at transportation equipment, industrial or commercial machinery manufacturing facilities include raw material unloading and product loading areas, material storage areas, and waste management areas. These activities and areas and their drainage points must be described in the plan.

(d) Inspections—Qualified personnel must inspect designated equipment and areas of the facility at the proper intervals specified in the plan. The plan should identify areas which have the potential to pollute storm water for periodic inspections. Records of inspections must be maintained onsite.

(e) Employee Training—Permittees must describe a program for informing and educating personnel at all levels of

responsibility of the components and goals of the storm water pollution prevention plan. A schedule for conducting this training should be provided in the plan. Where appropriate, contractor personnel must also be trained in relevant aspects of storm water pollution prevention. Topics for employee training should include good housekeeping, materials management, and spill response procedures. EPA recommends that facilities conduct training annually at a minimum. However, more frequent training may be necessary at facilities with high turnover of employees or where employee participation is essential to the storm water pollution prevention plan.

(f) Recordkeeping and Internal Reporting Procedures—Permittees must describe procedures for developing and retaining records on the status and effectiveness of plan implementation. This includes the success and failure of BMPs implemented at the facility.

(g) Sediment and Erosion Control—Permittees must identify areas, due to topography, activities, soils, cover materials, or other factors that have a high potential for soil erosion. Measures to eliminate erosion must be identified in the plan.

(h) Management of Runoff—Permittees must provide an assessment of traditional storm water management practices that divert, infiltrate, reuse, or otherwise manage storm water so as to reduce the discharge of pollutants. Based on this assessment, practices to control runoff from these areas must be identified and implemented as required by the plan.

(3) Comprehensive Site Compliance Evaluation. The storm water pollution prevention plan must describe the scope and content of comprehensive site inspections that qualified personnel will conduct to: (1) Confirm the accuracy of the description of potential sources contained in the plan, (2) determine the effectiveness of the plan, and (3) assess compliance with the terms and conditions of this section. Comprehensive site compliance evaluations must be conducted once a year for transportation equipment, industrial or commercial machinery manufacturing facilities. The individual(s) who will conduct the evaluations must be identified in the plan and should be members of the pollution prevention team. Evaluation reports must be retained for at least 3 years after the date of the evaluation.

Based on the results of each evaluation, the description of potential pollution sources, and measures and controls, the plan must be revised as appropriate within 2 weeks after each evaluation. Changes in the measures and controls must be implemented on the site in a timely manner, never more than 12 weeks after completion of the evaluation.

6. Numeric Effluent Limitation

There are no additional numeric effluent limitations under this section other than those included in part V.B of the permit.

7. Monitoring and Reporting Requirements

a. Monitoring Requirements. The regulatory modifications at 40 CFR 122.44 (i)(2) established on April 2, 1992, grant permit writers the flexibility to reduce monitoring requirements in storm water discharge permits. EPA has determined that the potential for storm water discharges to contain pollutants above benchmark levels, because of the industrial activities and materials exposed to precipitation, does not support sampling at facilities that manufacture transportation equipment, industrial, or commercial machinery. Based on a consideration of the BMPs typically used at these facilities, and generally low pollutant values from the application data, EPA believes that the pollution prevention plan with visual examinations of storm water discharges will help to ensure storm water contamination is minimized. Under the Storm Water Regulations at 40 CFR 122.26(b)(14), EPA defined "storm water discharge associated with industrial activity". The focus of today's permit is to address the presence of pollutants that are associated with the industrial activities identified in this definition and that might be found in storm water discharges. Under the methodology for determining analytical monitoring requirements, described in section VI.E.1 of this fact sheet, zinc is above the bench mark concentrations for the industrial and commercial machinery and transportation equipment sector. After a review of the nature of industrial activities and the significant materials exposed to storm water described by facilities in this sector, EPA has determined that the higher concentrations of zinc are not likely to be caused by the industrial activity, but may be primarily due to non-industrial activities on-site. Today's permit does not require industrial and commercial machinery and transportation equipment facilities to conduct analytical monitoring for this parameter. Because permittees are not required to conduct sampling, they will be able to focus their resources on developing and implementing the pollution prevention plan.

Quarterly visual examinations of a storm water discharge from each outfall are required at transportation equipment, industrial, or commercial machinery manufacturing facilities. The examination must be of a grab sample collected from each storm water outfall. The examination of storm water grab samples shall include any observations of color, odor, turbidity, floating solids, foam, oil sheen, or other obvious indicators of storm water pollution. The examinations must be conducted in a well lit area. No analytical tests are required to be performed on these samples.

The examination must be made at least once in each designated period during daylight hours unless there is insufficient rainfall or snow-melt to runoff. EPA expects that, whenever practicable, the same individual should carry out the collection and examination of discharges throughout the life of the permit to ensure the greatest degree of consistency possible. Examinations shall be conducted in each of the following periods for the purposes of inspecting storm water quality associated with storm water runoff and snow melt: January through March; April through June; July through September; October through December. Grab samples shall be collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 1 hour) of when the runoff begins discharging. Reports of the visual include: the examination date and time, examination personnel, visual quality of the storm water discharge, and probable sources of any observed storm water contamination. The visual examination reports must be maintained onsite with the pollution prevention plan.

EPA realizes that if a facility is inactive and unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly visual examination.

EPA believes that this quick and simple assessment will help the permittee to determine the effectiveness of his/her plan on a regular basis at very little cost. Although the visual examination cannot assess the chemical properties of the storm water discharged from the site, the examination will provide meaningful results upon which the facility may act quickly. The frequency of this visual examination will also allow for timely adjustments to be made to the plan. If BMPs are performing ineffectively, corrective action must be implemented. A set of tracking or follow-up procedures must be used to ensure that appropriate actions are taken in response to the examinations. The visual examination is intended to be performed by members of the pollution prevention team. This hands-on examination will enhance the staff's understanding of the storm water problems on that site and the effects of the management practices that are included in the plan.

When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the records of the visual examinations. Adverse weather conditions which may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

As discussed above, EPA does not believe that chemical monitoring is necessary for facilities that manufacture transportation equipment, industrial, or commercial machinery. EPA believes that between quarterly visual examinations and site compliance evaluations potential sources of contaminants can be recognized, addressed, and then controlled with BMPs. In determining the monitoring requirements, EPA considered the nature of the industrial activities and significant materials exposed at these sites, and performed a review of data provided in Part 2 group applications.

AC. Storm Water Discharges Associated With Industrial Activity From Facilities That Manufacture Electronic and Electrical Equipment and Components, Photographic and Optical Goods

1. Discharges Covered Under This Section

This sector covers storm water discharges associated with industrial activity from electronic and electrical equipment manufacturing facilities (SIC major group 36); measuring, analyzing, and controlling instruments, photographic, medical and optical goods, and watches and clocks manufacturing facilities (SIC major group 38); and computer and office equipment manufacturing facilities (SIC 357).

More specifically, the group of electronic and electrical equipment and components manufacturers includes manufacturers of electricity distribution equipment such as transformers and switch-gear, electrical industrial equipment such as motors and generators, household appliances, electric lighting and wiring equipment such as light bulbs and lighting fixtures, and audio and video equipment including phonograph records and audio tapes and disks. Also included are manufacturers of communication equipment including telephone and telegraph equipment, radio and television equipment, electronic components such as printed circuit boards and semiconductors and related devices, and miscellaneous electrical items such as batteries and electrical equipment for automobiles.

The group of analyzing, and controlling instruments, photographic, medical and optical goods, and watches and clocks manufacturers includes facilities which manufacture search, detection, navigation, or guidance systems such as radar and sonar equipment, measurement and control instruments and laboratory apparatus, surgical, medical and dental instruments and supplies, photographic equipment and supplies, and watches and clocks.

The computer and office equipment manufacturers group includes manufacturers of computers, computer storage devices, and peripheral equipment for computers such as printers and plotters. Manufacturers of miscellaneous office machines are also included in this group.

The SIC codes of the facilities covered by this section are in category (xi) of the definition of storm water discharges associated with industrial activity. Storm water discharges from facilities in this category are only regulated where precipitation and storm water runon come into contact with areas associated with industrial activities, and significant materials. Significant materials include, but are not limited to, raw materials, waste products, fuels, finished products, intermediate products, by-products, and other materials associated with industrial activities.

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

2. Pollutants Found in Storm Water Discharges

a. Sources of Pollutants. As noted in the preamble to the final storm water application regulations of November 16, 1990, most of the actual manufacturing and processing activity at these types of facilities normally occurs indoors (55 FR 48008).

Additional information concerning these manufacturing processes and the industrial sector itself can be found in the following documents: "Development Document for Effluent Limitations Guidelines and Standards for the Electrical and Electronics Components Point Source Category, Phase I," EPA 440/1–83/075; "Development Document for Effluent Limitations Guidelines and Standards for the Electrical and Electronic Components Point Source Category, Phase II," EPA 440/1–84/075; "Development Document for Existing Source Pretreatment Standards for the Electroplating Point Source Category," EPA 440/1–79/003; and "Development Document for Effluent Limitations Guidelines and Standards for the Metal Finishing Point Source Category," EPA 440/1–83/091.

The types of activities at these facilities where exposure to storm water may occur consist primarily of loading/unloading activities, and the storage and handling of raw materials, by-products, final products or waste products. A wide variety of materials are used at these facilities including metals, acids used for chemical etching, alkaline solutions, solvents, various oils and fuels and miscellaneous chemicals. Tanks or drums of these materials may be exposed to storm water during loading/un-loading operations, or through outdoor storage or handling at some facilities.

Liquid wastes which may be exposed at least temporarily include spent solvents and acids, miscellaneous chemicals and oily wastes. These wastes may be contaminated with a variety of heavy metals and chlorinated hydrocarbons. Used equipment, scrap metal and wire, soiled rags and sanding materials may also be exposed to storm water and constitute a potential source of pollutants. In addition, some facilities reported that dumpsters containing nonhazardous wastes or manufacturing debris may be exposed to storm water.

Table AC–1 lists potential pollutant sources from activities that commonly take place at facilities which manufacture electronic and electrical equipment and components, photographic and optical goods.

TABLE AC–1.—COMMON POLLUTANT SOURCES

Activity	Pollutant source	Pollutants
Outdoor Material Loading/Unloading	Wooden pallets, spills/leaks from material handling equipment, raw materials, finished products, solvents.	TSS, oil and grease, organics.
Outdoor Material and Equipment Storage	Sulfuric acid, alkaline solutions, solvents miscellaneous chemicals, oily wastes, lead, silver, copper, zinc, spent solvents and acids, scrap metal and wire, oily rags.	Organics, oil and grease, acids, alkalinity, heavy metals.

b. Storm Water Sampling Results. Based on the similarities of the facilities included in this sector in terms of industrial activities and significant materials, EPA believes it is appropriate to discuss the potential pollutants at electronic and electric equipment and photographic and optical goods manufacturing facilities as a whole and not subdivide this sector. Therefore, Table AC–2 lists data for selected parameters from facilities in the electronic and electric equipment and photographic and optical goods manufacturing sector. This data includes the eight pollutants which all facilities were required to monitor for under Form 2F, as well as the pollutants that EPA has determined may merit further monitoring.

TABLE AC–2.—STATISTICS FOR SELECTED POLLUTANTS REPORTED BY ELECTRONIC AND ELECTRICAL EQUIPMENT AND PHOTOGRAPHIC AND OPTICAL GOODS MANUFACTURING FACILITIES SUBMITTING PART II SAMPLING DATA [i] (mg/L)

Pollutant of sample type	No. facilities		No. of samples		Mean		Minimum		Maximum		Median		95th percentile		99th percentile	
	Grab	Comp [ii]	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp	Grab	Comp
BOD_5	25	22	64	56	8.8	7.48	0.0	0.0	54.0	139.0	5.5	5.10	27.2	17.92	48.9	30.08
COD	25	22	65	56	59.2	36.3	0.0	0.0	450.0	220.0	46.0	24.0	173.3	122.2	304.9	235.5
Nitrate + Nitrite Nitrogen	25	22	64	57	0.83	0.66	0.00	0.0	6.97	2.54	0.51	0.51	2.63	1.56	4.99	2.40
Total Kjeldahl Nitrogen	25	22	64	58	1.45	1.34	0.00	0.0	10.20	13.6	1.05	1.01	4.26	4.22	7.41	7.68
Oil & Grease	25	N/A	69	N/A	0.6	N/A	0.0	N/A	9.0	N/A	0.0	N/A	3.5	N/A	8.3	N/A
pH	25	N/A	69	N/A	N/A	N/A	5.0	N/A	8.8	N/A	7.5	N/A	9.0	N/A	9.7	N/A
Total Phosphorus	24	21	64	57	1.50	1.02	0.00	0.0	80.10	44.4	0.13	0.16	1.86	1.72	4.93	4.40
Total Suspended Solids	24	22	63	56	89	67	0	0	610	716	29	14	424	262	1209	722
Aluminum, Total	4	4	4	4	3.05	0.60	0.00	0.00	9.40	1.00	1.40	0.70	15.37	1.34	29.78	1.75
Zinc, Total	16	14	51	48	0.163	0.152	0.000	0.000	1.101	1.200	0.09	0.09	0.563	0.500	1.060	0.940

[i] Applications that did not report the units of measurement for the reported values of pollutants were not included in these statistics. Values reported as non-detect or below detection limit were assumed to be 0.

[ii] Composite samples.

3. Options for Controlling Pollutants

In evaluating options for controlling pollutants in storm water discharges, EPA must achieve compliance with the technology-based standards of the Clean Water Act [Best Available Technology (BAT) and Best Conventional Technology]. The Agency does not believe that it is appropriate to establish specific numeric effluent limitations or a specific design or performance standard in this section for storm water discharges associated with industrial activity from facilities which manufacture electronic and electrical equipment and components, and photographic and optical goods to meet BAT/BCT standards of the Clean Water Act. Instead, this section establishes requirements for the development and implementation of site-specific storm water pollution prevention plans consisting of a set of Best Management Practices (BMPs) that are sufficiently flexible to address different sources of pollutants at different sites.

Certain BMPs are implemented to prevent and/or minimize exposure of pollutants from industrial activities to storm water discharges. EPA believes the most effective BMPs for reducing pollutants in storm water discharges are exposure minimization practices. Exposure minimization practices lessen the potential for storm water to come into contact with pollutants. Good housekeeping practices ensure that facilities are sensitive to routine and nonroutine activities which may increase pollutants in storm water discharges. The BMPs which address good housekeeping and exposure minimization are easily implemented, inexpensive, and require little, if any, maintenance. BMP expenses may include construction of roofs for storage areas or other forms of permanent cover and the installation of berms/dikes. Other BMPs such as detention/retention ponds and filtering devices may be needed at these facilities because of the contaminant level in the storm water discharges. The types of BMPs implemented will depend on the type of discharge, types and concentrations of contaminants, and the volume of the flow.

The selection of the most effective BMPs will be based on site-specific considerations such as: facility size, climate, geographic location, geology/hydrology and the environmental setting of each facility, and volume and type of discharge generated. Each facility will be unique in that the source, type, and volume of contaminated storm water discharges will differ. In addition, the fate and transport of pollutants in these discharges will vary. EPA believes that the management practices discussed herein are well suited mechanisms to prevent or control the contamination of storm water discharges associated with manufacturers of electronic and electrical equipment and components, and photographic and optical goods.

Part 1 group application data indicated that the most widely implemented BMPs are spill prevention and response techniques (used by approximately 68 percent of the sampling facilities) and waste minimization practices (employed by approximately 54 percent of the sampling facilities). However, less than

30 percent of the sampling subgroup reported that they use covering; approximately 3 percent have roofs over their raw materials; and less than 3 percent store raw materials indoors.[103] Because BMPs described in part 1 data are generally limited, Table AC-3 is provided to identify BMPs associated with activities that routinely occur at manufacturers of electronic and electrical equipment and components, and photographic and optical goods.

TABLE AC-3.—GENERAL STORM WATER BMPS FOR MANUFACTURERS OF ELECTRONIC AND ELECTRICAL EQUIPMENT AND COMPONENTS, PHOTOGRAPHIC AND OPTICAL GOODS

Activity	Best management practices (BMPs)
Outdoor Unloading and Loading	Confine loading/unloading activities to a designated area. Consider performing loading/unloading activities indoors or in a covered area. Consider covering loading/unloading area with permanent cover (e.g., roofs) or temporary cover (e.g., tarps). Close storm drains during loading/unloading activities in surrounding areas. Avoid loading/unloading materials in the rain. Inspect the unloading/loading areas to detect problems before they occur. Inspect all containers prior to loading/unloading of any raw or spent materials. Consider berming, curbing, or diking loading/unloading areas. Dead-end sump where spilled materials could be directed. Drip pans under hoses. Use dry clean-up methods instead of washing the areas down. Train employees on proper loading/unloading techniques and spill prevention and response.
Outdoor Material Storage (including waste, and particulate emission management).	Confine storage of materials, parts, and equipment to designated areas. Consider secondary containment using curbing, berming, or diking all liquid storage areas. Train employees in spill prevention and response techniques. Train employees on proper waste control and disposal. Consider covering tanks. Ensure that all containers are closed (e.g., valves shut, lids sealed, caps closed). Wash and rinse containers indoors before storing them outdoors If outside or in covered areas, minimize runon of storm water by grading the land to divert flow away from containers. Leak detection and container integrity testing. Direct runoff to onsite retention pond. Inventory all raw and spent materials. Clean around vents and stacks. Place tubs around vents and stacks to collect particulate. Inspect air emission control systems (e.g., baghouses) regularly, and repair or replace when necessary. Store wastes in covered, leak proof containers (e.g., dumpsters, drums). Consider shipping all wastes to offsite landfills or treatment facilities. Ensure hazardous waste disposal practices are performed in accordance with Federal, State, and local requirements.

Sources: NPDES Storm Water Group Applications—Part 1. Received by EPA, March 18, 1991, through December 31, 1992.
EPA, Office of Water. September 1992. "Storm Water Management for Industrial Activities: Developing Pollution Prevention Plans and Best Management Practices." EPA 832-R-92-006.

4. Special Conditions

There are no additional requirements under this section other than those stated in Part VI.B of this fact sheet.

5. Storm Water Pollution Prevention Plan Requirements

There are no additional requirements beyond those described in Part VI.C. of this fact sheet.

6. Numeric Effluent Limitations

No numeric effluent limitations are included for facilities in this sector, beyond those described in Part V.B. of today's permit.

7. Monitoring and Reporting Requirements

a. Monitoring Requirements. The regulatory modifications at 40 CFR 122.44 (i)(2) established on April 2, 1992, grant permit writers the flexibility to reduce monitoring requirements in storm water discharge permits. EPA has determined that the potential for storm water discharges to contain pollutants above benchmark levels, because of the industrial activities and materials exposed to precipitation, does not support sampling at facilities that manufacture electronic and electrical equipment and components, photographic, and optical goods. Under the Storm Water Regulations at 40 CFR 122.26(b)(14), EPA defined "storm water discharge associated with industrial activity". The focus of today's permit is to address the presence of pollutants that are associated with the industrial activities identified in this definition and that might be found in storm water discharges. Under the methodology for determining analytical monitoring requirements, described in section VI.E.1 of this fact sheet, aluminum and zinc are above the bench mark concentrations for the electronic, electric, photographic and optical goods sector. After a review of the nature of industrial activities and the significant materials exposed to storm water described by facilities in this sector, EPA has determined that the higher concentrations of aluminum and zinc

[103] These percentages were based on the information reported in the Part 1 group applications. However, some facilities which utilize these BMPs as part of their daily activities may not recognize these practices as BMPs and as a result did not report this information in their applications.

are not likely to be caused by the industrial activity, but may be primarily due to non-industrial activities on-site. Today's permit does not require electronic, electric, photographic and optical goods facilities to conduct analytical monitoring for these parameters.

Based on a consideration of the BMPs typically used at these facilities, and generally low pollutant values from the application data, EPA believes that the pollution prevention plan with visual examinations of storm water discharges will help to ensure storm water contamination is minimized. Because permittees are not required to conduct analytical monitoring, they will be able to focus their resources on developing and implementing the pollution prevention plan.

Quarterly visual examination of a storm water discharge from each outfall are required. The examination must be of a grab sample collected from each storm water outfall. The examination of storm water grab samples shall include any observations of color, odor, turbidity, floating solids, foam, oil sheen, or other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on these samples.

The examination must be made at least once in each designated period during daylight hours unless there is insufficient rainfall or snow-melt to runoff. Whenever practicable, the same individual should carry out the collection and examination of discharges throughout the life of the permit to ensure the greatest degree of consistency possible. Examinations shall be conducted in each of the following periods for the purposes of inspecting storm water quality associated with storm water runoff and snow melt: January through March; April through June; July through September; October through December. Grab samples shall be collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 1 hour) of when the runoff begins discharging. Reports of the visual examination include: the examination date and time, examination personnel, visual quality of the storm water discharge, and probable sources of any observed storm water contamination. The visual examination reports must be maintained onsite with the pollution prevention plan.

EPA realizes that if a facility is inactive and unstaffed it may be difficult to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly visual examination.

EPA believes that this quick and simple assessment will help the permittee to determine the effectiveness of his/her plan on a regular basis at very little cost. Although the visual examination cannot assess the chemical properties of the storm water discharged from the site, the examination will provide meaningful results upon which the facility may act quickly. The frequency of this visual inspection will also allow for timely adjustments to be made to the plan. If BMPs are performing ineffectively, corrective action must be implemented. A set of tracking or follow-up procedures must be used to ensure that appropriate actions are taken in response to the inspections. The visual examination is intended to be performed by members of the pollution prevention team. This hands-on examination will enhance the staff's understanding of the storm water problems on that site and the effects of the management practices that are included in the plan.

When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the records of the visual examinations. Adverse weather conditions which may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

As discussed above, EPA does not believe that analytical monitoring is necessary for facilities that manufacture electronic and electrical equipment and components, photographic, and optical goods. EPA believes that between quarterly visual examinations and site compliance evaluations potential sources of contaminants can be recognized, addressed, and then controlled with BMPs. In determining the monitoring requirements, EPA considered the nature of the industrial activities and significant materials exposed at these sites, and performed a review of data provided in Part 2 group applications.

IX. Paperwork Reduction Act

EPA has reviewed the requirements imposed on regulated facilities in this proposed multi-sector general permit under the Paperwork Reduction Act of 1980, 44 U.S.C. 3501 et seq. The information collection requirements in today's permit have already been approved by the Office of Management and Budget (OMB) in previous submissions made for the NPDES permit program under the provisions of the Clean Water Act.

X. 401 Certification

Section 401 of the CWA provides that no Federal license or permit, including NPDES permits, to conduct any activity that may result in any discharge into navigable waters, shall be granted until the State in which the discharge originates certifies that the discharge will comply with the applicable provisions of Sections 301, 302, 303, 306, and 307 of the CWA. The Section 401 certification process has been completed for all States, Indian lands, and Federal facilities covered by today's general permit. The following summary indicates where additional permit requirements have been added as a result of the certification process and also provides a more detailed discussion of additional requirements for the District of Columbia, Louisiana, New Mexico, Oklahoma, Texas, Arizona, and Washington State.

Region I

Connecticut: Indian lands only, no 401 conditions.
Maine: No 401 conditions.
Maine Indian lands: No 401 conditions.
Massachusetts: No 401 conditions.
Massachusetts: Indian lands only, no 401 conditions.
New Hampshire: no 401 conditions.
New Hampshire: Indian lands only, no 401 conditions.
Rhode Island: Indian lands only, no 401 conditions.
Vermont: Indian lands only, no 401 conditions.
Vermont: Federal facilities only, no 401 conditions.

Region II

Puerto Rico: no 401 conditions.
Puerto Rico: Federal facilities only, no 401 conditions.

Region III

District of Columbia: see the following and Part XII of the permit for 401 conditions.

The District of Columbia has added the following permit conditions in order to protect water quality in the District. A copy of all storm water pollution prevention plans required under the permit shall be submitted to the District of Columbia's Department of Consumer and Regulatory Affairs, Environmental

Regulation Administration, for review and approval.

District of Columbia: Federal facilities only, see the following and Part XII for 401 conditions.

The District of Columbia has added the following permit conditions for Federal facilities in order to protect the quality of waters in the District and surrounding areas including the Chesapeake Bay. Any Federal facility regulated by this permit shall include in its storm water management plan required by this permit the following additional items: current nitrogen and phosphorus loads, current fertilizer usage, current exterior pesticide usage, and current urea for deicing usage; volume of any storm water diverted to the sanitary sewer from roof leaders or other connections and the volume of any ground water diverted to the sanitary sewer; proposed reductions in nutrient and pesticides loads in accordance with the Chesapeake Bay Restoration goals; any Federal facility regulated by this permit, which manages significant quantities of animals or animal wastes, shall provide in the storm water management plan an accounting of these animal wastes, and nutrient control measures for avoiding, reducing, or eliminating runoff of these animal wastes; and any Federal facility regulated by this permit whose storm water discharges to a combined sewer shall study, or contribute to any joint study, the impact of its storm water discharge(s) on combined sewer overflows, and address potential solution(s) to avoid, reduce, or eliminate the combined sewer overflows caused by its storm water discharge(s). In addition, a copy of all storm water pollution prevention plans required under the permit shall be submitted to the District of Columbia's Department of Consumer and Regulatory Affairs, Environmental Regulation Administration, for review and approval.

Delaware: Federal facilities only, no 401 conditions.

Region IV

Florida: no 401 conditions.

Region VI

Louisiana: see the following and Part XII of the permit for 401 conditions.

In accordance with the Louisiana Coastal Zone Management Program (LRS 49:214), all facilities whose activities occur in, or have an effect on, the designated costal zone of Louisiana, must obtain an individual coastal zone consistency concurrence, permit, or waiver from the Coastal Management Division of the Louisiana Department of Natural Resources. These facilities are provided with an address to help in determining if they have responsibilities for obtaining clearance from the Louisiana Department of Natural Resources. These facilities cannot be eligible for coverage under this NPDES permit unless they have fulfilled their responsibilities under the Louisiana Coastal Zone Management Program. This is a condition of certification from the State of Louisiana (letter June 29, 1995).

As a condition for certification under Section 401 of the CWA, the State of Louisiana (letter dated February 1, 1995) required inclusion of the following limitations necessary to insure compliance with State water quality standards. These limitations are required under Louisiana Annotated Code 33:IX.708 (LAC 33:IX.708).

(1) General Limitations become effective on the effective date of the permit.

Parameter	Daily maximum (mg/l)
Total Organic Carbon (TOC)	50
Oil & Grease	15

(2) Oil & Gas Exploration and Production Facility requirements become effective on the effective date of the permit.

Parameter	Daily maximum (mg/l)
Chemical Oxygen Demand (COD)	100
Total Organic Carbon (TOC)	50
Oil & Grease	15

Chlorides: (a) Maximum chloride concentration of the discharge shall not exceed two times the ambient concentration of the receiving water in brackish marsh areas.

(b) Maximum chloride concentration of the discharge shall not exceed 500 mg/l in freshwater or intermediate marsh areas and upland areas.

Monitoring requirements for Total Organic Carbon (TOC) and Oil and Grease have been added to all facilities required to monitor annually or semi-annually. Facilities without monitoring requirements must insure the pollution prevention plan will insure compliance with these effluent limitations. The definitions of brackish marsh, freshwater marsh, intermediate marsh, upland area, and saline marsh at LAC 33:IX.708 have been included in Part X. of the permit.

Louisiana: Federal Indian Reservations only, no 401 conditions.

New Mexico: see the following and Part XII of the permit for 401 conditions.

As a condition for certification under Section 401 of the CWA, the State of New Mexico required inclusion of the following conditions necessary to insure compliance with State water quality standards (letter dated June 16, 1995). These conditions apply to permittees with facilities discharging into waters of the State of New Mexico. This testing requirement is in addition to any other monitoring required under the permit.

Results of the testing requirement is to be reported only to the State of New Mexico at the address given in the permit. A copy of the data shall be kept with the Pollution Prevention Plan.

New Mexico: Federal Indian Reservations only, no 401 conditions.

Oklahoma: see the following and Part XII of the permit for 401 conditions.

Under section 301 of the CWA and 40 CFR 122.44, EPA is required to include permit conditions necessary to insure compliance with more stringent conditions of State law. The proposed permit included requirements based on the 1988 Oklahoma Water Quality Standards, prohibiting new point source discharges to several classes of high quality waterbodies of the State. The final permit conditions reflect the requirements of Oklahoma Annotated Code Title 785, chapter 45 (OAC 785:45–5–25), effective June 25, 1992.

In order to comply with OAC 785:45–5–25, the permit will not authorize any new point source discharge of storm water associated with industrial activity to "new" point source discharges of storm water associated with industrial activity (those commencing after the June 25, 1992, effective date of the Oklahoma Water Quality Standards—OAC 785:45) to the following waters:

(i) Waterbodies designated as "outstanding Resource Waters" and/or "Scenic Rivers" in appendix A of the Oklahoma Water Quality Standards;

(ii) Oklahoma waterbodies located within the watersheds of waterbodies designated as "Scenic Rivers" in appendix A of the Oklahoma Water Quality Standards; and

(iii) Waterbodies located within the boundaries of Oklahoma Water Quality Standards appendix B areas which are specifically designated as "Outstanding Resource Waters" in appendix A of the Oklahoma Water Quality Standards.

In addition to this general permit exclusion on coverage, the Agency would like to emphasize the OAC 785:45–5–25 also prohibits the issuance of any NPDES discharge permit (other than for storm water runoff from temporary construction activity) for new point source discharges to ORWs or

Scenic Rivers, that commences after June 25, 1992.

Outstanding Resource Waters and Scenic Rivers are located in the following river basins identified in Oklahoma Water Quality Standards.

Basin 1—Middle Arkansas River: Barren Fork and certain listed tributaries; and the Upper Illinois River above Barren Fork confluence and certain listed tributaries.

Basin 2—Lower Arkansas River: Lee Creek and certain listed tributaries.

Basin 4—Lower Red River: Upper Mountain Fork River and certain listed tributaries.

For specific applicability, or a complete listing of affected waterbodies, permittees should refer to the Oklahoma Water Quality Standards, appendices A and B, or contact the Oklahoma Water Resources Board.

Oklahoma: Federal Indian Reservations only, no 401 conditions.

Texas: see the following and Part XII of the permit for 401 conditions.

As a condition for certification under section 401 of the CWA, the State of Texas required inclusion of the following conditions necessary to insure compliance with State water quality standards.

The following effluent limitations are required under the Texas Water Quality Standards (31 TAC 319.22 and 319.23). All pollution prevention plans developed pursuant to this permit must enable the discharger to comply with the limitations listed below.

All Discharges to Inland Waters

The maximum allowable concentrations of each of the hazardous metals, stated in terms of milligrams per liter (mg/l), for discharges to inland waters are as follows:

Total metal	Monthly average	Daily composite	Single grab
Arsenic	0.1	0.2	0.3
Barium	1.0	2.0	4.0
Cadmium	0.05	0.1	0.2
Chromium	0.5	1.0	5.0
Copper	0.5	1.0	2.0
Lead	0.5	1.0	1.5
Manganese	1.0	2.0	3.0
Mercury	0.005	0.005	0.01
Nickel	1.0	2.0	3.0
Selenium	0.05	0.1	0.2
Silver	0.05	0.1	0.2
Zinc	1.0	2.0	6.0

All Discharges to Tidal Waters

The maximum allowable concentrations of each of the hazardous metals, stated in terms of milligrams per liter (mg/l), for discharges to tidal waters are as follows:

Total metal	Monthly average	Daily composite	Single grab
Arsenic	0.1	0.2	0.3
Barium	1.0	2.0	4.0
Cadmium	0.1	0.2	0.3
Chromium	0.5	1.0	5.0
Copper	0.5	1.0	2.0
Lead	0.5	1.0	1.5
Manganese	1.0	2.0	3.0
Mercury	0.005	0.005	0.01
Nickel	1.0	2.0	3.0
Selenium	0.1	0.2	0.3
Silver	0.05	0.1	0.2
Zinc	1.0	2.0	6.0

The definitions of "inland" and "tidal" waters has been included in part XI.E of the Texas permit. Inland waters are those not defined as tidal waters. Tidal waters include those waters of the Gulf of Mexico within the jurisdiction of the State of Texas, bays and estuaries thereto, and those portions of the river systems which are subject to the ebb and flow of the tides, and to the intrusion of marine waters.

All facilities that have demonstrated significant lethality, which has not been controlled, shall continue to perform WET testing in accordance with the State specified requirements. The Texas Surface Water Quality Standards contain a whole effluent toxicity standard requiring discharges to exhibit greater than 50% survival of the appropriate test organisms in 100% effluent for a 24-hour period (i.e., 24-hr LC50 > 100%). As a condition for certification, the State required modification of the toxicity test protocol contained in the permit to conform to that specified to demonstrate compliance with the State standard. The results of the toxicity testing will be used to insure that facilities which have exhibited toxicity in the past will be required to continue monitoring for whole effluent toxicity and identify discharges that will require more stringent pollution prevention plans and/or individual or alternative general permit coverage.

Texas: Federal Indian Reservations only, no 401 conditions.

Region IX

Arizona: see the following and Part XII of the permit for 401 conditions.

Arizona: Federal facilities only, see the following and Part XII of the permit for 401 conditions.

In order to ensure compliance with the requirements of the State of Arizona, discharges authorized by this permit shall not cause or contribute to a violation of any applicable water quality standard of the State of Arizona (Arizona Administrative Code, Title 18, Chapter 11). Notices of Intent, Notices of Termination, and for those facilities subject to monitoring and reporting requirements, Discharge Monitoring Report Form(s) and other required monitoring information shall be submitted to the State of Arizona Department of Environmental Quality at the following address: Storm Water Coordinator, Arizona Department of Environmental Quality, 3033 N. Central Avenue, Phoenix, Arizona 85012.

NOIs submitted to the State of Arizona shall include the well registration number if storm water associated with industrial activity is discharged to a dry well or an injection well.

SARA Section 313 (Community Right to Know) Facilities are subject to the following additional requirement: liquid storage areas for Section 313 water priority chemicals shall be operated to minimize discharges of Section 313 chemicals. Appropriate measures to minimize discharges of Section 313 chemicals shall include secondary containment provided for at least the entire contents of the largest tank plus sufficient freeboard to allow for the *25-year, 24-hour precipitation event*, a strong spill contingency and integrity testing plan, and/or other equivalent measures.

All facilities with any portion of the facility that is located at or below the Base Elevation shall delineate on the site map those portions of the facility that are located at or below the Base Elevation.

The following definitions are added to Part X of the permit:

"Significant Sources of Non-Storm Water"—includes, but is not limited to discharges which could cause or contribute to violations of water quality standards of the State of Arizona, and discharges which could include releases of oil or hazardous substances in excess of reportable quantities under Section 311 of the Clean Water Act (see 40 CFR 110.10 and CFR 117.21) or Section 102 of CERCLA (see CFR 302.4).

"Base Elevation"—elevation of a surface waterbody having a one percent chance of being equaled or exceeded during any given year.

Arizona: Federal Indian Reservations only (including those portions of the Navajo Reservation located outside Arizona), no 401 conditions.

California: Federal Indian Reservations only, no 401 conditions.

Nevada: Federal Indian Reservations only (including those portions of the Duck Valley, Fort McDermitt, and Goshute Reservations located outside Nevada), no 401 conditions.

Johnston Atoll: no 401 conditions.

Johnston Atoll: Federal facilities only, no 401 conditions.

Midway and Wake Island: no 401 conditions.

Midway and Wake Island: Federal facilities only, no 401 conditions.

Region X

Alaska: Federal Indian Reservations only, no 401 conditions.

Idaho: no 401 conditions.

Idaho: Federal Indian Reservations only (except the Duck Valley Reservation lands which are handled by Region IX), no 401 conditions.

Idaho: Federal facilities only, no 401 conditions.

Oregon: Federal Indian Reservations only, no 401 conditions.

Washington: Federal Indian Reservations only, no 401 conditions.

Washington: Federal facilities only, see the following and Part XII of the permit for 401 conditions.

In order to ensure compliance with the requirements of the State of Washington, discharges authorized by this permit shall not cause or contribute to a violation of any applicable water quality standard of the State of Washington, specifically Chapter 173-201A WAC Surface Water Quality Standards, Chapter 173-204 WAC Sediment Standards, and the National Toxics Rule for human health related to water quality standards.

XI. Regulatory Flexibility Act

Under the Regulatory Flexibility Act, 5 U.S.C. 601 et seq., EPA is required to prepare a Regulatory Flexibility Analysis to assess the impact of rules on small entities. Under 5 U.S.C. 605(b), no Regulatory Flexibility Analysis is required where the head of the Agency certifies that the rule will not have a significant economic impact on a substantial number of small entities.

Today's permit will provide any small entity the opportunity to obtain storm water permit coverage as a result of the group application process. Group applications provided small entities a mechanism to reduce their permit application burden by grouping together with other industrial facilities and submitting a common permit application with reduced monitoring requirements and shared costs. The group application information submitted to EPA provided a basis for the development of storm water permit conditions tailored specifically for each industry. The permit requirements have been designed to minimize significant administrative and economic impacts on small entities and should not have a significant impact on industry in general. Moreover, the permit reduces a significant burden on regulated sources of applying for individual permits.

Accordingly, I hereby certify pursuant to 5 U.S.C. 605(b) that this permit will not have a significant impact on a substantial number of small entities.

Authority: Clean Water Act, 33 U.S.C. 1251 *et seq.*

XII. Unfunded Mandates Reform Act

Under section 202 of the Unfunded Mandates Reform Act of 1995 ("Unfunded Mandates Act"), which was signed into law on March 22, 1995, EPA must prepare a written statement to accompany any rules with Federal mandates that may result in estimated costs to State, local, or tribal governments in the aggregate, or to the private sector, of $100 million or more in any one year. When such a statement is required for EPA rules, under section 205 of the Unfunded Mandates Act, EPA must identify and consider alternatives, including the least costly, most cost-effective or least burdensome alternative that achieves the objective of such a rule. EPA must select that alternative, unless the Administrator explains in the final rule why it was not selected or it is inconsistent with law. Before EPA establishes regulatory requirements that significantly or uniquely affect small governments, including tribal governments, it must develop under section 203 of the Unfunded Mandates Act a small government agency plan. The plan must provide for meaningful and timely input in the development of EPA regulatory proposals with significant Federal intergovernmental mandates, and informing, educating, and advising them on compliance with the regulatory requirements.

In response to the requirements of the Unfunded Mandates Act, the Act generally excludes from the definition of a "Federal intergovernmental mandate" (in sections 202, 203, and 205) duties that arise from participation in a voluntary Federal program. A municipal discharger of storm water associated with industrial activity may voluntarily elect to seek coverage under today's multi-sector general permit rather than obtain an individual permit or coverage under a baseline general permit. Coverage under today's permit, therefore, is voluntary in that the permit does not automatically apply to any particular entity. Thus, it imposes no Federal intergovernmental mandate within the meaning of the Act.

Small government agency plans under section 203, on the other hand, are required when small governments may be significantly or uniquely affected by regulatory requirements. "Regulatory requirements" arguably include the requirements of this permit should a municipality seek to be covered under the permit. EPA envisions that some municipalities may elect to seek coverage under this permit for certain storm water discharges, for example, from the following types of industrial activity: hazardous waste treatment, storage, and disposal; industrial landfills, land application sites and open dumps; scrap and waste material recycling; steam electric power generation; ground transportation (local and suburban transit, interurban highway passenger transportation, including railroads, petroleum bulk stations, and motor freight transportation); air transportation; domestic waste water treatment; and water transportation. Any such permit requirements, however, do not significantly affect small governments because they are subject to the same requirements as other entities whose duties result from today's rule. Permit requirements also do not uniquely affect small governments because compliance with the permit's conditions affects small governments in the same manner as other entities seeking coverage under the permit. Thus, any applicable requirements of section 203 have been satisfied.

The regulated community that may seek coverage under this general permit, including small governments, have been involved in the development of this permit and, therefore, have had notice of the requirements that they may incur under this permit. EPA has prepared permit Fact Sheets to accompanying this permit in order to inform and educate permit applicants about how to comply with the terms of the permit. EPA has already published instructional guidance: Developing Pollution Prevention Plans for Construction and (other) Industrial Activity (1992), NPDES Storm Water Sampling Guidance Document, 833/B–92–001 (July 1992), and Guidance for the Preparation of Discharge Monitoring Reports: Facilities required to Report Semi-annual Monitoring Results Under NPDES Storm Water General Permits, 833/B–93–002 (rev. April 1994). Therefore, EPA encourages any small governments that may seek coverage under this multi-sector general permit to refer to that instructional guidance, as well as contact EPA Regional storm water coordinators listed in the Permit Fact Sheet for any additional assistance such small governments may require.

Accordingly, I hereby certify pursuant to the provisions of the Regulatory Flexibility Act, that these permits will not have a significant impact on a substantial number of small entities.

Authority: Clean Water Act, 33 USC 1251 *et seq.*

Dated: August 29, 1995.

Marley Laing,

Acting Regional Administrator, Region I.

Accordingly, I hereby certify pursuant to the provisions of the Regulatory Flexibility Act, that these permits will not have a significant impact on a substantial number of small entities.

Authority: Clean Water Act, 33 USC 1251 *et seq.*

Dated: August 16, 1995.

Jeanne M. Fox,

Regional Administrator, Region II.

Accordingly, I hereby certify pursuant to the provisions of the Regulatory Flexibility Act, that these permits will not have a significant impact on a substantial number of small entities.

Authority: Clean Water Act, 33 USC 1251 *et seq.*

Dated: September 11, 1995.

Stanley L. Laskowski,

Acting Regional Administrator, Region III.

Accordingly, I hereby certify pursuant to the provisions of the Regulatory Flexibility Act, that these permits will not have a significant impact on a substantial number of small entities.

Authority: Clean Water Act, 33 USC 1251 *et seq.*

Dated: September 11, 1995.

Patrick M. Tobin,

Acting Regional Administrator, Region IV.

Accordingly, I hereby certify pursuant to the provisions of the Regulatory Flexibility Act, that these permits will not have a significant impact on a substantial number of small entities.

Authority: Clean Water Act, 33 USC 1251 *et seq.*

Dated: September 12, 1995.

William G. Laxton,

Acting Regional Administrator, Region VI.

Accordingly, I hereby certify pursuant to the provisions of the Regulatory Flexibility Act, that these permits will not have a significant impact on a substantial number of small entities.

Authority: Clean Water Act, 33 USC 1251 *et seq.*

Dated: August 24, 1995.

Alexis Strauss,

Acting Regional Administrator, Region 9.

Accordingly, I hereby certify pursuant to 5 U.S.C. 605(b) that this permit will not have a significant impact on a substantial number of small entities.

Dated: September 11, 1995.

Chuck Clarke,

Regional Administrator, Region 10.

Appendix A—Summary of Responses to Public Comments on the November 19, 1993, Proposed Draft Multi-Sector Storm Water General Permit

The following discussion is a summary of the major issues identified by EPA that were raised regarding the storm water multi-sector industrial general permit during the public comment period, along with EPA's response to each major issue. This summary aggregates comments by similarity of the issues and does not discuss each and every public comment that was received on the proposed permit. A comprehensive discussion of each comment that was raised is provided in a separate detailed response to comment document which is maintained by EPA as a part of the record for this permit issuance action. The first part of this appendix responds to the major issues raised by commenters during the comment period and the second part responds to key industry-specific issues.

Eligibility of Non-Group Members

As proposed, the multi-sector storm water general permit may provide discharge authorization for any industrial activity described in the coverage sections of the twenty-nine industrial sectors that have point source discharges of storm water to waters of the United States or to a municipal separate storm sewer system and which meet the general eligibility provisions of the permit. Coverage under the permit, as proposed, was allowed for owners and operators of these types of industrial activities regardless of whether or not they participated in a group application. Several commenters expressed concern that owners/operators of facilities which did not participate in the group application process will be eligible for coverage under the multi-sector general permit, and suggested that only those facilities that participated in the group process be allowed coverage under the permit.

EPA set forth the storm water permit application process (including group applications) in the storm water regulations published in November, 1990 (55 FR 47990). EPA's strategy, as stated in this notice, was to regulate storm water discharges from industrial activity by promulgating a baseline general permit for most industrial dischargers (Tier 1), and then to develop more specific industry and/or watershed general permits (Tiers 2 & 3). An integral part of the process to develop the multi-sector storm water general permit, which is similar to a Tier 3 permit (industry-specific), was the assimilation of the industry-specific data gathered from the group applications. It was always EPA's intention to utilize this information in the development of permits to cover all applicable facilities, and to provide the resulting permit as a model to States for use in State permitting programs. In the preamble to these regulations on pages 48027 and 48028, EPA made it clear that the group application process would lead to either general permits for large groups of similar discharges or to individual permits for individual facilities. EPA did not commit to issue permits that were open only to group members. The concept of the general permit implies wide-ranging issuance to all eligible facilities.

Given the large number of group applications and the similarity between groups, EPA chose to develop and propose one general permit with twenty-nine different industry sectors covering all the industries represented in the group applications, rather than issue twenty-nine separate sector general permits, one by one, to each and every group. Likewise, EPA chose not to issue a separate and distinct "group" permit to each and every group because of the similarity between groups, in the industrial activities, significant materials stored exposed to storm water and the material management practices employed, as reported in the group application information. Given the similarity of the industrial activities represented in the group applications, twenty-nine sectors represented were determined by EPA as a reasonable grouping of the industries that participated in the group process. EPA further believes that the use of the twenty-nine sectors provides a fair and reasonable method for permitting each industry group that participated in the group application process.

To make the best use of the proposed multi-sector general permit, EPA chose not to limit coverage under this general permit to those facilities that only participated in the group process. The application information provided by the groups was extremely valuable in preparing the permit and has resulted in an accurate and more applicable industrial permit for the types of facilities represented in the applications. EPA is not precluded or restricted from utilizing information gathered from particular types of applications submitted to the Agency during the application process, and accordingly, coverage under today's general permit will remain available to all industrial facilities that meet the eligibility criteria of the permit, whether or not they participated in a group application.

Choice Between Baseline and Multi-Sector Permit

In the fact sheet for the proposed multi-sector general permit, EPA stated that group applicants could seek coverage under the baseline general permit rather than under this multi-sector general permit, but noted that certain deadlines for pollution prevention plan preparation and implementation had already expired for existing facilities under the baseline permit. Commenters supported the option that group applicants be allowed to chose coverage under either the multi-sector general permit or the baseline general permit once the multi-sector permit is issued in final. In addition, commenters requested that group applicants choosing to obtain coverage under the baseline general permit not be required to prepare a pollution prevention plan prior to submitting an NOI. These comments raise two issues: (1) Should group applicants be allowed to apply for coverage under the baseline general permit after the permit's October 1, 1992 deadline for existing facilities to apply for coverage; and (2) should the deadlines in the baseline general permit for pollution prevention plan preparation and implementation, sampling, etc. be waived for facilities filing for coverage after the October 1, 1992 deadline.

EPA will allow group applicants to submit an NOI for coverage under either today's multi-sector general permit or the baseline general permit. Although Part II.A.6 of the baseline general permit currently allows existing facilities to submit an NOI for coverage after October 1, 1992, the Agency reserves the right to limit coverage under the baseline general permit at a later date.

EPA will not, however, extend compliance deadlines in the baseline general permit for facilities that participated in the group application process. Group applicants had the opportunity to apply for the baseline general permit in a timely manner. It would be inappropriate for EPA to favor group applicants over facilities that complied with the baseline general permit by allowing them more time to come into compliance. Additionally, extending the baseline permit deadlines would require a modification of the baseline general permit, which is beyond the scope of today's final rule.

Consolidation of the Group Applications Into 29 Industry Sectors

Over 1,200 group applications were submitted to EPA pursuant to the group application option contained in 40 CFR 122.26(c)(2). As the group application option progressed, many of the groups dropped out leaving approximately 700 groups. Based on the similarity of many of the groups, and to maintain a manageable number of permits to be issued, EPA consolidated the approximately 700 groups into 29 industrial sectors, and developed BMP and monitoring requirements for each sector.

EPA received 50 comments regarding the consolidation of group applications. Thirty-eight comments objected to consolidation, while 12 comments expressed support. Another 38 comments suggested that the 29 industrial sectors should be divided into additional subsectors. Some commenters that objected to consolidation suggested that the use of SIC codes as one of the underpinnings for consolidation was inappropriate because SIC codes are based on economic activity, and are not meant to be indicative of an industry sector's affect on the quality of storm water runoff. Some commenters suggested that the consolidation process failed to take into account the climatic variations of different geographic regions across the country. Other commenters objected to the consolidation process on the basis that it represented a significant departure from the group application process as described in the preamble to the storm water permit application regulations published on November 16, 1990 (55 FR 48024). Some comments expressed disappointment that the group applications were not handled in a more "individualized" manner, and one comment suggested that the group application consolidation process violated the Administrative Procedure Act (APA).

Many of the commenters that expressed objections to the consolidation of the group applications offered alternative suggestions. Most recommended that additional sectors or subsectors be established, and it was also suggested that the general permit include a provision allowing industries the option of petitioning for the creation of subsectors during the term of the permit. Other suggestions included establishing minimum activity requirements that trigger monitoring requirements, or deleting the priority/nonpriority monitoring structure altogether.

For the final general permit, EPA has retained the 29 industrial sectors as listed in the proposed rule, with the addition of supplementary subsectors that establish specific monitoring requirements for different types of facilities within industrial sectors. In response to comments expressing concern over monitoring requirements that apply to all facilities within the priority sectors, the Agency re-evaluated the monitoring data submitted by facilities in the 29 industrial sectors, and modified the methodology for determining the types of facilities that are required to conduct storm water monitoring. Accordingly, the final general permit has been changed to focus monitoring requirements on industrial sub-sectors which, according to the submitted monitoring data, pose the greatest potential risk to storm water runoff quality. The final permit also provides the opportunity for facilities in sub-sectors that are subject to storm water monitoring to apply the alternative certification provisions (see section VI.E.3 of the Fact Sheet). The alternative certification provisions provide facilities an opportunity to reduce or avoid storm water monitoring requirements under certain circumstances and is discussed in more detail below.

As noted above, some commenters questioned whether the consolidation process was consistent with NPDES and APA regulations. EPA conducted a thorough review of the consolidation process for consistency with the NPDES regulations. Section 122.28(a)(2)(i) allows EPA to issue general permits for "storm water point sources;" this section does not in any way limit or qualify the types of sources subject to regulation. EPA also has broad regulatory discretion regarding geographic boundaries pursuant to section 122.28(a)(1). In developing the general permit, the Agency attempted to strike a balance between recognizing the variety of facilities that comprise the group applicants and developing a permitting process that could be administered without an undue expenditure of Agency resources. In summary, all actions taken by EPA, including the consolidation process, are also within the discretion accorded to the Agency under the Clean Water Act and NPDES regulations.

In regards to consistency with the APA, Section 553 of the APA requires that public notice and opportunity for public comment be provided for all rulemakings. EPA published the proposed NPDES General Permit for Storm Water Discharges From Industrial Activities in the **Federal Register** and provided a 90-day comment period on November 19, 1993 (58 FR 61146). Public hearings were also held in the EPA Regions. Furthermore, EPA invited comment on the 29 sector consolidation. These efforts by the Agency are consistent with the provisions of the APA.

As noted earlier, some commenters suggested that the use of SIC codes were inappropriate as a basis for consolidating industrial facilities into 29 industrial sectors. EPA notes that the nature of the industrial activities, as described in the group application information, in conjunction with SIC codes are an appropriate basis for sector consolidation. Although SIC codes are used to categorize industries based on economic activities, these codes are generally grouped together based on similar industrial activities. In addition, EPA was aware of the differences and similarities among the facilities included in a particular sector based upon the group application data that was submitted by the participants. Using this information in conjunction with the activity descriptors in the SIC codes, EPA was able to appropriately group similar industrial activities into the 29 sectors.

Credit for Group Members

EPA requested and received 75 comments that addressed the issue of whether EPA should grant some form of credit for facilities that participated in the group application process. Specifically, these commenters objected to EPA developing a permit that applies not only to group applicants but also to facilities that did not participate in the group application process. Thus, many of these commenters are seeking credit for the costs they incurred in the preparation of group permit applications.

A majority of the commenters expressed a desire for reduced monitoring as compensation for completing the sampling requirements and submitting the data for Part 1 and Part 2 of the application process. Specific suggestions included exemptions from one of the four samples taken during the first year, from the second year of monitoring, or from the first five years of monitoring. Other commenters suggested that EPA allow the monitoring requirements to be left to the discretion of the States and that civil fines be waived for inadvertent non-compliance of group members. In response to these comments, EPA wants to clarify that it is not allowing exemptions from monitoring requirements based on whether a facility participated in the group application process. EPA based the monitoring requirements in the permit on data submitted during the application process and does not intend to allow those facilities to conduct less frequent monitoring because of their participation in the group application process. Rather, facilities that participated in the group application process are actually in a position to benefit from the permit in the sense that this permit is tailored directly to their industrial sector and is based specifically on information provided in their group application. Facilities that did not participate in group applications will be required to comply with the permit conditions regardless of their site-specific circumstances.

Many commenters also expressed concern that the multi-sector permit would be available to non-group members. Although EPA regrets that the group application process did not produce the results that some participants hoped for, it would be a misuse of tax dollars to limit coverage under the multi-sector permit to group members and then develop another permit for non-group members. However, EPA would like to point out that facilities that participated in the group application process are in compliance with the permit application requirements under the storm water program, whereas facilities that did not participate in a group application and that are not covered under another permit are not in compliance and remain subject to enforcement action until covered by a permit.

Several other commenters suggested providing compensation for group members by waiving permit fees equal to the amount spent on data collection fees. In response, EPA is unable to devise an equitable manner for credit to be provided in this way.

Finally, some commenters advocated that group members be either exempted from the NOI submittal requirement or allowed to at least submit one NOI for the group. Other commenters suggested that the dates for submitting NOIs be extended for group members and that previously submitted NOIs be accepted. In today's general permit requirements, EPA requires each facility seeking coverage under the permit to submit their own NOI form. This requirement allows EPA to successfully track every facility covered by the permit. It will also increase the likelihood that facility operators will read the permit and makes enforcement actions easier to implement. EPA believes this is a justifiable requirement because the NOI form is a simple one-page form that requires little effort to complete.

In summary, EPA believes that credit has been provided to the group application members through the group application process. This included a reduced burden in submitting a permit application over the individual application option and reduced storm water sampling requirements for the application. With industry-specific information upon which to base the proposed multi-sector storm water permit, group applicants will be issued a more applicable and tailored storm water discharge permit which better takes into account the characteristics of each industry sector.

Storm Water Runon

The owner or operator of a regulated industrial facility with point source discharges of storm water is responsible for the storm water discharges that leave its property and enter waters of the U.S. or a municipal separate storm sewer system. There are instances, however, whereby the storm water that is discharged at least partially consists of storm water flowing onto the facility from a nearby facility or property (referred to here as "runon").

Commenters have requested clarification of the permit language on the issue of runon. One commenter asked for a provision to be added to the permit that would relieve facilities from any responsibility for pollutants present in storm water runon which is eventually discharged from their property. The commenter also indicated that runon from adjacent sites cannot always be separated from onsite discharges.

Today's general permit does not change the provisions related to runon. Facilities that discharge point sources of storm water associated with industrial activity, even if it includes offsite runon, remain responsible for the permitting of those discharges. Such facilities which seek coverage under today's permit must address storm water runon in their storm water pollution prevention plan (storm water pollution prevention plan). If a facility cannot effectively address the runon problem in their storm water pollution prevention plan, then the facility should contact their NPDES permitting authority for assistance on how to deal with the runon problem. In addition, the facility may chose to monitor the runon to document that the source of pollutants is offsite. By doing so, a facility with a runon problem may be better able to show that the pollutant source is offsite and that their pollution prevention plan is adequately addressing all onsite sources. Offsite facilities which are the source of the contaminated runon could be designated by the permitting authority as a co-permittee with the adjacent facility and jointly develop a storm water pollution prevention plan, and perform any monitoring which may be required to address the situation. They may also be designated as a separate permittee by the permitting authority.

Acceptance of Group Application in Lieu of an NOI

A number of commenters suggest EPA exempt members of approved group applications from the Notice of Intent (NOI) submittal requirements. The commenters indicate these facilities should automatically be covered under today's permit because they have already satisfied the NPDES storm water application requirements.

EPA cannot exempt members of the approved group application from the NOI submittal requirements. Federal regulations under 40 CFR 122.28(b)(2) require an NOI for all NPDES general permits for the discharge of storm water associated with industrial activity. EPA cannot assume that all members of the approved group applications wish to be covered by today's permit, or that they satisfy the eligibility provisions of the permit.

Encourage NPDES States To Accept Group Applications

Several commenters requested that EPA require or encourage NPDES-authorized States to accept the group applications and/or issue permits based on the multi-sector model.

EPA has, and continues, to encourage States to make use of the multi-sector general permit for permitting industrial activities. EPA has encouraged States by sending them the original permit and fact sheet and by supporting them with additional information necessary to issue the permit within their States. EPA has also given NPDES States databases of the group application members which allows each State to identify group applicants within their States. EPA will make available to all NPDES authorized States a copy of the final multi-sector general permit. In addition, EPA will make available group application information to any NPDES States that request it. However, EPA cannot require NPDES-authorized States to accept group applications and to utilize the multi-sector permit as a model for developing a State permit. This would be inconsistent with previously stated EPA position. The response to comments for the final storm water regulations (55 CFR 48028) specifically noted that NPDES-authorized States were free to adopt the group application process, "* * * but is not required to." EPA also recommended that "(b)efore submitting a group application, facilities should ascertain from the State permitting authority whether that State intends to issue permits based on a group application * * *." The Agency believes general permits offer an efficient means of providing discharge permit coverage to a large number of facilities and that the multi-sector general permit represents an appropriate permit for the industries that were members of group applications. However, once the NPDES program is approved for a State, basic permitting decisions lie with the State.

Co-Located Industrial Activities

A number of commenters expressed concern over the conditions in the permit which require facilities with multiple "co-located" industrial activities to comply with all industry sector requirements that are applicable to one or more of the industrial activities on their site. Commenters argue that given the large number of industry sectors and the complexity of the eligibility requirements, it will be difficult for facilities to determine which industry sector requirements apply. Commenters expressed concern that a permittee could unknowingly violate the permit conditions by failing to recognize that a portion of his/her facility is subject to another industry sector requirements. Commenters also stated that the cumulative burden of the monitoring and pollution prevention plan requirements for facilities with a number of industrial activities would be excessive.

In response to these concerns, EPA has modified those sections of today's permit addressing co-located activities to reduce confusion that could arise from the co-located conditions as proposed. However, under today's permit facilities with multiple industrial activities are still required to prepare and implement a pollution prevention plan which addresses the requirements of all the applicable industry sector requirements. These facilities are also required to comply with the industry sector monitoring requirements on an outfall by outfall basis. The intent of today's permit remains the same, which was to require pollution prevention plan measures and storm water monitoring which specifically addresses the pollutant sources at the permitted industry facility. Operators of facilities with multiple industrial activities will need to carefully and completely review the permit and fact sheet to determine all necessary applicable terms and conditions. EPA believes the sector descriptions are clear. Application of the sector descriptions to co-located activities is within the scope of responsibilities of a permittee under the NPDES program and does not place an undue burden on the facility operator. For clarification, with co-located industrial activities, still only one storm water pollution prevention plan is required for the facility. Monitoring requirements for each outfall will not be duplicative but will be complementary. If the same pollutant is required to be monitored in two different sectors for industrial activities found on the site, if the industrial activities drain to the same storm water outfall, only one sample and analytical measurement for that pollutant is necessary.

Notice of Intent Submission Requirements

A number of commenters expressed concern over the requirement in the proposed permit for submission of a Notice of Intent (NOI) when there is a change in the operator of the facility. The proposed permit required the new operator to submit an NOI 2 days prior to the transfer of operations. The commenters opposed this time frame for submittal of the NOI, stating that the purchaser of an industrial activity will not be able to complete the NOI or prepare a Storm Water Pollution Prevention Plan in advance of the property transfer. The commenters suggested different time frames for submittal of an NOI which ranged from 30 to 120 days after the transfer of operations.

Today's permit retains the requirement that new operators notify EPA at least 2 days in advance of a transfer of operator responsibility for an industrial activity. EPA believes that the simple information required for completion of the NOI can easily be obtained by the purchaser in advance of the actual property transfer. Operators of recently purchased facilities which discharge storm water associated with industrial activity without an NPDES permit would be in violation of the Clean Water Act.

In addition to submitting the NOI two days prior, new operators which assume ownership of an industrial facility without a break in operations must continue to implement the Storm Water Pollution Prevention Plan prepared by the previous operator, otherwise failure to do so would constitute a violation of the NPDES storm water general permit conditions. These facilities may subsequently modify the storm water pollution prevention plan to accommodate any changes in operation which they choose to make, provided the storm water pollution prevention plan still meets all requirements of the permit.

Submission of a Copy of the Notice of Intent (NOI) to the Operator of the Municipal Separate Storm Sewer

Several commenters opposed the requirement for facilities which discharge to Municipal Separate Storm Sewers (MS4) to submit a copy of the NOI to the operator of the MS4. The commenters argue that submitting the notice places an additional paperwork burden upon the facilities. Others argue that the submission is unnecessary because all industrial activities discharging to MS4's were required to notify their municipalities prior to May 15, 1991. Finally one commenter stated that there would be no benefit from facilities covered under this permit notifying municipalities since facilities covered under other general permits or individual permits would not be required to notify the MS4 operator.

Today's permit retains the requirement for facilities which discharge to a MS4 to send a copy of the NOI to the operator of the MS4. This requirement is retained as a provision to assist municipalities comply with the anticipated requirements of their NPDES permits. This will be a key piece of information for municipalities to identify industrial discharges to their MS4s as required under 40 CFR 122.26. Through submittal of the NOI to the MS4, municipalities can keep an up-to-date inventory of storm water discharges associated with industrial activity that discharge to the system. From this inventory, municipalities may (as a part of their storm water management plan activities) review industrial pollution prevention plans of the industries which discharge to their system. EPA does not believe this requirement presents a significant paperwork burden for the facility since the facility is simply required to make an additional copy of the one page NOI form, which they send to EPA, and send that copy to the operator of the MS4. This requirement is a provision of EPA's baseline general permit and is also a requirement of most individual permits issued to industrial dischargers where the permitting authority determines it is necessary. Making use of information from a previous notification done in 1991 would not allow the municipality to keep their industrial inventory up-to-date.

Prohibition of Non-Storm Water Discharges

A number of the comments received discussed the prohibition of non-storm water discharges contained in the permit. The multi-sector permit authorizes some non-storm water discharges. These discharges include those from firefighting activities; firehydrant flushings; irrigation drainage; lawn watering; routine external building washdown without detergents; pavement washwaters where spills or leaks of toxic or hazardous materials have not occurred (unless all spilled material has been removed) and where detergents are not used; air conditioning condensate; springs; uncontaminated ground water; and foundation or footing drains where flows are not contaminated with process materials such as solvents that are combined with storm water discharges associated with industrial activity. The non-storm water discharges must be identified within the storm water pollution prevention plan to be authorized under this permit. All other non-storm water discharges including vehicle and equipment wash water, boiler blow down, and steam condensate are excluded from coverage under today's permit and must be covered under a separate NPDES permit. Today's permit requires that a facility certify that the presence of non-storm water discharges has been tested for at its outfalls and that an inventory of the locations of the outfalls with non-storm water discharges has been conducted.

EPA received several comments requesting that additional non-storm water discharges be authorized by the multi-sector permit. These discharges included those from vehicle washing that did not use detergents, air compressor condensate, discharges from drinking fountains and clean water discharges from holding tanks. EPA has reviewed the requests for additional allowable non-storm water discharges and determined that air compressor condensate and drinking fountain water are not expected to contain pollutants and will be added to the list of allowable non-storm water discharges covered by today's permit. Other non-storm water discharges such as vehicle wash waters, regardless of detergent usage, and holding tank discharges are not covered by today's permit since there is a significant potential for these types of discharges to be contaminated. Such non-storm water discharges should be authorized under another NPDES permit.

Several commenters also requested modification to the requirement that building and pavement wash water discharge only be allowed under the permit where there has been no past spill or leaks or where all spilled material has been removed. The commenters indicated that it was not reasonable to require all residue to be removed. Commenters requested a more reasonable cleanup standard. EPA has not modified this provision in today's permit. The non-storm water discharges covered by today's permit are eligible because EPA believes these discharges will not contain contamination. To the contrary, there is a significant possibility that pavement or building wash water from an area in which a pollutant residue remains will contain pollutants which would then be discharged. Such discharges, if they are not completely cleaned up, are required to be permitted, but under a separate NPDES permit. If such discharges are numerous at a facility, the operator of the facility may find it advantageous to apply for an individual NPDES permit which could cover these types of discharges in addition to the storm water and process discharges that may be present. Under any permitting scenario, however, the preferential environmental result is to remove the residual contamination and prevent the contamination of storm water runoff.

Releases in Excess of Reportable Quantities

Under the proposed permit permittees were required to report releases of hazardous substances as required under 40 CFR 117 and 40 CFR 302 that exceed a reportable quantity (RQ). If the spill exceeds the RQ the facility must report the spill to the National Response Center, modify the storm water pollution prevention plan, and notify EPA in writing of the nature of the spill. The permit further required facilities to minimize the discharges of these substances in storm water through the implementation of applicable best management practices. When releases do occur, the facilities are required to submit a written report which outlines the steps to be taken to reduce the chance of further spills in the future. Commenters were concerned about how to interpret the reporting requirements for RQ releases. For instance, at an airport, if individual airlines release ethylene glycol at levels below the RQ, then is the combined discharge from several airlines considered reportable? Commenters also wanted clarification on what constituted a significant spill or leak. Is the spillage of two cups of oil significant if it causes a visible sheen?

Today's permit requires each individual permittee to report spills equal to or exceeding the RQ levels specified at 40 CFR 110, 117, and 302. If an airport authority is the sole permittee, then the sum total of all spills at the airport would be assessed against the RQ. If the airport authority is a co-permittee with other permittees at the airport, such as numerous different airlines, the assessed amount would be the summation of all spills by each co-permittee. If separate, distinct individual permittees exist at the airport, then the amount spilled by each separate permittee is the assessed amount for RQ determination. These facilities must follow the necessary procedures for reporting spills or leaks equal to or exceeding the RQ level. Where a sole permittee is identified, this permittee would report. Where co-permittees are present, the co-permittees should identify in their pollution prevention plan for the airport who the responsible party is for reporting purposes, otherwise all co-permittees are responsible. In relation to the RQ for oil, quantity does not necessarily matter. The oil RQ is a visible sheen or slick and if such is produced by a spill of oil then the RQ has been exceeded.

Non-Storm Water Discharge Certification

Many commenters felt that the storm water pollution prevention plans should not include an inventory of non-storm water discharges or the NPDES permit numbers that cover those discharges. Today's permit does not require the permittee to list the NPDES permit numbers for the separately permitted non-storm water discharges, however, the permit does require that facilities identify the potential sources of the non-storm water discharges. The list of potential sources will assist the operator in efforts to eliminate or redirect non-storm water discharges.

Deadlines for Preparation, Implementation and Revisions to the Storm Water Pollution Prevention Plan

The proposed multi-sector permit currently requires that all facilities certify that they have prepared and implemented a storm water pollution prevention plan in accordance with part IV of the permit. For existing facilities, the storm water pollution prevention plan must be prepared and implemented within 270 days after permit issuance. New facilities must have prepared and implemented the storm water pollution prevention plan prior to submitting the NOI. Where construction is necessary to implement the plan, the facility should complete construction as soon as possible, but has up to a maximum of 3 years to comply with the plan. There is also a provision for an extension of the deadline for implementation of the storm water pollution prevention plan where the Director may establish a later date for compliance with the plan where a facility can show good cause.

Oil and gas facilities which have discharges of reportable quantities of oil or a hazardous substance will be required to develop and implement a plan on or before 60 days after first knowledge of a release. EPA requested comment as to whether the multi-sector permit should require all permittees to submit certification that the storm water pollution prevention plan has been prepared and implemented in accordance with the terms and conditions of the permit. The proposed permit also would have required any needed revisions of the plan to be developed within 2 weeks of the Comprehensive Site Compliance Evaluation and implemented no more than 12 weeks after the inspection.

In general, commenters indicated that they needed more time to develop and implement the storm water pollution prevention plan properly because of the complexity and resources involved. These commenters were commenting on both new and existing facility requirements. Five commenters did not like the deadlines for development and implementation of a storm water pollution prevention plan in the multi-sector permit because these deadlines were inconsistent with EPA's baseline storm water general permit. They argued that the multi-sector permit should allow the same time frame of 6 months from the effective date of the permit to develop the plan with 360 days for implementation. Four commenters argued that new facilities should not have to certify that their storm water pollution prevention plan is complete at the time of NOI submittal. They felt that new facilities should be afforded the same compliance deadline as the existing facilities which are given 270 days. One commenter suggested that a more reasonable cut-off time be established for new facilities when the storm water pollution prevention plan would be required to be developed and implemented prior to the NOI. Another commenter argued that new facilities should be given 6 months after submittal of the NOI to develop and implement the plan to allow for the evaluation of plan needs while the facility is in operation. One commenter felt that a minimum of 90 days would be needed for smaller facilities for internal development and training under the storm water pollution prevention plan. Another commenter argued that in order to develop an appropriate and effective storm water pollution prevention plan it is necessary to evaluate the facility while in operation. This commenter therefore suggested that new facilities be allowed six months to develop a storm water pollution prevention plan. One commenter stated that large waste water treatment plants need more than 270 days just to prepare the storm water pollution prevention plan and to get additional funding for the non-storm water discharge certification provisions. In addition, some commenters did not agree that the plan should be implemented within the same time frame as it is developed. They suggested a year for implementation. Another commenter would prefer a deadline of 14 months to develop and implement a storm water pollution prevention plan, arguing that companies that have many facilities, such as the freight industry, may be required to develop and implement upwards of 500 plans in the 270 days. Scrap processing and recycling facilities want longer than the 270 days (such as three years) for the implementation of treatment BMPs exceeding $10,000 in cost, otherwise they argued that financial hardships would result. One commenter argued that facilities originally part of the group application process, who will now be submitting an NOI to be covered under the baseline general permit, should be given the same 180 to 270 days to develop and implement the storm water pollution prevention plan as those who will submit NOI's for coverage under the multi-sector permit.

A few commenters commented upon the 3-year time frame to implement BMPs requiring construction. One commenter suggested 5 years to construct storm water control measures with 50% construction at 2 years, 75% at 3 years and 100% at 5 years. One commenter also commented that 3 years was not enough time to construct controls under the storm water pollution prevention plan for federal facilities. At federal facilities funding for construction is awarded in a 5-year process. Two organizations commented on the time frames for modifications to the storm water pollution prevention plan after the site compliance evaluation. They argue that 12 weeks for implementation of necessary changes is not practical because they may require engineering design and construction. One commenter suggested that a period of 1 year be allowed for changes requiring facility modification.

EPA does not agree with the numerous comments on the deadlines for development and implementation of a pollution prevention plan, and has decided to maintain the deadlines as proposed in the multi-sector permit for the development, implementation, and modification of the storm water pollution prevention plan. EPA believes that 9 months is adequate time for facilities to develop and implement storm water BMPs that do not require construction and for those that do, up to 3 years is sufficient. EPA has issued guidance on developing storm water pollution prevention plans for industrial activities, and this guidance is readily available. In addition, the multi-sector permit fact sheet provides an extensive amount of information on the types of industry-specific BMPs that can be implemented by facilities in each of the 29 sectors. Those facilities that cannot meet those deadlines may apply, on a case-by-case basis for an extension of the timeframes as specified in the permit.

Most new facilities should have no problem developing and implementing their storm water pollution prevention plans prior to the submittal of their NOI and the start of operations. Subsequent site compliance evaluations may show that modifications are needed based on operations at the new facility, however, they will have the additional 12 weeks after the inspection to implement the needed changes.

Certification of the Storm Water Pollution Prevention Plan

The proposed multi-sector permit requests comment on requiring all permittees to submit a certification to EPA upon completion and implementation of the storm water pollution prevention plan. Most commenters were against submitting a certification statement confirming the completion of the storm water pollution prevention plan. Comments indicated that the certification statement would put an unnecessary burden on the facilities. Commenters felt that when the NOI is signed and submitted, the permittee is certifying that he/she will comply with all applicable permit conditions including the development and implementation of a storm water pollution prevention plan. However, some commenters felt that submitting the certification would help facilities effectively plan the development of their storm water pollution prevention plans.

Today's permit does not require all facilities under the multi-sector permit to provide a certification upon implementation of their storm water pollution prevention plans. EPA agrees with the commenters that by signing the NOI form, permittees are agreeing to comply with all permit conditions within the specified deadlines of the permit. This includes developing and implementing a storm water pollution prevention plan within 270 days after permit finalization for pre-existing facilities or prior to operation for new facilities. EPA reserves the right to request a copy of the completed storm water pollution prevention plan at any time and failure to comply would be a permit violation. EPA also notes that under CWA Section 402(j), permit applications and permits must be available to the public. Because the storm water pollution prevention plan constitutes a portion of the permit, such plans must be publicly available. Accordingly, EPA will contact permittees as necessary to make such plans available.

Identification of Outfall and Sampling Locations, and Types of Discharges Contained in Outfalls

The pollution prevention plan requirements under the proposed multi-sector permit includes the development of a site map. This site map must denote certain site characteristics, such as the pattern of storm water drainage, structural features that control pollutants in runoff, and places where significant materials are exposed to storm water. EPA requested comment as to whether the final permit should require that the site map indicate the outfall locations, sampling locations, and types of discharges contained in the outfalls.

A slim majority of the comments received indicate that the additional requirements should not be included in the final permit. Commenters believed the requirements, if adopted, could confuse users by cluttering the map, and would be a duplication of information that is required under other sections of the pollution prevention plan. In addition, several commenters stated that sampling locations may vary, depending upon factors such as the amount of rain, safety considerations, and activities occurring at the facility. Commenters argued that to continually revise the map to include these changes would place an unnecessary burden on the facility.

Commenters in favor of the additional requirements stated that the information will assist users that did not participate in the development of the site map. In addition, the map would be a good tool for training new employees. Commenters note that these requirements should be limited to outfalls covered under this permit, not others, such as those discharging to POTWs or those covered under separate

NPDES permits. Also, it may be more efficient to document some of the information on a key to the map or in a separate attachment. This would make the map easier to read and avoid the problem of clutter.

Today's permit requires permittees to indicate, on the site map, the location of all outfalls covered under the final permit. In addition, the facility must prepare an inventory of the types of discharges contained in each outfall (e.g., storm water and air conditioner condensate). This inventory, however, may be kept as an attachment to the site map. Basic information on the discharge points that are to be covered under the permit should be readily accessible. EPA believes that denoting the location of the outfalls is important to the permittee and will assist in determining potential pollutant sources for each outfall. EPA believes the benefit of doing so outweighs the problems pointed out by the commenters.

Inventory of Significant Materials and Significant Spills and Leaks Within the Past Three Years

The proposed multi-sector permit required that facilities prepare an inventory of significant materials that are or have been exposed to storm water discharges within the past three years. Facilities were also required to provide a list of significant spills and/or leaks within the past three years. Both these items must be included within the storm water pollution prevention plan with a description of the BMPs used to prevent exposure of such leaks or spills to storm water discharges.

Commenters stated that such inventories would be burdensome to compile. Commenters felt that facilities would not have this information readily available, especially recently acquired facilities. In lieu of preparing the inventories to cover activities within the past three years, commenters wanted inventories to be prepared from the effective date of the permit.

Residuals from the leaks and spills may be a major source of contamination of storm water discharges. EPA believes that it is important for facilities to develop inventories of significant materials and past significant spills and leaks. These inventories will help facilities identify the areas where best management practices should be implemented and is an integral part of storm water pollution prevention. EPA believes that this information is available to facilities and can be readily compiled from existing records. EPA does not believe this requirement represents an undue burden upon the permittee. In addition, this requirement is commonly included within other issued NPDES storm water permits, therefore EPA is retaining this requirement in the final multi-sector storm water general permit.

Employee Training Requirements

The proposed multi-sector permit requested comment on whether a minimum training frequency of once per year should be specified for all industry sectors. Employee training is an effective tool in prevention pollution of storm water discharges. Employees that have been taught the importance of the pollution prevention plan measures and controls are more likely to thoroughly implement and continually maintain them. The training program is required to be described within the facility's pollution prevention plan and is applicable to all employees (including contractor personnel where relevant). Typical topics to be addressed include good housekeeping, materials management, and spill response procedures.

Many commenters supported the annual training requirement offered by EPA and one commenter felt that the training requirements were too high. However, most comments indicated that the training requirements should be more flexible. For instance, training should be based on the industrial activity and the complexity of the storm water pollution prevention plan which will affect how often an employee training program is necessary. This flexibility will ensure that training occurs only when necessary and may lessen the burden on those facilities that find training to be too burdensome.

To provide additional flexibility as the commenters suggested, today's permit includes training requirements that are sector-specific depending upon the needs assessed for each industry sector. Sectors with industrial activities that have a significant potential for storm water contamination to occur for reasons such as; operator error, lack of understanding of the operation of storm water controls, the need for frequent routine maintenance, the frequent changing of processes conducted outdoors, etc., will warrant some frequency of training. These types of facilities must conduct employee training at appropriate intervals which they determine necessary based upon these factors and others such as the number of employees, the complexity and types of pollution prevention measures and the rate of employee turnover.

Guidance for Storm Water Pollution Prevention Plan Development

Several commenters requested guidance on how to develop storm water pollution prevention plans and how to educate employees on storm water pollution prevention plan implementation. This information has already been prepared by EPA and is readily available. EPA published a guidance manual for storm water pollution prevention plan development and implementation in September 1992. The guidance manual, Storm Water Management for Industrial Activities, Developing Pollution Prevention Plans and Best Management Practices (EPA 832/R–92–006), was written to provide guidance for those facilities covered under the baseline general permit. However, the storm water pollution prevention plan requirements are similar and the manual is applicable for those who will be covered under the multi-sector permit. EPA also prepared a companion guidance document for construction activities, entitled Storm Water Management for Construction Activities, Developing Pollution Prevention Plans and Best Management Practices (EPA 832/R–92–005). This document is also available from EPA.

Monitoring Requirements

Benchmarks

The proposed multi-sector permit describes "pollutant benchmark values" (See Table 7, 58 FR 61169) which were used by EPA to determine the analytical monitoring conditions in the proposed permit. The benchmarks are also to be used by permittees who are required to conduct monitoring for comparison to determine if they qualify for the low concentration waiver. The standards are based primarily upon EPA Recommended Ambient Water Quality Criteria (Gold Book) values for toxic pollutants, and certain others, and NURP median concentrations for most conventional pollutants.

The benchmark values were used in two ways in the proposed permit. First, they were used as a standard of comparison against the median industry concentration for each pollutant that was sampled during the application process. If a median pollutant concentration in the sampling data for an industry sector was above the benchmark values it was considered a pollutant of concern for the industry sector. Under the proposed permit, when five or more median pollutant concentrations were higher than the benchmark values, the industry sector was required to perform analytical monitoring under the terms of the proposed permit.

Second, the benchmark values were used as a standard of comparison for an individual permitted facility that wishes to qualify for the low concentration waiver to be relieved from monitoring in the fourth year of the permit (monitoring cut-off values). The permittee would conduct storm water sampling as required under the permit in the second year of coverage. From this data, the permittee would average the pollutant concentrations for each monitored pollutant and would then compare these averages against the monitoring cut-off values. If the average concentrations were below the cut-off values then the permittee would be relieved from monitoring in the fourth year of the permit on the conclusion that the pollution prevention plan was effective in controlling the discharge of the storm water pollutants of concern.

Although most commenters favored the concept of an incentive approach to monitoring, if monitoring had to be required, a significant number of commenters indicated that the benchmark concentrations/monitoring cut-off values were inappropriate. Reasons given for this comment include the following: (1) The use of water quality criteria is an inappropriate comparison for discharge data, because it does not consider dilution of the discharge in the receiving water; (2) benchmarks should be determined based upon local conditions not by using national standards; (3) EPA should not use NURP median concentrations as benchmark values. These values have no bearing to industrial storm water discharge or to water quality; (4) several of the benchmark values are below the method detection limit (e.g., arsenic) and would therefore be impossible to achieve; (5) other benchmark values are far too stringent, (some are even lower than drinking water standards) and runoff from industrial areas would not meet these benchmarks; (6) many of the commenters were concerned that the benchmark concentrations are, or will become storm water effluent limitations.

Under today's final permit, EPA continues to use benchmark concentrations as a means for selecting priority industries for analytical monitoring and as a means for determining if the facility is eligible for a sampling waiver in the fourth year of permit coverage. However, because of the comments received, the basis for development of the benchmarks/monitoring cut-off values has been re-evaluated by EPA.

The revised benchmarks/monitoring cut-off values and the basis for these are presented in the Fact Sheet to today's permit. Changes made to the benchmarks/monitoring cut-off values to address the concerns expressed in the comments are summarized below.

Conventional Pollutants: NURP median data for conventionals have been replaced as benchmark values and monitoring cut-off values for all conventional pollutants except TSS and nitrate plus nitrite nitrogen. The replacement conventional benchmarks are based upon pollutant concentration levels required under the secondary treatment regulations, North Carolina water quality standards and existing storm water effluent guidelines. In most cases, the final benchmarks for conventionals/monitoring cut-off values are at higher concentration levels than the benchmarks in the proposed permit.

Non-Conventional-Inorganic: Acute water quality criteria based upon human consumption (where acute values do not exist) will be retained as benchmarks and monitoring cut-off concentrations for parameters if the values are not lower than method detection limits. Where the values are lower than the method detection limits, the benchmark has been replaced by the minimum level. A minimum level for such a pollutant is the method detection level multiplied by a factor of 3.18. The factor of 3.18 has been determined by EPA to be the most appropriate level above the detection level (for most pollutants) at which reliable quantitation of the pollutant can be analytically accomplished.

Non-Conventional-Organic: Water quality criteria values based on human consumption values are now used as benchmarks. Acute water quality criteria for these pollutants are generally too high to be used as benchmark values.

EPA believes that the revised pollutant benchmarks represent a reasonable standard of comparison for industrial storm water discharges for the two principle purposes described above. All levels are above the method detection limits for the respective parameters and provide a reasonable target for controlling storm water contamination by pollution prevention plans.

EPA emphasizes that the pollutant benchmark concentrations are not storm water effluent limitations, they are simply standards of comparison or targets by which EPA determined if discharges from an industry sector or facility merit monitoring under the terms of the permit. Facilities are not required to meet these concentrations as effluent limitations in their discharges. The benchmarks are designed to assist facility operators in determining if their pollution prevention plans are reducing pollutant concentrations to below levels of concern. Given the purpose of these benchmarks/monitoring cut-off values, EPA does not believe that dilution or background concentrations of each pollutant need to be considered. The monitoring benchmark cutoff values are not effluent limitations. For this same reason, local conditions do not need to be considered.

Facilities wishing to obtain a permit which considers their local conditions have the option of not seeking coverage under this multi-sector general permit but may submit an individual permit application to their applicable EPA permitting authority.

Minimum Required Data Needed for Pollutants To Be Analyzed for Monitoring

When determining industry-specific monitoring requirements for facilities under the multi-sector permit, EPA performed statistical analyses on pollutant data submitted in the group applications. For pollutants of potential concern, (those with at least three observations (outfall samples) within an industrial sector), EPA compared the median values to the benchmark values to determine a potential pollutant for monitoring.

Commenters felt that three observations of a parameter per sector was not a fair minimum representation for the facilities within a sector since the pollutants may all be showing up at three outfalls at only one facility and this facility may not be representative of an entire industry sector. Commenters argued that a parameter should only be considered as a pollutant of concern if it is observed at some significant percentage of the sites sampled within the sector. Other commenters stated that the minimum should be based upon at least three separate facilities instead of outfalls. An entire sector should not be required to monitor based upon the information received from one facility that sampled three outfalls.

EPA agrees with the commenters and the methodology for developing monitoring requirements for today's permit has been revised. In the methodology used for the monitoring provisions for the final permit, EPA only considers a pollutant to be of concern where 3 separate facilities submitted data within a subsector or sector.

Under the methodology for the proposed permit it was possible for an entire sector to be required to monitor based upon the data submitted by one facility with three outfalls and EPA agrees that one facility should not be considered necessarily representative of an entire industry sector for the purposes of determining the need to monitor. If three facilities which discharge a pollutant, however, the pollutant is not unique to a particular facility and is indicative of the industrial activities conducted in the industry sector or subsector. EPA conducted the monitoring evaluation assuming both a normal distribution and a lognormal distribution of the data set. The results were not significantly different.

Quality of the Part II Database

The Part 2 group application database includes Part 2 monitoring data from participants which participated in the group application process. Statistical analyses (e.g., mean, median, 95th percentile, and 99th percentile values) of this data was conducted for each parameter within every industrial sector. These analyses were conducted assuming both a normal distribution to the data and a lognormal distribution. The results of the analyses were used in the methodology to determine the proposed monitoring requirements.

Several commenters stated that the database, which only included monitoring data received prior to January 1, 1993, was incomplete and/or contained errors. The commenters stated that the database should be expanded to include all the group application data, as well as further reviewed to eliminate duplications and inaccuracies. Other commenters requested that the methods used to develop the statistical evaluation of the data be revamped (e.g., use a lognormal distribution of the data). In addition, a few commenters stated that the analysis did not properly consider facilities which did not submit data for a pollutant listed in Part C of the Form 2F since these facilities had no reason to believe the pollutant was present in their discharge. Therefore, the commenters argued, EPA's analysis should assume that the discharge concentration of these pollutants is zero.

EPA has again reviewed and double-checked the monitoring data analyzed for the development of the permit. EPA concludes that the monitoring data analyzed is representative of the industries evaluated. EPA analyzed data which was submitted months after the application deadline for the purpose of identifying pollutants of concern and developing monitoring requirements. In addition, on a sector-by-sector basis, EPA reviewed data that was submitted late to determine if the additional data was consistent with what had already been evaluated. Given this extra level of effort to analyze and consider all submitted data, even though some data was not loaded into the database that was publicly distributed, EPA believes that the analyses performed on the group application sampling data, and the results that were derived, are valid and reasonable.

EPA also believes that the concerns raised by commenters about the number of duplications and errors contained in the database which was distributed, is no longer warranted in that as errors were noted, EPA further screened and corrected the database. In response to the recommendation from commenters that a zero concentration value should be entered into the database every time a facility did not sample for a given pollutant because they did not believe it was present on their site, EPA does not agree. Obviously, assuming zero concentrations for these facilities would significantly reduce the mean and median concentrations. This would be imposing a major, unsupported assumption into the database. It cannot be assumed that facilities which did not submit data for a part B or C pollutant have a discharge concentration of zero for that pollutant. Facilities which did not sample for a pollutant because they did not believe it was present, may not have adequately considered all potential sources of these pollutants. In addition, facilities that did sample were supposed to be representative of the entire group in which they were located. This was a process determined by the group applicants themselves, with approval from EPA. Therefore, where facilities did sample and report for a given pollutant, and other facilities in the group did not, it could be assumed that the pollutant really was present at all other facilities. To be more accurate and unbiased in the analyses of the data, EPA chose not to assume either a zero value or an extrapolated value for pollutants that were not analyzed for by some facilities within a sector. EPA analyzed only actual data points that were submitted. Where a pollutant was tested for, and the result was below detection levels, EPA assumed these data points to be zero values for the pollutant.

Establishing Priority Monitoring Sectors

The multi-sector permit requires analytical monitoring only for 'priority' sectors. A sector was considered a 'priority' if, based on the Part II data for the sector, five or more pollutants sampled for had median concentrations above benchmark values. If the sector had median values greater than benchmark values for four or less parameters, only visual examinations would need to be conducted.

Several commenters stated that the methodology employed for establishing priority sectors was arbitrary and/or flawed (i.e there is no basis for choosing five as the number of parameters needed to be above benchmark levels to trigger sampling). Others indicated that the approach did not consider the relative impacts (e.g., toxicity) of the pollutants on receiving waters. Commenters also indicated that it was inappropriate to group together a wide range of industrial activity discharge data into one industry sector, and to use that data as a basis for comparison.

In response to these comments, EPA has revised the methodology for selecting which industries must conduct analytical monitoring. EPA reviewed the grouping of industries into sectors for statistical analysis. It was determined that in some cases a sector contained a grouping of industrial activities which may have different storm water discharges. In these cases EPA modified its analysis to statistically summarize the industry by subsectors. Division into industry sub-sectors was prepared in most cases based upon the three digit SIC codes provided by the group participants in their group application information. The results of the subsector analysis of the data were then used for comparison to the revised benchmarks (discussed above).

Today's permit also eliminates the five pollutant threshold for determining if a sector merited monitoring. For each subsector (or sector where it was not possible to further divide the sector into subsectors) EPA compared, on a pollutant by pollutant basis, the median concentration to the benchmark. Where the median concentration for a pollutant is higher than the benchmark, where there are likely sources of the pollutant associated with the industrial activity, and where the concentrations are high enough so as not to be due to "background" or natural sources, the subsector (or sector) is required to conduct analytical monitoring for the listed pollutant. This methodology is pollutant-specific and addresses the concerns that some commenters had that some industries within a sector may be inherently clean compared to other industries in the same sector. In addition, this approach is more environmentally protective in that the number of different pollutants in a discharge does not necessarily increase the risk posed by that discharge. It is possible that a receiving water may be significantly impacted by a discharge containing a high concentration of just one pollutant and therefore monitoring should be conducted to determine if controls are adequately reducing the levels of the discharge.

Selection of Additional High Priority Sectors Based Upon Factors Other Than Sampling Data

When determining industry-specific monitoring requirements for facilities under the multi-sector permit, EPA identified three additional industry sectors based upon a review of the degree of exposure, types of materials exposed, and the need for more sampling data than what was submitted in the group application. The industry sectors identified are hazardous waste treatment, storage and disposal facilities (TSDFs), auto salvage yards and airports.

Commenters felt that selection of these industries as priority sectors was arbitrary, particularly for those sectors where it was determined that the monitoring data submitted was not adequate (automobile salvage yards and airports). Under today's permit EPA is continuing to require monitoring for these three sectors which were selected based upon criteria other than the methodology employing the part 2 sampling data. It is EPA's best professional judgement that these industries merit further monitoring based on anticipated presence of significant pollutants. The data submitted was insufficient to disprove the EPA conclusion that these types of facilities have a significant potential to discharge contaminants. EPA believes the data submitted for these industries is insufficient and not representative of the discharges from the facilities and therefore additional data should be collected.

Should the Multi-Sector Permit Require Facilities That Must Monitor for Total Recoverable Metals To Also Monitor for pH?

Not all sectors of the proposed multi-sector permit require facilities that must monitor for total recoverable metals to also monitor for pH. Because it is known that the toxicity of metals is affected in part by pH, EPA requested comment as to whether to add pH to the list of parameters to be monitored in those sectors where total recoverable metals are also being chemically monitored.

Several commenters agreed with the addition of pH as a parameter that should be measured for all sectors where monitoring of a total recoverable metal is required. These commenters argued that it is not an expensive burden, requires little effort, and the data is needed to evaluate the impact of metals in the storm water discharge. One commenter stated that monitoring of pH would be appropriate since the pH of local rainfalls varies by the particular region where a facility is located. One commenter supported the use of this parameter only if toxicity changes in the metals could be demonstrated to occur at pH values presented in the group data. Several commenters stated that rather than the pH of the discharge being monitored that it is the pH of the receiving stream that is of critical concern. One commenter supported the monitoring of this parameter only if the EPA granted facilities the option of monitoring for other total recoverable metals or dissolved metals.

One commenter stated that monitoring of pH would only be necessary if pH in the receiving water is a problem and should be considered only after the total loading of an entire watershed is established showing that fluctuations in pH are not the result of pollutants from industrial activities, but are from sources such as acid rain. One commenter stated that they have performed studies which show that pH is not a concern for the food and kindred products sector.

The majority of the commenters were opposed to the blanket requirement to monitor pH whenever total recoverable metals were required to be monitored. The opposition was mainly due to the inherent problems associated with acid rain and in evaluating and linking the cause of toxicity to industrial activities and the associated storm water discharge. Several commenters strongly opposed a requirement to monitor pH believing it to be unnecessary. Many of those opposed felt the analysis should be left to the discretion of the facility in the development of their storm water pollution prevention plan.

EPA will not require facilities to also monitor pH for every sector that must monitor total recoverable metals. Rather, the decision will be left to the discretion of the facility or will be specifically required within a sector for other reasons. Monitoring the pH of the storm water may not provide an indication of the effectiveness of the storm water pollution prevention plan because of the influences of factors other than the facility's industrial activities on the pH of the discharge (i.e., acid rain). Allowing the facility to evaluate the effectiveness of the measurement of pH for each particular facility will alleviate the misinterpretation of the data that may result. This may be particularly true for extreme pH values beyond those normally anticipated with acid rain.

Support or Opposition to Baseline Monitoring Requirements

In the proposed multi-sector permit, EPA modified some sector monitoring requirements based upon the group application data submitted. EPA requested comment for each industrial sector on the changed requirements from the 1992 baseline general permit that were proposed in the multi-sector permit. Fifteen of the sixteen commenters that commented on this issue were opposed to the monitoring requirements in the baseline permit. Several supported the deviations from the baseline permit which they claimed was based only on theoretical and potential discharges, whereas the monitoring requirements for the multi-sector permit were based on actual storm water discharge data from the industries. A couple of commenters stated that the use of the baseline monitoring requirements would defeat the purpose of the money and effort spent on collecting data for the application process.

One commenter, while still opposed to any monitoring requirements for the fiberglass and aluminum boat builders, supported the monitoring parameters in section IX.R.8 of the multi-sector permit in lieu of the baseline permit. Two commenters supported the change from the baseline permit requirements, which triggered monitoring at 50,000 flight operations per year, for airports. One commenter in the rubber and miscellaneous sector was concerned that *any* analytical monitoring was being associated with the sector because they do not have any outside storage.

Another commenter supported the changes in the requirements for the Glass, Clay, Cement, Concrete, and Gypsum product sector where only the ready-mix concrete plants must monitor because visual monitoring is more appropriate for determining whether BMPs are effective. One commenter from the steam electric group felt that the monitoring requirements from the baseline permit were more appropriate, particularly the annual monitoring, compared to the monthly visual observations and quarterly chemical monitoring in the multi-sector permit. The commenter stated that pollutants in their storm water discharge are essentially unvarying and that the original list of pollutants in the baseline general permit provided a more appropriate set of indicators of storm water contamination from their site.

EPA has reviewed both sets of monitoring requirements and as a result will not incorporate the monitoring conditions from the baseline general permit into the final multi-sector permit. EPA believes that the monitoring requirements in the baseline permit are designed primarily to characterize pollutants in storm water discharges from those facilities seeking coverage under the permit. For the most part, this characterization effort has already been accomplished through the group application sampling. Whereas, the multi-sector general permit monitoring strategy has been designed primarily to provide information on the effectiveness of the storm water pollution prevention plan.

Visual Examinations of Storm Water Discharges

The multi-sector permit includes requirements for facilities to perform visual examinations of storm water discharges. "High risk" industry sectors were required to perform visual examinations of storm water samples on a monthly basis. "Low risk" sectors were required to perform the exam on a quarterly basis.

EPA received a large number of comments on the proposed visual examination requirements, both in support and in opposition. The majority of comments were in reference to the frequency of visual examinations. Others commented that the costs/requirements of the visual exams were too burdensome, and some facilities wanted no visual exams at all. Other comments included requests for: clarification of language requiring visual examinations; more specific criteria for when to conduct a visual examination; provision of a checklist for performing visual exams; and criteria for examining snow melt runoff.

Commenters who opposed the requirements did so because; visual exams are too burdensome for facilities with many outfalls; conducting visual exams is too time consuming; the logistics associated with performing visual exams are too difficult for the average worker to understand; the results of the exam will be of no value; and the visual exam requirements are too frequent and will encourage fraudulent submissions.

Some commenters were opposed to the visual monitoring requirements stating that it is not as effective as examining the equipment installed to accomplish pollution prevention. They suggested that if the requirement is retained, the idea of comparing the visual observation to a baseline be addressed because the use of the same site personnel over time is not viable due to continuous rotation of personnel. Other commenters were opposed to the burden that would result from the support documentation needed to meet the 72 hour dry weather and 0.1 inch rainfall requirements. These commenters felt this would require constant monitoring of the weather, recordkeeping, and the development of monthly visual observation reports which would be costly for small companies.

Numerous commenters supported the use of visual examinations to monitor the effectiveness of the pollution prevention plan and the implemented BMPs. These commenters stated that visual examinations can be an effective tool and would allow easy detection of suspended and settled solids, oil sheen and other obvious indicators. Some commenters that favored visual monitoring suggested this be done in lieu of any chemical analyses.

EPA believes that the visual examinations will provide permittees a quick and inexpensive assessment of the effectiveness of the facility's pollution prevention plan on a more frequent basis, but at a more cursory level, than just analytical chemical monitoring. The examinations are intended to be conducted by the company's pollution prevention team, or someone who will be familiar with storm water management at the facility. The team may be able to identify sources of contamination in the storm water discharge given their knowledge of the industrial activities conducted at the facility and the materials stored exposed to storm water. From these observations, the team may be able to identify additional BMPs that can be implemented to control the contaminant sources, or ways to improve the efficiency of existing BMPs. EPA will retain the requirement to perform a visual examination of the storm water discharge in today's multi-sector permit. EPA believes the visual examination of the discharge will become an important part of an active facility's overall effort to control storm water contamination. EPA maintains that the visual examination of the storm water discharges will allow a quick and simple assessment of the quality of the storm water runoff which can then be used to help assess the effectiveness of a facility's pollution prevention plan at very little cost. The results of the visual examination should be used in conjunction with the results from the comprehensive site compliance evaluation, analytical monitoring, if required, and sector-specific inspections to determine if appropriate BMP's have been implemented.

Today's permit and fact sheet include more detailed language which elaborates on the description of the visual exam requirements. Additionally, the frequency for visual examination for all applicable industry sectors will be quarterly under today's permit. This responds to a majority of the commenters by reducing the burden placed upon facilities, and allows a more reasonable amount of time for a representative storm event to occur. The information from visual monitoring is intended to be used by the facility as a quick and simple means of determining any obvious changes in the quality of storm water runoff from the site when the discharges are occurring. EPA understands that there is a measure of uncertainty and subjectivity in performing visual exams, but believes this will not adversely affect the purpose of the examinations. In summary, visual examinations of the storm water discharges provide a low cost means for the facility operator to routinely assess storm water problems at a facility and will provide an indication of major problems with the effectiveness of the storm water pollution prevention plan.

Alternative Monitoring Provisions

In the proposed permit, EPA requested comment on alternative monitoring and reporting requirements in lieu of the proposed requirements. Most of the commenters were opposed to the alternative monitoring requirements. Some commenters believed the alternative monitoring requirements would focus too much attention on sampling and not enough on pollution prevention plans. Some commenters did not think the whole effluent toxicity testing, where it was proposed in the alternative requirements in certain sectors, would be appropriate for storm water evaluations also stating that they are too expensive and complicated. Some commenters supported the proposed alternative monitoring requirements stating that the alternative requirements should be kept as an option assuming there is appropriate data demonstrating the need for this monitoring.

In response to the comments concerning the alternative monitoring provisions discussed in the fact sheet of the proposed permit, EPA is not incorporating these monitoring requirements into the final permit. Rather, as explained above, EPA has reconsidered the entire monitoring strategy as proposed in the permit and has developed a new monitoring strategy based upon a sub-sector analyses of the data to be responsive to the majority of concerns regarding storm water monitoring in the proposed permit.

Signatory Requirements

The multi-sector permit requires that all Notices of Intent (NOI), Notices of Termination (NOT), storm water pollution prevention plans, reports, certifications or other information, either to be submitted, or to be maintained by the permittee, be signed in accordance with the requirements in 40 CFR Part 122.22.

One commenter stated that the NOI certification is significantly different than the wording in the September 9, 1992 baseline general permit. Another commenter stated that the signatory requirements should be similar to those required by the national pretreatment program to maintain consistency and to avoid confusion. One commenter stated that the signatory requirements were appropriate for the NOI and the NOT, however, were not appropriate for the storm water pollution prevention plan and other such documents because they are excessive when compared to similar programs. This commenter suggested that an appropriate company representative such as those outlined in VII.G.2 would be more appropriate to provide a signature because they are more familiar with the regulations and the operations of the industrial facility. One commenter requested that a member of the storm water pollution prevention plan team be allowed to sign the site compliance report.

EPA will maintain the signature requirements as proposed in the multi-sector permit which requires that all NOIs, NOTs, storm water pollution prevention plans, reports, certifications or information either to be submitted to the Director, or that are required to be retained by the permit, be signed by a responsible corporate officer. The certification and signature requirements in the multi-sector permit are the same requirements as those used in other areas of the NPDES program and the pretreatment program and have not been changed from the September 1992 baseline general permit. Furthermore, the requirements allow authorized representatives to be appointed for signature authority. Therefore, if a facility feels it is more appropriate for a member of the storm water pollution prevention plan team to sign the documentation, that option is available under the permit.

Miscellaneous Inspection Requirements

EPA received comments on inspection requirements, recordkeeping requirements, and reporting requirements from 24 commenters. Most of these stated that the proposed requirements are too burdensome and suggested ways to scale down this burden, with suggestions ranging from decreasing inspection schedules to requiring less paperwork. A few commenters opposed the frequency of inspections required in several of the sectors of the proposed permit. Specifically, two commenters stated that monthly inspections of designated equipment and areas of the facility are unnecessary and inappropriate.

EPA has established visual and other inspection requirements tailored to each industrial sector based on conditions specific to each sector. Where appropriate, today's permit contains daily, weekly, monthly, or less frequent inspections of various important facility areas and activities. EPA believes the frequencies in the permit are necessary to ensure that storm water runoff from these key areas does not cause significant discharges of pollutants.

Retention of Records

Seven commenters stated that the requirement that records be retained for 6 or more years (three years after the permit expires) is excessive. One commenter suggested that a more discrete time period be specified for records retention, so as to eliminate the undesirable result of inadvertently requiring facilities to retain records indefinitely if a permit is continually extended. Five commenters suggested that a three-year retention period is adequate and consistent with other NPDES permits. Another commenter suggested that records be retained for a maximum of one year after the inspection or monitoring occurs. Two other commenters stated that the documentation and recordkeeping requirements are too elaborate and could require excessive resources from small businesses. Four other commenters stated that the reporting requirements are unnecessary and unduly burdensome.

EPA has retained all recordkeeping requirements from the proposed permit. However, in response to commenters' concerns about inconsistent timeframes, the Agency has standardized the retention period for all records to be the minimum period allowed under 40 CFR 122.41(j). Thus, today's permit requires permittees to retain all records (those from inspections as well as monitoring data) for a minimum of three years from the date of the inspection, sampling, or measurement. In addition, to help reduce the amount of reports permittees may be required to generate during a permit term, EPA has reduced some of the inspection and examination requirements for some industrial sectors. For example, the requirement for visual examinations of discharges has been changed to quarterly for all sectors (except air transportation) and pollutant-by-pollutant no exposure certifications are now allowed. EPA believes these changes, and others in today's permit, will decrease the recordkeeping burden on many facilities, including small businesses.

Special Requirements for Facilities Subject to Reporting Requirements Under EPCRA 313

EPA received a number of comments that addressed the proposed special requirements for facilities subject to the EPCRA Section 313 reporting requirements. Specifically, 52 of these comments addressed the proposed requirement for a certification of the storm water pollution prevention plan for an EPCRA 313 facility by a Professional Engineer (PE), of which 50 opposed such certification and two favored it. Thirty-one of the commenters opposed to the certification indicated that other categories of professionals with knowledge of pollution prevention, including hydrologists and certified hazardous materials managers, would be more appropriate than a PE to review the plan. Most indicated that someone very familiar with the facility would be the most appropriate person to make the certification. Other commenters noted that the facility manager is legally responsible and should be responsible for certifying or selecting the certifying party. A few commenters stated that the PE provision would be unnecessarily costly, particularly for small facilities. One commenter added that the frequency of certification should be reduced to once every five years.

In response to these commenters, EPA has removed the requirement for PE certification from the permit as well as the requirement to certify the plan every three years. The permit now requires facilities subject to the EPCRA Section 313 requirements to conduct the same storm water pollution prevention plan certification procedures as facilities not subject to EPCRA Section 313. Thus, facilities subject to EPCRA Section 313 requirements need only certify their pollution prevention plan when it is developed or when revisions or changes are made and does not include a PE certification.

EPA also received numerous comments that opposed the extension of special requirements for EPCRA Section 313 facilities to all facilities with above-ground storage tanks and/or exposed handling of liquid chemicals. About half of these commenters stated that there was no basis for extending these specific Best Management Practices (BMP) to facilities that already have BMPs under the EPCRA program. The other half indicated that these special provisions were redundant with requirements in other programs, such as RCRA. Two commenters also stated that such an extension of requirements associated with EPCRA to all facilities covered by the multi-sector permit would be inappropriate regulatory duplication. Based on these comments and further review, EPA is not extending the Section 313 requirements to additional facilities.

In addition to these specific comments, EPA received 25 comments opposed to the special storm water pollution prevention plan requirements for EPCRA Section 313 facilities. These commenters objected that there are a variety of burdensome aspects of the prescribed practices. Sixteen of these commenters suggested that the special requirements are redundant with those imposed by other programs and/or are inappropriate given the data presented in the notice on the presence of pollutants in storm water from EPCRA Section 313 facilities and non-313 facilities. They indicated that the data show no distinguishable differences between storm water pollution from these two categories. Other commenters stated that the costs of complying with the special provisions for Section 313 facilities are excessive. With the exception of the PE certification, EPA is not reducing the special pollution prevention plan requirements for facilities subject to EPCRA Section 313 requirements. The Agency is leaving them in place because of the nature of the industrial activities and chemicals handled at such facilities. These controls are necessary to ensure that storm water runoff does not become contaminated with EPCRA Section 313 water priority chemicals. The use of these controls represents an established level of technology-based controls that are already being implemented at many of these types of facilities and EPA believes this level of technological control should be maintained.

On January 12, 1994, EPA proposed to add 313 new chemicals to the EPCRA Section 313 list of chemicals found at 40 CFR 372.65. On November 30, 1994, EPA published a final notice in the **Federal Register** adding 286 chemicals to the list. A Section 313 water priority chemical is defined as a chemical or chemical categories which are: 1) are listed at 40 CFR 372.65 pursuant to Section 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA) (also known as Title III of the Superfund Amendments and Reauthorization Act (SARA) of 1986); 2) are present at or above threshold levels at a facility subject to EPCRA Section 313 reporting requirements; and 3) that meet at least one of the following criteria: (i) Are listed in Appendix D of 40 CFR 122 on either Table II (organic priority pollutants), Table III (certain metals, cyanides, and phenols) or Table V (certain toxic pollutants and hazardous substances); (ii) are listed as a hazardous substance pursuant to section 311(b)(2)(A) of the CWA at 40 CFR 116.4; or (iii) are pollutants for which EPA has published acute or chronic water quality criteria.

In response to this rulemaking, EPA analyzed the list of Section 313 water priority chemicals in the proposed multi-sector general permit by comparing these 286 new chemicals against Tables II, III, and V of Appendix D of 40 CFR 122, the list of hazardous substances listed at 40 CFR 116.4, and the list of pollutants for which EPA has published acute or chronic water quality criteria. Based on this analysis, EPA is adding 44 of the 286 new chemicals or chemical categories to the list of Section 313 water priority chemicals which is an appendix to today's permit. In developing the original definition of Section 313 water priority chemicals, EPA included a reference to the EPCRA 313 chemical listing and noted that future additions to the list could occur and that these would automatically expand the storm water EPCRA 313 water priority chemical list used in the industrial storm water general permits. In addition, the proposed regulation to expand the EPCRA 313 list notified the public that with an expansion of the list, other programs, such as the storm water permitting program that incorporated the EPCRA 313 listing, would also be similarly affected.

By adding these new chemicals to the water priority chemical list, potentially more facilities will be required to implement the EPCRA 313 special pollution prevention plan requirements. However, EPA believes that the additional water priority chemicals will not have a significant impact on the cost of compliance by any individual facility. Facilities already implementing these provisions may have additional chemicals to address in their plans beyond those they already consider, but EPA believes many of the BMPs and pollution prevention measures already being implemented will be applicable to the new chemicals. EPA re-examined the estimated upper range of cost of compliance by a facility required to implement the special EPCRA water priority chemical pollution prevention plan requirements, and has determined that the added chemicals will not cause this range to be exceeded.

Cost of Compliance

EPA received several comments concerning cost estimates for the permit requirements, many of which offer similar viewpoints. EPA provided estimates of the cost of compliance in the fact sheet to the proposed permit. These costs covered a range of costs, from low to high, that may be necessary to implement a storm water pollution prevention plan at the wide range of types of facilities that will be covered under this permit. Twenty-eight commenters stated that the estimated cost for industry to comply with the multi-sector permit is too high. In response to these comments, EPA re-examined its cost estimates to ensure that they were accurate and to ensure that the range, as estimated, adequately covered all anticipated circumstances. From this re-evaluation, EPA believes that the costs of compliance, which includes preparing and implementing a pollution prevention plan during the term of the permit, are accurate and adequately cover the range of anticipated costs for facilities that will be covered under this permit. In addition, EPA believes the cost of compliance is not high when compared to the potential site-specific requirements that may be imposed in order to comply with an individual permit. Therefore this multi-sector general permit represents a significant cost savings over the individual permit option.

Six of these commenters also cited the high end of the EPA cost estimates as being too high for small businesses. In response to this, EPA wants to clarify that the high-end cost estimates will mostly, if not entirely, apply to larger, more complex facilities with more potential sources of pollutants and therefore a more comprehensive storm water pollution prevention plan. In deriving the cost ranges, EPA anticipated that most small business compliance costs would fall at the low end of the cost ranges.

Twenty-four of the twenty-eight commenters who believed that the estimated cost of compliance is too high also expressed concern that the proposed permit will bear an unfair burden on small businesses and possibly threaten their ability to remain in operation. However, several of these commenters based their position on the high end of the cost estimates, which are most likely to apply to larger facilities. In response to this concern, EPA estimated the cost of compliance for a hypothetical small business in the automobile salvage yard industry. This example has been added to the fact sheet of the permit and illustrates an estimate of a small auto salvage yard costs that such a facility many actually incur in complying with this permit. The Agency expects that the actual cost of compliance with the permit for a hypothetical small automobile salvage yard would be $874 in the first year and $561 for each following year. The low-end estimate is appropriate for the majority of smaller facilities, with some facilities, like the hypothetical small auto salvage yard, likely to face even lower costs.

Nineteen commenters (including eleven of the twenty-eight who believe that the estimated cost of compliance is too high) stated that EPA's upper cost estimates given for complying with the proposed permit are too low. Many of the commenters questioned how EPA has developed its cost estimates and argued that the actual cost of compliance will greatly exceed the costs cited by EPA. In response, EPA does not believe its cost estimates are too low as mentioned above. EPA based the cost estimates in the proposed permit on those prepared for the baseline general permit. Because the compliance requirements in today's permit reflect those in the baseline permit, EPA believes that the cost of compliance with the multi-sector permit will be similar to the baseline permit. Actual costs for some facilities may be lower in some circumstances under the multi-sector permit because the multi-sector permit fact sheet provides guidance on the types of BMPs that may be applicable for an industry sector.

In addition, several other specific concerns were presented by small businesses. Sixteen small businesses commented that the compliance costs would force small businesses to either lay off employees or go out of business completely. Another seven commenters warned of the consequences that could result if small automobile recyclers were forced out of business by the cost of compliance with the permit. They argued that vehicles would be abandoned along roads, left in back yards, etc., resulting in a worse scenario than that which existed before the permit was put into effect. In response, EPA does not expect the costs of compliance with the multi-sector permit to force a small business out of business as described above. In developing the permit, the Agency considered not only the needs for storm water controls, but also the capabilities of each sector's facilities to maximize available in-house resources. EPA encourages facilities to use activities and controls already routinely conducted to the maximum extent possible to meet the permit requirements. EPA anticipates that many small businesses will be able to tailor their existing activities to satisfy many of the requirements of the multi-sector permit and that trade associations will help in developing model pollution prevention plans and in providing technical information and assistance to their membership.

Eight small business responses called for a small business exemption to eliminate storm water sampling and documentation requirements. They perceived the costs for sampling and documentation to be most burdensome on small businesses, many of which have limited human resources. In response, EPA is not providing exemptions in the multi-sector permit to businesses because of their size. However, EPA has changed several requirements of the permit which will reduce burden on the permittee. For example, comprehensive site compliance evaluations are now required only annually for all industrial sectors. EPA has also reduced some of the inspection requirements where appropriate. Additional revisions have been made to various industrial sector requirements to help reduce the burden on small business and other permittees.

Endangered Species Act (ESA) and National Historic Preservation Act (NHPA)

To address the provisions of the Endangered Species Act, the proposed permit denied coverage to any discharge which had "a direct or indirect effect upon a listed endangered or threatened species or its designated habitat". The permit allowed coverage to discharges with an impact on endangered or threatened species where the facility had obtained an incidental take permit from either the U.S. Fish and Wildlife Service (FWS) or the National Marine Fisheries Service (NMFS). The proposed permit required that a discharger seeking coverage, certify in its Notice of Intent (NOI) to be covered by the multi-sector permit that its storm water discharge will not have any direct or indirect effect on listed species or critical habitat unless the discharger had first obtained a permit under § 10 of the ESA (for incidental takings).

To comply with the provisions of the National Historic Preservation Act, the proposed permit denied coverage to discharges that "disturb a site that is listed or eligible for listing in the National Historic Register." A discharge that does disturb a historic site may be eligible for coverage if the facility obtained, and is in compliance with, a written agreement with the State Historic Preservation Officer (SHPO). The permit required that a discharger seeking coverage must certify in its Notice of Intent (NOI) to be covered by the multi-sector permit that its storm water discharge will not disturb a site that is listed or eligible for listing.

A number of commenters opposed these eligibility restrictions and suggested that the requirements be modified. Several commenters suggested that the permit allow coverage for all facilities initially, but include a provision which would allow the Director to exclude from coverage any discharge which was determined to have an impact upon a threatened or endangered species, or which disturbs a historic site. Others stated that the terms "no direct or indirect effect" in the ESA eligibility restrictions, and "will not disturb" in the NHPA eligibility restrictions are overly broad and subject to varying degrees of interpretation. These commenters requested clarification as to what constitutes a direct effect, an indirect effect or a disturbance. Still other commenters suggested that the eligibility requirements merely require the applicant to send a letter to the appropriate Agency requesting a determination of the facility's impact upon threatened species, endangered species or historic sites. These commenters argued that a facility does not have the resources to make a determination on its own. Several commenters suggested that the eligibility restrictions only apply to new facilities. They argued that existing facilities should not be required to make the determination because any effects or disturbances due to their discharges have already occurred.

Commenters also listed a number of reasons for removing the eligibility restrictions altogether. Many commenters stated that the permit inappropriately deferred EPA's responsibility to consult with FWS, NMFS or Historic Preservation Offices to the discharger. They argued that both ESA and NHPA require EPA to perform the consultation prior to issuing the permit. The commenters argued that the consultation would be costly and time consuming for dischargers to perform. Several commenters stated that the Services and Offices which would have to be consulted would be overwhelmed by the number of inquiries generated by the permit and unable to respond to requests for consultations in a timely manner. Other commenters stated that it was unnecessary to include the ESA and

NHPA requirements in the permit because facilities are already subject to these and other existing federal laws and regulations. Requiring compliance with these provisions in the permit places undue emphasis upon these statutes in comparison to all other laws and regulations.

In response to the comments regarding endangered species, the ESA requires, among other things, that EPA ensure, in consultation with the FWS and/or NMFS that actions it authorizes or carries out are not likely to jeopardize the continued existence of threatened and endangered ("listed") species or result in the destruction or adverse modification of the designated critical habitat of listed species. In addition, the ESA generally prohibits EPA, as well as those seeking general permit coverage, from "taking" listed species without the prior authorization of the FWS/NMFS.

To fulfill its responsibilities under the ESA, EPA developed a series of conditions in the proposed permit which were reviewed by the services during the consultation. The consultation culminated in the issuance of a FWS/NMFS Biological Opinion that EPA's approach would not likely jeopardize listed species, adversely modify critical habitat, or result in takes. The consultation also resulted in changes to the conditions of the permit for endangered species protection. The revised conditions represent a simplified process that should be easier for permittees to comply with, yet will still ensure that storm water discharges authorized under this permit will not adversely affect endangered species.

The revised ESA conditions require that an applicant comply with the ESA and be granted coverage under the permit only if the storm water discharges and BMPs to be constructed are not likely to adversely affect the endangered species listed in Addendum H of the permit; or the applicant has received previous authorization under the ESA and established an environmental baseline; or the applicant is implementing other appropriate measures, as required by the Director, to address adverse affects. In addition, the applicant must certify that their storm water discharges and potential BMP construction activities are not likely to adversely affect the species listed in Addendum H of the permit. Addendum H is a county-by-county listing of the endangered species upon which the consultation is based. EPA believes this new process fully implements the requirements of the ESA and the outcome of the consultation with FWS and NMFS, and is protective of endangered species. EPA also considers this revised approach to be a more practical and straightforward process for an applicant to gain coverage under the multi-sector general permit.

EPA expects that the vast majority of applicants will be able to meet the ESA certification requirement by either determining that no listed species are found in the county of the discharge or by determining that listed species found in the county are not in proximity to the discharge. EPA believes that requiring applicants to provide the certification commented upon is reasonable and necessary so that EPA may act to lawfully authorize an applicant's general permit coverage. See § 308(a)(A)(v).

EPA does not need to enforce every law and regulation through permits—only those which create obligations on EPA for *its* actions (through statutes such as the ESA and the NHPA) that are in response to permit applications presented to EPA by persons seeking to comply with the CWA, e.g., applicants for NPDES permits.

As to permit coverage for existing facilities, "action" under the pertinent ESA regulations includes "all activities. . .of any kind authorized by federal agencies. . .[including] the granting of. . .permits.. . ." 50 C.F.R. § 402.02. Agencies must consult with the FWS or NMFS wherever an action may affect listed species. 50 C.F.R. § 402.14. Given that storm water discharges from existing facilities may have new or continuing effects on listed species (in addition to past effects), there was a clear need for coverage of existing facilities also to be adequately protective.

In response to the comments raised regarding the NHPA, EPA recognizes that the National Historic Preservation Act ("NHPA") imposes obligations on the Agency to take into account the effect of permit issuance on historic properties. Today's general permit establishes a mechanism whereby the Agency can efficiently administer the permit and still take into account the effect of general permit coverage on historic properties consistent with its obligations under the NHPA. EPA will assure NHPA compliance primarily through the eligibility and certification requirements of the general permit. The general permit does not authorize discharges that (1) affect a property that is listed or eligible for listing on the National Register of Historic Places, unless (2) the applicant has obtained and is in compliance with a written agreement between the applicant and the State Historic Preservation Officer ("SHPO") that outlines all measures to be undertaken by the applicant to mitigate and prevent adverse effects to the historic property. Applicants for general permit coverage must certify that they have read and are in compliance with the eligibility provisions of the permit.

The operation of this mechanism should assure compliance with the NHPA for any authorization to discharge provided under today's permit. EPA anticipates the first component of the eligibility/certification mechanism will provide an adequate opportunity to take into account the effect on historic properties for the vast majority of discharges to be authorized under the permit. EPA anticipates that the preliminary evaluation by the applicant will quickly identify those discharges that may implicate concerns about historic preservation. The second component will allow for general permit coverage after effects have been effectively addressed (minimizing the need for an individual permit).

EPA recognizes that the eligibility/certification mechanism in today's permit will not resolve all historic preservation concerns that may arise due to control of storm water discharges. In some instances, the first component of the eligibility/certification may not assure "no effect" on historic properties, for example, if the applicant's certification of eligibility is subsequently determined to be false. In such instances, the discharge would be "without a permit" based on the eligibility provisions. In some instances, the applicant and the SHPO may have difficulty in reaching agreement on how to resolve historic preservation concerns. Such instances may necessitate EPA intervention or issuance of an individual permit. The eligibility/certification mechanism represents EPA's effort to assure Agency compliance with the National Historic Preservation Act consistent with the efficiencies of general permitting under the Clean Water Act.

Comprehensive Site Compliance Evaluations

The proposed permit contained requirements for facilities to perform and document comprehensive site compliance evaluations. The intent of the compliance evaluation is to: confirm the accuracy of the description of potential pollution sources at the site, determine the effectiveness of the storm water pollution prevention plan, and assess compliance with the permit. The evaluation should be conducted by members of the pollution prevention team. Deficiencies in the plan must be corrected within two weeks of the evaluation and the corrections must be implemented within 12 weeks. Most of the industry sectors required the evaluation to be performed annually, however, a few sectors required more frequent comprehensive site compliance evaluations. For example, the chemical and allied products sector of the proposed permit required quarterly comprehensive site compliance evaluations. A few industry sectors allowed less frequent evaluations, for example the ore mining and dressing sector only required evaluations every three years at inactive mine sites.

Commenters expressed several concerns with the comprehensive site compliance evaluation requirements. The primary concern dealt with the required frequency for the evaluation. A number of commenters stated that the evaluation should not be required more frequently than once per year in any industry sector. Commenters stated that an annual evaluation was sufficient to assure compliance of the plan with permit requirements. Commenters also stated that the frequency should be consistent across all sectors unless more frequent evaluations could be justified. Commenters were also concerned with the time frame allowed to modify the pollution prevention plan following the evaluation. Commenters stated that two weeks is not sufficient time to obtain the resources necessary to modify the plan. A few commenters also felt that the comprehensive site compliance evaluation is redundant and duplicative of the inspections required by the storm water pollution prevention plan. The commenters argued that the evaluation should not be required unless the inspections reveal recurring problems with the plan. Finally, one commenter stated that the evaluation should be performed by an outside consultant or corporate official with expertise in storm water pollution prevention.

In response, EPA has reconsidered the frequencies of the comprehensive site compliance evaluation in the proposed permit and has standardized the frequency to once per year in all sectors, unless sector-specific justification is given for a more frequent inspection. EPA also wants to clarify that the comprehensive site compliance evaluation requirements are different from other inspection and monitoring requirements of the permit. The comprehensive site compliance evaluation is intended to be an overall comprehensive inspection that is conducted at a minimum on an annual basis where the pollution prevention plan is totally reviewed. The inspection should 1) confirm the accuracy of the description of potential pollution sources contained in the pollution prevention plan, 2) determine the effectiveness of the plan, and 3) assess compliance with the terms and conditions of the permit. These goals, in combination, are more comprehensive than the other inspection and monitoring requirements in the permit. The annual comprehensive site compliance evaluation also satisfies the minimum monitoring requirement of all NPDES permits (40 CFR 122.44(i)(4)). Therefore, EPA is retaining the requirement that all industrial sectors conduct an annual comprehensive site compliance evaluation. To the extent that this compliance evaluation overlaps with other inspections (e.g., daily inspections of storage areas), the comprehensive site compliance evaluation can be used in place of the other inspections. Because the comprehensive site compliance evaluations are intended in part to determine the effectiveness of the pollution prevention plan and compliance with the permit, EPA believes it is important that a member of the pollution prevention team be involved in conducting the evaluation.

In response to the concern about the two week timeframe being to short to fully implement changes to the plan if such are necessary as a result of the inspection, EPA disagrees and believes a clarification is necessary. Under the terms of the final permit, if a facility operator determines a deficiency in the storm water pollution prevention plan after conducting the annual comprehensive site compliance evaluation, then the permit provides for up to two weeks to modify the plan and then up to 12 weeks to implement the actual plan modifications. EPA anticipates that many plan changes will be procedural or programmatic in nature and as such should not take an excessive amount of time to perform. EPA expects these to be easily completed within the 12 week deadline. Where major changes are necessary that require construction, such as installation of a new structural BMP, the permit conditions allow for up to three years. EPA believes these timeframes are adequate and therefore no changes to the final permit have been made.

Response to Major Sector-Specific Issues

Timber Products Facilities

The proposed permit for timber product facilities does not cover nonpoint source silvicultural activities, such as timber harvesting operations and certain other silvicultural activities described under SIC code 2411, which may be exempt from the National Pollutant Discharge Elimination System (NPDES) permit program as described in the silvicultural definition at 40 CFR Part 122.27. Many commenters agreed that certain silvicultural activities are not covered by NPDES permit requirements and are best controlled under the section 319 nonpoint source program. Because these discharges are addressed by the section 319 nonpoint source program, some commenters recommended that the language in the permit and the fact sheet be changed from providing an "exemption" of these discharges to say that "certain silvicultural activities are not prohibited by or otherwise subject to these regulations." Other commenters requested that the language concerning coverage of silvicultural activities that is in the permit fact sheet, also be placed in the permit to avoid confusion.

In response, EPA believes that nonpoint source silvicultural activities not covered under this permit (e.g., harvesting operations, and certain other activities) are exempt from the NPDES permit program. Exempt activities do not need to obtain an NPDES storm water discharge permit. EPA does not believe that further clarification is necessary beyond that already stated in the fact sheet to the timber products sector. If a facility operator questions its regulatory status after reviewing the fact sheet, the operator should contact the permitting authority for the State in which it is located for additional guidance on its regulatory status.

Many commenters suggested that the definition of timber products activities not required to obtain NPDES permits for storm water discharges be expanded in the fact sheet. Some commenters wanted to include remote log sort/concentration yards that do not conduct processing activities. These commenters were concerned that the proposed permit groups all log sort/concentration yards into the same category as facilities processing timber products. They stated that the activities performed at these yards are similar to forest harvesting operations including unloading, stacking, storing and reloading roundwood. In addition, they stated that the pesticides, herbicides, and fertilizers presumed present at these sites are not usually there. Another commenter requested that forest roads be included as nonpoint sources, as well as forest recreational sites and national forest administrative sites that do not include treatment facilities. The commenter stated that these facilities could be effectively covered under nonpoint source programs.

In response, the permit fact sheet discusses coverage of certain silvicultural activities which are classified as storm water discharges associated with industrial activity under the NPDES storm water program and those which are considered to be nonpoint source discharges. This discussion explains the consistency between coverage under this multi-sector permit and existing NPDES storm water regulations defining storm water discharges associated with industrial activity for the Timber Products industry. EPA believes this discussion is clear and consistent with NPDES regulations and that further expansion of the definition of exempt nonpoint source activities at timber products facilities would be inconsistent.

Many commenters were concerned that the proposed sector had grouped together all facilities that perform any wood treating, including facilities that only end-treat boards with a paraffin wax. In response, EPA has grouped together all those facilities that perform any wood treating because they exhibit similar types of industrial activities at their facilities. The groupings were made because the documentation and data submitted in the group applications described them as similar. Therefore, wood preservers who treat their wood with paraffin were not separated from wood preservers, as a whole. In relation to monitoring, while the proposed multi-sector permit required specific monitoring by wood preservers and surface treaters, including those that only end-treat boards, the final multi-sector permit comprehensively changes the monitoring requirements for all timber products facilities due to a reassessment of the benchmark levels used to trigger monitoring and the revised sub-categorization approach to determining the need for industry sub-categories to monitor (See response to comments on monitoring provisions). Facilities that end-treat boards with paraffin are still required to monitor their storm water discharges, but for fewer pollutants. Although the revised monitoring provisions in the permit now require monitoring for all subcategories within the timber products sector, the revised alternative certification provisions should allow individual facilities with no exposure of the pollutants of concern to forego the need to monitor. In relation to pollution prevention plans, all timber products facilities will still be required to control pollutants discharged into storm water through the use of site-specific best management practices implemented through pollution prevention plans which are tailored to each specific facility on a case-by-case basis. This site-specific approach will allow a facility which end-treats wood with paraffin to design a pollution prevention plan appropriate for their facility.

The proposed permit authorized non-storm water discharges from the spray down of lumber at wood product storage yards where no chemical additives are used in the spray down waters and no chemicals are applied to the wood during storage. Several commenters supported the proposed permit condition as an acceptable non-storm water discharge. The commenters believed that the authorization of these discharges at timber processing facilities is appropriate because these discharges are intermittent and the activity is performed only when necessary. In response, EPA believes that these non-storm water discharges, where identified in a pollution prevention plan and where appropriate pollution prevention measures are implemented, can be effectively controlled under today's multi-sector permit and therefore are allowable non-storm water discharges.

Numerous entities commented on the pollution prevention plan for timber product facilities. Many commenters supported the use of best management practices in that they allow the permittees to determine the most efficient and cost-effective measures for controlling pollutants in storm water discharges. Several commenters provided lists of additional BMPs that are appropriate for use at timber product facilities. However, many commenters stated that the proposed requirement for daily inspections of "material handling activities and unloading and loading areas whenever industrial activities occur in those areas" is confusing because these areas are considered industrial activities. In addition, they believe the proposed frequency of the inspections is overly burdensome and clarification of the required documentation is needed. Some facilities stated that they already conduct inspection of material handling and loading/unloading areas when chemical preservatives are shipped or received. Some commenters suggested that no documentation be required.

In response, EPA would like to clarify that the proposed requirement was intended to require site personnel to inspect the areas where material handling and loading/unloading activities were occurring on a daily basis. These areas would be inspected on those days when material handling or loading/unloading activities were occurring but would not be required to be inspected when the activities were not occurring. This requirement was placed in the permit because these areas are subject to leaks and spills of materials, tracking of spilled chemicals by equipment, discharge of wood debris and dust generation from heavy equipment. Daily inspection of these areas would only require that someone be responsible for examining each of the areas to determine which BMPs should be implemented to limit the contamination of storm water discharges. For example, the inspector may see that a small amount of a chemical has been spilled near a loading dock which could potentially either be tracked away from the site on truck tires or if it rained could enter the storm water discharge. With daily inspections of these areas, the inspector could immediately initiate clean up of the spill and make suggestions for additional BMPs to be implemented into the plan to avoid future spills. No elaborate documentation of these inspections is required, however, the facility's pollution prevention team should develop a simple method of tracking whether someone has observed the areas when material handling and loading/unloading activities are being performed on a daily basis. If follow-up measures are appropriate in response to the inspection, these should be documented as well. For example, the documentation may simply be checking a log sheet and stating on the sheet that the inspection was performed on a particular day. Follow-up action may require initiating the work and marking a log sheet stating that the work was performed.

EPA disagrees that daily inspections would be burdensome. The inspection of material handling and loading/unloading areas is being required daily (when activities are occurring in those areas) because of the nature of the activities. These activities create a high risk for discharging pollutants to storm water discharges and require that more frequent assessments be made to ascertain the effectiveness of BMPs in those areas. These inspections, which should become a simple daily routine, may be made by personnel who are already in these areas at the time the activity is occurring. If inspections are already being conducted at material handling and loading/unloading areas when chemical preservatives are shipped or received then these can be incorporated as part of the pollution prevention plan and may satisfy part of the requirement. In addition, EPA believes the commenters are confused by the proposed language for daily inspections of material handling and loading/unloading areas in the permit. Therefore, the language in today's multi-sector permit will clarify this requirement.

Numerous comments were received on the requirement to perform monthly inspections at processing areas, transport areas and treated wood storage areas of facilities performing wood surface protection and preservation activities. The commenters argued that these inspections are unnecessary because employees are currently trained to prevent drippage of treatment chemicals on unprotected soils. They feel these requirements are duplicative of requirements under RCRA Subpart W. EPA disagrees that these inspections are unnecessary. Documentation associated with the listing of wood preserving and wood surface protection wastes at 40 CFR 261 showed that there remains a potential for storm water to become contaminated through incidental activities such as tracking of material, fugitive emissions, rushed operations and miscellaneous other activities. EPA therefore believes it is necessary to require these inspections so that site personnel may identify sources of pollutants and to implement BMPs to minimize contamination of storm water discharges at each facility. Where inspections of this type are being conducted for another program requirement, such as for RCRA, those inspections can suffice for meeting the requirements of this permit.

Some commenters were concerned that the requirement to identify areas where soils are contaminated as a result of past surface protection and preserving activities would be too burdensome. Some commenters stated that it might require extensive and very expensive testing of areas to determine where residual contamination remained and may even require expensive environmental site assessments. Several commenters argued that areas where contamination still remains could be identified through the site inspections, and once identified could then be remediated. In response, EPA disagrees that the requirement is too burdensome. The proposed permit stated that "Where information is available, facilities that have used chlorophenolic, creosote, or chromium-copper-arsenic formulations for wood surface protection or preserving activities on site in the past should identify in the inventory the following: areas of contaminated soils, treatment equipment and stored materials that still remain and practices employed to minimize the contact of these materials with storm water runoff." If information is readily available, then the pollution prevention team would merely incorporate that information into the plan and identify pollution prevention measures to minimize contact with run-off. If the information is not available, no additional site assessments would be required. The fact sheet language in today's multi-sector permit clarifies this requirement.

In general, commenters supported the proposal that timber product facilities that do not surface protect or preserve should not be required to monitor their storm water discharges. These commenters agreed that storm water pollution prevention plans provide the necessary protection for controlling storm water pollution at timber product facilities. Many comments were received on the sampling and monitoring required by those timber products facilities that use formulations for wood surface protection and preservation. Many of the commenters were opposed to the sampling and monitoring requirements because they would impose significant administrative and economic burdens on wood preserving facilities in particular. They stated that the data obtained through the proposed monitoring program would provide marginal benefits to EPA because the highly variable data could not be used to measure the performance of BMPs. They believe that the efforts and expenses would be better used in developing and implementing pollution control measures. A few commenters also argued that wood preserving facilities should not have to monitor for TSS, COD and BOD because the requirement is based on concentrations from NURP studies which were performed in residential areas and because these pollutants are not toxic to aquatic life. Some commenters were opposed to monitoring requirements at remote storage sites because there is neither meteorological equipment nor staff available and transportation to these sites is very difficult.

Some commenters did not agree with the requirement for facilities that use copper-chromium-arsenic formulations to sample for both copper and arsenic because it is not supported in the data. These commenters suggested that, if additional data was needed, only one of the parameters (copper) be monitored because sampling for both was unnecessary. Other commenters argued that arsenic should not be required to be sampled because, while toxic to humans if ingested, it is not toxic to aquatic organisms. Numerous commenters argued that timber product facilities where chlorophenolic formulations were used in the past for wood preservation should not be required to monitor storm water discharges for pentachlorophenol where prior testing has shown that there is no chlorophenolic residue at the facility.

A number of commenters in this sector also commented about: the proposed cut-off concentrations that would be used to determine whether facilities must sample during the fourth year of the permit term or under the alternative certification provisions of the permit; the variability of pollutant concentrations in storm water discharges; the eventual imposition of effluent limitations based on the cutoff concentrations; the use of total recoverable metals analyses; the toxicity of pollutants to aquatic organisms given receiving water dilution during wet weather events; the alternative monitoring provisions proposed in the fact sheet; the use of visual monitoring; the quality of the part II sampling database; the identification of priority sectors for monitoring and other monitoring issues that are discussed under the monitoring section of this summary.

As a result of the comments on monitoring throughout the multi-sector permit, EPA has revised the methodology for determining which sectors need to monitor (See discussion under monitoring). The methodology developed for the final permit analyzed the group application data based on three digit (or more) sub-sectorization of the industries represented in the groups. Based on this revised methodology, the timber products sector has been divided into four sub-sectors for data analysis. These four sub-sectors are SIC code groups 2421 (sawmills and planing mills), 2491 (wood preserving), 2411 (log storage), and 2426/2429/243/244/245/2493/2499 (millwork, veneer, wood containers, plywood and structural wood, and wood products not elsewhere classified). Using the data in the group application database, and data submitted subsequent to development of the database, EPA analyzed the monitoring requirements for these four sub-sectors using the revised benchmarks. As a result, EPA is now requiring monitoring of all four sub-sectors in the timber products sector. SIC code 2421 will monitor for COD, TSS and zinc. SIC code group 2491 will monitor for total recoverable arsenic and total recoverable copper. SIC code group 2411 will monitor for TSS and SIC code groups 2426/2429/243/244/245/2493/2499 will monitor for COD and TSS. In addition, the timber products industry must perform quarterly visual examinations of their storm water pollution prevention plan. EPA believes these revised monitoring requirements are responsive to the major comments received on the proposed monitoring provisions in that the monitoring is more industry-specific due to the sub-sector approach and that this approach more accurately identifies the pollutants of concern within each industry subsector. In response to the issue of whether a remote facility should be required to comply with the monitoring provisions, EPA realizes that if a facility is inactive and unstaffed it may be difficult for the operator to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly chemical sampling. In addition, if an active facility cannot collect a sample within a given quarter due to weather problems, inaccessibility, etc. then the permit allows the facility operator to take a replacement sample in the next quarter.

With regard to the requirement to conduct monthly visual examinations, EPA has reduced the visual examination schedule for active sites to only quarterly and has allowed a waiver of this requirement for inactive, unstaffed facilities. The operator should consult their permitting authority. Under these circumstances, the multi-sector storm water permit may not be a feasible permit for the facility and an alternative storm water discharge permit may be more appropriate.

Chemical and Allied Products Manufacturing

EPA received 19 comments specifically concerning the Chemical and Allied Products Manufacturing sector. A common concern of these commenters was a disagreement with EPA's grouping of all chemical and allied product manufacturers into one sector. Various commenters stated that they should not be in the same sector with certain facilities which they believed posed more of a threat to water quality. Several commenters suggested that this sector be subdivided with different requirements for each of the subdivisions.

Although the proposed permit divided the Chemical and Allied Product Manufacturing sector into eight subsectors, it applied the same requirements to each of these subsectors. Commenters expressed dissatisfaction with this aspect of the proposal. One commenter stated that some groups in this sector should get monitoring exemptions granted if they can demonstrate that they are substantially different from other groups in the sector. Commenters raised several other issues. One stated that there is no such thing as a typical chemical manufacturing facility and that EPA needs to visit each in the "broad array of chemical facilities" in order to understand the diversity of the industry. EPA understands that there may be significant differences between facilities in each sector and even within a subsector. Each facility has its own unique land features, operations and storage activities, material management practices, and chemical product manufacturing, packaging, and transferring techniques. It is not feasible that EPA visit each facility that will be regulated under this permit and in fact this level of scrutiny would best lead to the development of an individual storm water discharge permit for each chemical manufacturing plant. However, this is not the intent of this permit action, which is to issue a storm water general permit for similar types of industrial activities described under this sector and subsectors. In recognition of the differences between facilities, EPA is issuing a flexible storm water general permit, which allows each permittee to develop a pollution prevention plan for their own facility. This permit also contains an "alternative certification" condition, which allows a waiver for any chemical monitoring requirement for a pollutant that the permittee believes is not present at the facility.

One commenter stated that the proposal arbitrarily and capriciously requires thirty (30) mandatory structural and non-structural Best Management Practices (BMPs) and that EPA should defer BMP selection to the discretion of the facility operators. In response to this concern, EPA has reviewed the requirements in this sector, and for all other sectors, for BMP implementation and has revised the final permit to maintain flexibility in the selection of BMPs to be implemented at any particular industrial activity. The facility operator is allowed to choose the best type of management practices for their facility and their particular storm water problems. The permit does not mandate specific structural controls.

Asphalt Paving and Roofing Materials and Lubricant Manufacturing Facilities

Several commenters indicated that there should be further subdivision of the industries covered by the asphalt paving and roofing materials manufacturers and lubricant manufacturers sector. Commenters indicated that the industries covered by the sector do not have similar raw materials, finished products or processes. EPA realizes there are differences in the industrial activities covered under this section of the permit. EPA has analyzed the sampling data for the asphalt paving and roofing materials manufacturers separately from the lubricant manufacturers. The determination of the monitoring requirements for the final permit were made based upon the subsector analyses, not upon analyses of the entire sector's data. Although there were differences in the concentrations of pollutants in storm water discharges from these types of facilities, these differences are not substantial. Regardless, the permit requirements allow for variation from facility to facility. The operator must prepare a storm water pollution prevention plan based upon the sources of contamination which they identify.

Commenters also expressed concern with the portion of the proposed permit's fact sheet which discusses the potential pollutants of concern. Commenters stated that they disagreed with EPA's characterization of several pollutants being "of concern". The commenters felt that the part 2 application sampling results clearly indicated that these pollutants were not of concern for the industry.

The pollutants of concern are the parameters listed in the fact sheet as potentially being present in the storm water discharges and they may be different from the pollutants which a sector is required to monitor. These pollutants are listed based upon significant materials and industrial activities and other information submitted in the group applications. The listing of these pollutants provides guidance to facility operators in helping identify potential sources of storm water contamination and in selecting appropriate BMPs. EPA believes that the Part 2 sampling results cannot be the sole factor considered when selecting pollutants of concern for an industry. Permit writers must also consider all significant materials and industrial activities exposed to storm water.

Several commenters reinforced EPA's decision not to include analytical monitoring requirements for the asphalt or lubricant manufacturing facilities. A number of commenters stated their opposition to the alternative monitoring requirements included in the proposed permit's fact sheet. (The alternative monitoring requirements included annual analytical requirements for TSS, COD, pH and oil and grease.) One commenter expressed support for the analytical requirements, indicating that this would be the best way to evaluate the effectiveness of the storm water pollution prevention plan.

Based on the revised methodology for determining pollutants of concern (discussed under monitoring), EPA has determined that limited analytical monitoring requirements are necessary to aid the asphalt or lubricant manufacturing facilities in evaluating the effectiveness of the permit. Today's permit contains analytical monitoring requirements for total suspended solids (TSS) from these facilities. There are also compliance monitoring requirements for asphalt emulsion manufacturing facilities which are subject to the storm water effluent limitations guidelines. Facilities in this sector should not overlook this requirement.

One commenter indicated that the frequency of the visual examination of storm water discharge was burdensome and suggested reducing the frequency to a semi-annual basis. In response EPA believes that facilities must perform visual examinations of storm water discharges in order to assess the effectiveness of the storm water pollution prevention plan over the course of the year. The discharge of pollutants may be impacted by the seasonal weather changes, or operational changes that occur over the course of 6 months. It is necessary for a facility to examine their storm water discharge on a quarterly basis to assess how these changes impact the quality of the discharge. The same commenter also suggested that a facility not be required to perform the visual exam after two consecutive "clean" samples are observed. EPA does not agree with the commenters suggestion. It is not possible to define a "clean" sample for a visual examination, because the visual exam is subjective. The exam is not intended to provide facilities with an absolute means of comparing their discharge to other facilities' discharges, it is intended to provide operators with a relative comparison of the discharge quality from one period to another.

One commenter indicated that the compliance monitoring requirements and numerical effluent limitations should be eliminated for the asphalt roofing emulsion manufacturing facilities. The commenter felt that group application sampling data showed there was no need for monitoring. EPA's response is that the numerical effluent limitations for storm water discharges associated with asphalt roofing or pavement emulsion must be included in any NPDES permit which covers these discharges as required by the effluent limitations guideline at 40 CFR Part 443. The permit must also require at least annual monitoring for any pollutant limited by the effluent limitations guideline. These are requirements which cannot be modified in the context of this permit issuance.

Stone, Clay, Glass, and Concrete Products

There were a number of comments received regarding the proposed permit requirements for the glass, clay, cement, concrete, and gypsum product manufacturing sector. These comments focused primarily upon three areas; the types of industrial activities addressed under the sector, the storm water pollution prevention plan storm water pollution prevention plan requirements, and the monitoring requirements.

Several commenters indicated that they believed the sector included too diverse a range of industrial activities, and that sectors should be created for each of the various industrial activities currently covered under the one sector. Commenters were concerned that industries with relatively little discharge of contaminated storm water had been placed into a sector with industries with higher contamination, and that more stringent monitoring requirements were being placed upon their industry than would have been required had their industry or group been considered separately.

In response to these and other concerns, EPA has revised its methodology for determining the monitoring requirements. EPA divided this sector into four subsectors for further data analyses and comparison to benchmarks. The subsectors included: glass products manufacturing, cement manufacturing, clay products manufacturing, and concrete products manufacturing. Monitoring requirements were determined based upon this subsector analyses.

However, in relation to the storm water pollution prevention plan requirements for the sector, these requirements remain the same as proposed. EPA believes there is sufficient flexibility within these requirements to allow the each permittee to select the most appropriate measures for their site. Therefore, subsectored pollution prevention plan requirements were not added to the final permit.

Commenters also expressed concern that the storm water pollution prevention plan requirements for this sector are burdensome, particularly the requirements for storage of fine granular solids, removal of spilled materials, and management of runoff. One commenter stated that storage of bulk dry materials in an enclosed area would be too costly, and that covering the materials with a tarp would be impractical given the need to access the piles. In response, EPA wishes to clarify that today's permit requires that facilities prevent the exposure of fine, dry granular solids to storm water. The permit does not require these materials to be enclosed, or permanently covered. At a minimum, a facility must cover these storage piles while the piles are not in use and while it is raining. However, the piles need not be constantly covered, provided a tarp or other removable cover is near by. It should also be clarified that the requirement does not apply to coarse granular material such as sand or gravel, only to fine granular materials that are readily suspended or dissolved into storm water such as cement or fly ash.

The same commenter stated that a facility should be permitted to select the BMPs for removal of spilled materials from paved areas. In response, EPA wishes to clarify that the permit allows "regular sweeping, or other equivalent measures" therefore the permit does provide the permittee flexibility in selecting the methods for removing spilled materials.

The majority of the comments received regarding the requirements for glass, clay, cement, concrete, and gypsum product manufacturing facilities addressed the monitoring requirements contained in the proposed permit. Many of these comments addressed the methodology for selection of this sector as a "priority" monitoring sector. These comments expressed concern that the monitoring methodology did not consider the variation in industrial activities within the sector.

The comments also expressed concern that the bench mark or "cut-off" concentrations were too restrictive. As a result of these and other comments, EPA has modified the methodology for selection of industries as "priority monitoring sectors (comments regarding the methodology for selection are addressed separately in this attachment). The selection of industries and parameters for monitoring was made at the subsector level. Sampling requirements for the glass subsector, the cement subsector, the clay subsector, and the concrete subsector were determined separately. The results of the modification in the monitoring methodology are a reduced list of parameters for analytical monitoring in the concrete, clay and cement products manufacturing facilities.

A number of commenters endorsed the alternative monitoring requirements which were included in the fact sheet for the proposed permit because these requirements only consisted of visual examination of discharge without any

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analytical monitoring. After further review and consideration of the sampling data submitted, EPA has determined there is a significant potential for the clay and concrete products facilities to discharge pollutants at high concentrations. Sampling at these facilities during the term of the permit is necessary to determine the presence of pollutants and to assess the effectiveness of the storm water pollution prevention plan in controlling them. The alternative monitoring requirements are not included in today's permit for this sector.

Several commenters state that the requirements for monthly visual examination of storm water is unreasonable, and burdensome. In response, EPA has determined that a monthly visual examination is not necessary and that a quarterly (four times per year) visual examination of storm water discharge will provide sufficient information to the permittees in evaluation of the storm water pollution prevention plan, without imposing a substantial burden on the facility.

Primary Metals

A number of commenters were opposed to the use of benchmark levels for the determination of which sectors should conduct monitoring, or opposed benchmark levels for specific pollutants as being inappropriate. Generally, commenters expressed concern that the benchmark levels were unrealistically low and would result in monitoring requirements even for "clean" facilities. Primary metals facilities were especially concerned about the proposed benchmark level for pyrene, which commenters believed was below detection levels, and is not used by many facilities in the industry.

In response, EPA has reevaluated benchmark levels for all pollutants, and has adjusted the level for several. The new benchmark level for pyrene is 0.01 mg/L based on a laboratory derived minimum level (ML). Because of this new benchmark, facilities in the Primary Metals sector are no longer required to monitor for pyrene under the standard monitoring requirements of this sector. In addition, flexibility has been added to the permit through the adoption of an alternate certification that allows facilities that can certify that they do not have exposure of a particular pollutant to storm water to eliminate monitoring for that specific pollutant.

EPA received many comments opposing the combination of several group applications into the primary metals sector. Commenters pointed out differences between industry subgroups and requested different requirements for different subgroups. Several commenters stressed that unless monitoring requirements were to be determined based on subgroups within the sector, that additional flexibility was needed to account for the wide variety of facilities within the sector.

Although EPA agrees that industries within the primary metals sector conduct a variety of activities, the flexible conditions of the permit address those differences adequately. In response to comments regarding inappropriate grouping of industry sectors, sampling data has been reevaluated at the 3 digit SIC code level to determine which facilities will be required to conduct monitoring. Facilities in the primary metals sector have been subdivided into seven groups: SIC 331—steel works, blast furnaces, and rolling and finishing mills; SIC 332—iron and steel foundries; SIC 333—primary smelting and refining of nonferrous metals; SIC 334—secondary smelting and refining of nonferrous metals; SIC 335—rolling, drawing, and extruding of nonferrous metals; SIC 336—nonferrous foundries (castings); and SIC 339—miscellaneous primary metals products. The final permit monitoring requirements now apply to only facilities in SIC groups 331, 332, 335, and 336.

Some commenters also opposed the monthly inspections and visual monitoring requirements, as well as the quarterly comprehensive site compliance evaluations for this sector. EPA has dropped the monthly facility inspections and visual monitoring requirements. EPA believes that quarterly facility inspections and visual monitoring should be adequate to evaluate the effectiveness of the pollution prevention plan. The requirements for conducting comprehensive site compliance evaluations have also been modified. Comprehensive evaluations will be required only on an annual basis for this sector rather than quarterly, as proposed.

Many commenters suggested alternate monitoring frequencies than those proposed. Generally, commenters felt that monitoring four times per year in years 2 and 4 was unnecessarily burdensome, impractical, or unrealistic, especially in arid and remote locations. Some commenters suggested that monitoring one or two times per year would provide representative data at less expense to regulated facilities.

EPA disagrees that quarterly sampling is unrealistic and has provided some flexibility for active facilities that do not experience a representative storm event during the required sampling period. When a discharger is unable to collect a sample during a monitoring period due to adverse climatic conditions, the discharger may collect two samples from two separate qualifying storm events in the next period and submit these data. This waiver is only intended to apply to insurmountable weather conditions such as drought or dangerous conditions such as lightning, flash flooding, or hurricanes. EPA believes that quarterly sampling will allow better characterization of storm water discharges and assessment of the effectiveness of the facilities' pollution prevention plan, without placing an undue burden on permittees. Annual sampling could not accomplish an adequate assessment.

Several commenters expressed opposition to the potential inclusion of whole effluent toxicity (WET) testing under the multi-sector permit and characterized WET testing as expensive, impractical, inappropriate, and useless. Although EPA is not including WET testing under the terms of today's permit for this sector, EPA disagrees that WET testing is inappropriate for testing storm water discharges. EPA believes that WET testing can be a valuable monitoring tool in certain circumstances.

Metal Mining

Comments on permit requirements in the metal mining (ore mining and dressing) sector, focused on the application of the effluent limitation guidelines, compliance time, grouping of facilities, end-of-pipe treatment, definition of inactive and active mining, scope of coverage offered by the permit, and monitoring requirements.

A special condition of the multi-sector general permit is that those discharges subject to the effluent limitations guidelines (ELG) for the Ore Mining and Dressing Point Source Category (40 CFR 440) cannot be covered under the permit. Table G–4 in Part VIII.G. of the Fact Sheet contains a listing of various sources of discharges at active metal mining facilities and specifies whether or not discharges from those sources are subject to the ELG. Several commenters contend that through this clarification, EPA will expand the scope of discharges subject to the ELG by including storm water runoff from overburden, waste rock piles, haul roads, and other sources as being subject to the ELG. The commenters contend that storm water runoff from these sources previously had not been subject to the ELG and could, in the past, be permitted as storm water discharges.

EPA believes Table G–4 represents a clarification of the relationship of ELG and storm water at active metal mining sites, and does not expand the current ELG requirements. EPA also believes the development document and the ELG support the interpretation given in Table G–4. In the November 6, 1975 preamble to the effluent limitations guideline, it states "The definition of a mine was intended to be sufficiently broad to cover all point source pollution resulting from all of the activities related to operation of the mine including drainage tunnels, haul roads, storage piles, etc." (40 FR 51727). In the 1978 development document (Development Document for Effluent Limitations Guidelines and New Source Performance Standards for the Ore Mining and Dressing Point Source Category, EPA, July 1978, page 146), the following definition of a mine was given for purposes of recommending subcategories and effluent limitations guidelines and standards:

> A mine is an area of land upon which or under which minerals or metal ores are extracted from natural deposits in the earth by any means or methods. A mine includes the total area upon which such activities occur or where such activities disturb the natural land surface. A mine shall also include land affected by such ancillary operations which disturb the natural land surface, and any adjacent land the use of which is incidental to any such activities; all lands affected by the construction of new roads or the improvements or use of existing roads to gain access to the site of such activities and for haulage and excavations, workings, impoundments, dams, ventilation shafts, drainage tunnels, entryways, refuse banks, dumps, stockpiles, overburden piles, spoil banks, culm banks, tailings, holes or depressions, repair areas, storage areas and other areas upon which are site structures, facilities, or other property or materials on the surface, *resulting from* or incident to such activities (emphasis added).

It is important to note that the definition of "mine" includes the term "resulting from". Thus, something "resulting from" the mining activity is considered part of the active mine even though there is no activity at that specific part of the mine (e.g. waste rock is no longer being placed on a waste rock pile that is part of the mine). It would continue to be considered as part of the active mine until reclamation is started on that same portion of the mine. Residuals (waste rock piles, tailings piles, etc.) from historical mining at the site are not part of the active mining area unless they are re-disturbed by the current mining activity. The revision of the ELG in 1982 addressed best available technology economically achievable (BAT), best conventional pollutant control technology (BCT), and best available demonstrated technology (BADT). That revision did not address the issue of what discharges were subject to the ELG. The definition of mine remained unchanged. In 1983, training sessions on how to implement the ELG were held for permit writers from EPA Regions and approved NPDES States. The guidance document used for those training sessions included the following Statement:

> "Active mine areas" include the excavations in deep mines and surface mines; leach areas; refuse, middling, and tailing areas; tailing pond, holding and settling basins; and other ancillary areas to a mine or mill. Active mine areas do not include areas unaffected by mining or milling.

Based on the above, it is EPA's position that the following storm water discharges at active metal mining facilities are not subject to the ELG and can be covered by the multi-sector general permit: offsite haul/access roads; onsite haul roads not constructed of waste rock or spent ore; runoff from tailings dams/ dikes when not constructed of waste rock/tailings; concentration building and mill site if storm water only and no contact with material storage piles; chemical storage area; docking facility; explosive storage; fuel storage; vehicle/equipment maintenance area/building; vehicle/ equipment parking areas; power plant; truck wash area; reclaimed areas released from reclamation bonds prior to December 17, 1990; and partially/ inadequately reclaimed areas or areas not released from reclamation bond. Storm water discharges from inactive mining facilities can be covered under the multi-sector permit.

In developing Table G–4, consideration was given to such factors as the nature of the source, the materials in the sources (e.g. raw materials, intermediate products, or waste products from the mining and milling operations), and whether or not it was likely that source was considered in the development of the ELG. It was decided that runoff from on-site haul roads not constructed of waste rock or spent ore, and runoff from tailings dams/dikes not constructed of waste rock/tailings should not be considered subject to the ELG because they do not have the same potential for containing toxic pollutants as do mine wastes. Such runoff would be similar to that from non-mine facilities.

Two commenters stated that if the scope of discharges subject to the ELG for the Ore Mining and Dressing Point Source Category is expanded, then the permit needs to allow additional time (up to 3 years) to come into compliance with the effluent limitations as was proposed for the effluent limitations in the mineral mining sector. As explained in the response to the previous comment, Table G–4 is a clarification, not an expansion, of the discharges subject to the ELG. The multi-sector general permit does not authorize (apply to) discharges subject to the ELG for metal mining (i.e., 40 CFR Part 440). Therefore, a schedule for achieving compliance with those effluent limitations is not appropriate for the multi-sector general permit. Furthermore, the statutory deadline for compliance with the ELG is past.

A commenter felt that the draft multi-sector permit is extremely generic and lumps together all facilities in an extremely broad industry sector (e.g., ore mining and dressing), regardless of differences in product, processes used, or topographic and climatic conditions. The commenter further stated that difficulties caused by generic treatment of disparate facilities in a broad industry "sector" (e.g., the ore mining and dressing sector) are exemplified by the manner in which EPA determined the need for analytical monitoring requirements. The commenter had understood the purpose of the group application process to be the development of tailored, industry-specific permits for groups of facilities located in very similar areas, with permit conditions being tied to the particular circumstances of those facilities as described in the group application (including the sampling data provided in those applications).

This comment is similar to comments on several other sectors of the permit. The requirements to develop a storm water pollution prevention plan for metal mining facilities allows a great deal of flexibility to take into consideration such variables as type of ore being mined, pollutants of concern, type of mine, and local topography and climate. It would be difficult to have a variety of monitoring options to cover the various combinations of ores and climates, given the limited data submitted. Decisions being made on benchmark values may reduce monitoring requirements. Two commenters felt that imposing end-of-pipe treatment requirements for storm water discharges from mining operations, such as those contained in the ore mining and dressing effluent limitation guidelines, is both impractical and unnecessary. In the commenters opinion, the use of BMPs is more appropriate than the use of numerical effluent limitations.

This comment appears to be related to a previous comment about EPA expanding the scope of discharges from metal mining facilities that are subject to the effluent limitations guidelines (ELG) for the Ore Mining and Dressing Point Source Category (40 CFR Part 440). As previously mentioned, those discharges subject to the ELG are not authorized by the multi-sector permit. The storm water pollution prevention plan requirements in the permit do not include the requirement to use end-of-pipe treatment for those storm water discharges from metal mining operations that can be covered by the permit. In some situations end-of-pipe treatment may be the appropriate means of control and should be used. That would be determined on a case-by-case basis.

With regard to the definition of inactive metal mining and dressing facilities, two commenters stated that the proposed 10-year period for declaring inactive status is arbitrary. They suggest that a more logical date for the distinction between active and inactive facilities would be December 17, 1990, which is now expressly referenced in EPA's storm water regulations at 40 CFR § 122.26(b)(14)(iii).

In response, some metal mining facilities may be temporarily shut down due to poor market conditions (e.g., uranium mines), seasonal conditions (e.g., heavy winter snows), and/or other factors. Some of these facilities are "mothballed" with the intent of bringing them back into operation when conditions improved to an acceptable level. For purposes of the multi-sector permit it was decided to consider such facilities as "temporarily inactive" rather than inactive. The distinction between "temporarily inactive" and "inactive" often is unclear when no reclamation activities have occurred at the site. In the draft permit the distinction between temporarily inactive and inactive was a period of ten (10) years with no mining and/or milling activity at the site. In the final permit the determination will be based on whether or not the facility has an active mining permit issued by the applicable (federal or State) governmental agency that authorizes mining at the site. All States now have agencies that have the authority to authorize mining on non-federal lands. Even though there may be no activity at the facility, it will be considered temporarily inactive as long as it has a permit for mining activity at the site.

The definitions of inactive and temporarily inactive facilities have been revised somewhat to reflect what EPA believes to be the appropriate distinction between the two definitions. In order for a site, or portion thereof, to be considered "inactive," there must not be any current metal mining and/or milling activities, as defined in this permit, at that portion of the site and that portion of the facility does not have an active mining permit issued by the applicable governmental agency that authorizes mining at the site.

A metal mining facility, or portion thereof, is considered to be "temporarily inactive" if metal mining and/or milling activities occurred in the past, but currently are not being actively undertaken, the facility has an active mining permit issued by the applicable governmental agency that authorizes mining at the site. There is no time limitation on how long such a site can be considered to be temporarily inactive. EPA believes such sites should provide the extra storm water pollution prevention requirements that the temporarily inactive status requires compared to what is required for inactive status.

The proposed permit would require metal mining sites to identify, in pollution prevention plans, the outfalls from the site that contain mine drainage or process water and designate for each outfall the boundaries of the area that contribute to such areas. A commenter objected to this permit condition as being beyond the scope of the proposed multi-sector permit. Except for primary metals industrial sector, this is not being required of other industrial sectors.

In response, Part XI.G.3.a(3)(a)(i) of the draft permit stated "A site topographic map shall be included in the plan that indicates, at a minimum: . . . and boundary of area that contributes runoff to outfalls that are subject to effluent limitations guidelines." EPA would like to clarify that the last part should read ". . . boundary of tributary area that is subject to effluent limitations guidelines." Those discharges that are subject to effluent limitations guidelines (ELG) need to be regulated under another permit. It is the permittee's responsibility to identify discharges that are not authorized under this permit, but that mix with those storm water discharges that are authorized by the permit. This requirement is included in the metal mining sector because at most metal mines there are numerous areas where the storm water runoff is subject to the ELG. That is not the situation for most of the other sectors covered under the multi-sector permit.

One commenter stated that EPA should clarify that storm water permits are not required for discharges at mining sites which are not contaminated by contact with significant materials. This comment also applies to the coal mining and mineral mining sectors.

In response, based on the definition of storm water discharges associated with industrial activity (40 CFR 122.26(b)(14)(iii)), a permit is required for discharges from mining and milling facilities where the discharge has come into contact with any overburden, raw material, intermediate products, finished products, byproducts, or waste products located on the site. The exception is for discharges from areas of coal mining operations no longer meeting the definition of a reclamation area under 40 CFR 434.11(l) because the performance bond issued to the facility by the appropriate SMCRA authority has been released, or for discharges from areas of non-coal mining operations which have been released from applicable State or Federal reclamation requirements after December 17, 1990.

Two commenters felt that EPA's proposed analytical monitoring requirements for metal mining facilities should be substantially reduced, and they should be eliminated if EPA does not retract its proposed overly expansive interpretation of the Part 440 regulations.

In response, EPA has reevaluated the monitoring requirements for all the sectors of the multi-sector general permit and the number of pollutants for which monitoring is required for the metal mining sector has been reduced. EPA does not see any reason why the monitoring requirements should be further reduced just because EPA provided clarification as to what sources are subject to the effluent limitations guidelines for Metal Mining and Ore Dressing. The determination of the monitoring requirements for the metal mining sector was based on an evaluation of the monitoring data submitted with the group applications for metal mining facilities. The activity status of many metal mining facilities was taken into consideration in determining the monitoring requirements. Monitoring for the metal mining sector was limited to the active facilities.

Oil and Gas Extraction

Comment on Sector I, the oil and gas extraction sector, focused on coverage allowed under the general permit for oil and gas sites and pollution prevention plan requirements, particularly for remote, unmanned sites. Representatives of the oil industry made

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the comment that the landfarming of oilfield wastes as a practice to allow biological break down should be covered by this sector of the general permit. They state that this is a common practice at exploration and production facilities sites and should be considered a part of the oil and gas facility activity and not an industrial waste land application site subject to the requirements under the land application sector in part XI.L. of the multi-sector permit.

In response, EPA would first like to note that the land application or disposal of oilfield wastes, produced waters, and oilfield drilling muds is an activity that is regulated by most States; and as such must be taken to State approved disposal sites. The discharge of any of these materials and their associated pollutants to a water of the U.S. is not authorized under this sector. Although, in theory, the practice of landfarming oilfield wastes would seem consistent with a no discharge requirement, there is the potential for pollutants from these land application sites to be discharged in storm water runoff and as such should comply with the permitting requirements of 122.26(b)(14). The oil and gas industry is not unique in that it land applies industrial wastes as a disposal practice. EPA must be consistent in its approach to land disposal practices under the storm water program. Also, EPA is concerned that proximity of the disposal site to actual drilling activity may be variable. For these reasons EPA believes these sites are more accurately described as land application/disposal sites and are subject to storm water permitting under section XI.L. of this permit. Where these sites are indeed proximate to the drilling/production site the disposal activity would be considered a co-located activity and would be subject to the additional requirements under Sector XI.L. of this permit.

Commenters requested that the construction activities associated with oil and gas exploration and production (e.g., construction of access roads, drill pads, mud pits etc.) should be covered under the erosion requirements of this permit and that those activities not require a separate general permit coverage for the construction activities. In response, erosion, sediment, and pollution control should be addressed in all pollution prevention plans for industrial activity. Particularly where the industrial activity has the potential to disturb vegetation or natural runoff patterns and exacerbate erosion. This is true of oil and gas exploration and production activities. Therefore EPA has included additional requirements in the development of pollution prevention plans for these facilities. However, where the construction of a drilling site or any construction of facilities covered by this sector would cause the disturbance or is part of a plan to develop which would disturb five acres or more, then that construction activity itself, becomes an industrial activity which is defined in the regulations (40 CFR 122.26) as having storm water associated with industrial activity which requires separate permitting. EPA has issued a general permit which addresses the runoff from construction activities. This multi-sector general permit, while providing guidance for construction activities under five acres that may occur at a site, does not authorize large scale construction (5 or greater acres) and erosion control. EPA does not believe that it is unnecessarily burdensome for the oil and gas industry to file a construction general permit Notice of Intent and be compliant with the pollution prevention requirements for their sites which will cause the disturbance of five acres or more.

Many commenters expressed concern that it will be very difficult (if not impossible) for oil and gas facilities to do visual monitoring on their remote unmanned sites. They complain that they will not know when its raining and cannot get there in time to get a proper sample. These commenters request that this quarterly visual monitoring be dropped from the multi-sector general permit as a requirement for remote, unmanned oil and gas sites.

In response to the issue of a remote facility being required to comply with the monitoring provisions, EPA realizes that if a facility is inactive and unstaffed it may be difficult for the operator to collect storm water discharge samples when a qualifying event occurs. Today's final permit has been revised so that inactive, unstaffed facilities can exercise a waiver of the requirement to conduct quarterly visual examinations.

Commenters asked for a two-tiered storm water pollution prevention plan. One for those facilities with lots of activity and a less burdensome plan (a de minimis plan) for remote facilities that are unmanned and have no activities (e.g., old oil field with a few capped wells on the property).

EPA agrees that a pollution prevention plan for inactive, unmanned sites should not include all of the same elements of a facility with continuous activity and personnel. However, the proposed pollution prevention plan requirements already allow for a plan that addresses potential pollutant sources in a way that is appropriate for each facility. EPA believes that this allows adequate flexibility for operators of unstaffed, inactive sites to address activities such as housekeeping and preventive maintenance in a manner that is appropriate for that site.

Coal Mines and Related Facilities

EPA includes inactive mining areas because significant materials remain on site which can be exposed to storm water and runoff. Two commenters disagreed with the listing of solvents, cleaning agents, contaminated soils and sludges as significant materials found on inactive sites. EPA agrees that these materials are not normally found on inactive sites in significant amounts, especially compared to exposed overburden and refuse piles. However, the Agency wishes to call attention to the possibility of these materials existing at inactive sites where machinery has been intensively used or has been abandoned.

One commenter disagreed with the Agency's conclusion that suspended solids and iron in storm runoff merit attention based on sampling data submitted. The commenter indicated that the sampling could not be presumed representative and that very high suspended solids concentrations are found in runoff from undisturbed areas in many western coal mines. The Agency agrees that the data was provided by only a small percentage of coal mines participating in the group application process and may not be representative. However, the sampling data submitted does give some indication of the relative amounts of pollutants contributed by storm runoff and the Agency wishes to call attention to those pollutants which appear to be more significant.

EPA requested comments on alternative monitoring and reporting requirements which include annual sampling of 20 percent of haul road discharges and analyzing the samples for settleable solids. Four commenters responded to these alternative requirements, all negatively. The primary reason indicated was that the expense and burden of analytical monitoring would not be justified. Most indicated that controls through Best Management Practices (BMPs) and visual examinations would be sufficient. EPA acknowledges these responses and, although it believes there is value in occasionally performing settleable solids evaluations, withdraws the alternative monitoring requirements as an option to the required visual examinations.

Four commenters indicated that the Surface Mining Control and

Reclamation Act (SMCRA) requires sediment and erosion controls in the form of BMPs and this requirement should be sufficient for purposes of the storm water general permit. One of the commenters disagreed with the reference of SMCRA requirements as minimum requirements rather than primary requirements of the pollution prevention plan of the general permit. EPA acknowledges the SMCRA sedimentation and erosion control requirements as the primary requirements for active coal mining-related areas and for inactive areas under SMCRA bond authority. The permit wording is modified to this effect while still indicating that, where determined appropriate for protection of water quality, additional sedimentation and erosion controls may be warranted.

Four commenters felt that the requirement for quarterly sampling and visual examination of representative discharges is burdensome and unnecessary. Reasons cited were that active areas and regulated by SMCRA, haul roads in some areas are remote, and rainfall in some western areas is unpredictable and spotty. Two of these commenters suggested as-needed visual examinations, one suggested annual examinations, and one suggested semi-annual examinations.

Although haul roads are regulated by SMCRA and in some cases may be remote, EPA is concerned that they can be a significant source of stream siltation if sediment and erosion control measures are not adequate to provide necessary protection of stream quality during precipitation events. The Agency believes that a requirement for periodic visual examinations of representative discharges is necessary in order to provide some evaluation of the effectiveness of control measures under actual runoff conditions. EPA also acknowledges that drier western areas would have less frequent incidences of precipitation resulting in runoff. The Agency has reduced the sampling and visual examination requirements from quarterly to semi-annually both for areas having an average annual precipitation of 20 inches or less as well as for inactive areas under SMCRA bond.

One commenter suggested that the requirement to collect samples form discharges resulting from storm events greater than 0.1 inch should be replaced by a requirement to collect samples resulting from any storm event sufficient to produce a visual flow. The Agency is concerned that some very small storm events may not have sufficient potential to significantly disturb and carry off sediment even though the storm events may produce visual flows. To evaluate effectiveness of sediment and erosion control measures under conditions which have potential for stream siltation, sampling discharges resulting from at least a 0.1 inch storm is felt warranted.

Four commenters disagreed with the requirement to sample within a 30-minute period or, where not practical, within a one-hour maximum period after beginning of a discharge resulting from a 0.1 inch storm event. Their concerns were similar in that some mining areas are extensive, rainfall measurements may differ in different parts of a mining area, and one hour is not enough time to respond with sampling. One of the commenters suggested that the sampling be required within one hour or as soon as practical after discharge begins. Another of the commenters suggested that samples be collected within two hours of discharge within normal business hours at 25 percent of a facility's representative outfalls.

The requirement of a 30-minute period (one hour where impractical) for obtaining samples is based on the fact that the highest potential of sediment runoff and resulting stream siltation occurs during early stages of storm periods where loose dirt and other materials are most likely to be swept away. However, the Agency recognizes possible problems at large mining areas for sampling within the required 30-minute to one-hour maximum period after beginning of discharge. The requirements are changed to allow sampling within the first one hour after beginning of discharge or, as soon as practical, but not to exceed a two-hour maximum time period. The Agency believes that this requirement is not burdensome since samples are required only from representative discharges and at frequencies of once per quarter and less in drier areas of the nation. Sampling flexibility is also provided by the number of 0.1 inch or greater precipitation events occurring during the quarterly or semi-annually sampling periods.

One commenter pointed out that the chemical monitoring requirements do not distinguish between active and inactive areas. This commenter and three others opposed monitoring requirements for inactive areas. Two of these commenters suggested, however, that samples be collected if discharges occurred during an inspection. The Agency agrees that mandatory sampling of inactive areas within a specific time period after initiation of a discharge due to a minimum precipitation event may be burdensome and has changed that requirement for operators of inactive, unstaffed facilities.

Three commenters suggest that inspections for inactive sites be specified at once every three years rather than yearly with an allowance under certain conditions of less frequent inspections. EPA does not believe that an across-the-board allowance of one inspection every three years would be adequate. Although no mining-related activity may be taking place at inactive sites, exposure of unreclaimed overburden, refuse or other materials on site is susceptible to erosion and runoff and warrants more frequent inspections of sediment and erosion control measures. Yearly inspections are felt to be appropriate to better assure that control measures have not deteriorated.

Mineral Mining and Processing Sector

The comments on sector J, the mineral mining and processing sector focussed on eligibility under the sector, monitoring requirements, and the pollution prevention plan requirements of the permit. EPA requested comment on whether mine dewatering should be included in the storm water multi-sector permit, and if included, if it should be expanded from just Region VI to all EPA Regions.

EPA has elected to allow currently unpermitted mine dewatering discharges from Construction Sand and Gravel, Industrial Sand, and Crushed Stone mines to be included in this permit, but only for facilities located in EPA Region VI and Arizona. This option does not exist in other EPA regions. Region VI and Arizona have a large number of unpermitted mine dewatering discharges and limited resources necessitating this requirement.

EPA Region VI proposed a limited amount of monitoring. Commenters felt that monitoring should be limited to only those parameters for which there are ELGs. For example, the construction sand and gravel subcategory (SIC Code 1442) only has ELGs for pH.

EPA Region VI has elected to require monitoring for those parameters indicated in the proposed permit. EPA believes that such monitoring is necessary to assess the pollutants levels in the discharge and to assess the effectiveness of the pollution prevention plan.

Commenters felt that industry should not be required to attain discharge levels for solids to a greater degree than that occurring in the natural erosion of the surrounding area or that found in the receiving stream during storm events. To that end, the commenters requested that the industrial facility or the State be

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responsible for establishing criteria for TSS limitations. In the proposed storm water discharge permit EPA did not establish any new storm water effluent limitations. Rather, the limits in the proposed permit are existing effluent guidelines under the NPDES program which the discharger should already be meeting. EPA believes that it would be imprudent to allow industry to establish its own TSS limitations. The method which a owner/operator of a facility chooses to reduce storm water discharges is left to the industrial facility.

In addition, EPA wishes to clarify that the "cut off" concentrations are not the same as effluent limitations. If a facility is unable to verify that its storm water discharge is below the cut-off concentration it will be responsible for the continued monitoring of that pollutant in its storm water discharge. Once again, the "cut off" concentrations are not storm water effluent limitations and should not be viewed as limits that must be met.

Commenters felt that while assessment and implementation of needed BMPs may be necessary, written discussion, documentation and scheduling of this procedure should not be a requirement of the storm water pollution prevention plan. According to the commenters, such assessments and decisions should be made prior to the development of the storm water pollution prevention plan. The outcome of those decisions should be made a part of the storm water pollution prevention plan. The commenters felt that the storm water pollution prevention plan represents the avenue for preventing storm water pollution and should not be used as an engineering report for BMP evaluation and selection.

On page 61162 of the November 19, 1993, **Federal Register** EPA identified the focus of storm water pollution prevention plans. The plan has "two major objectives: (1) to identify sources of pollution potentially affecting the quality of storm water discharges associated with industrial activity from the facility and (2) to describe and ensure implementation of practices to minimize and control pollutants in storm water discharges associated with industrial activity. . . ." EPA further States the storm water pollution prevention plan requirements are intended to facilitate a process whereby the operator of the industrial facility thoroughly evaluates potential pollutant sources at the site and selects and implements appropriate measures designed to prevent or control the discharge of pollutants in storm water runoff. EPA believes it is necessary to include the discussion and documentation of BMP selection in the storm water pollution prevention plan to ensure the plan developed for a facility is operating effectively. The storm water pollution prevention plan process involves four steps including the assessment of potential storm water pollution sources, the selection and implementation of appropriate management practices and controls, and the periodic evaluation of the effectiveness of the plan to prevent storm water contamination. Because of the uniqueness of mine sites, the effectiveness of the BMPs can most effectively be evaluated after their implementation.

Commenters requested that EPA provide for reduced inspection and visual examination requirements for active mineral mining and processing sites given the Agency's findings that these sites have "generally low pollutant values." In response, EPA strongly believes that quarterly visual examinations of storm water discharges is appropriate. Since EPA is not proposing the monitoring of storm water discharges from all subsectors, quarterly visual examinations will allow for feedback to be incorporated into a storm water pollution prevention plan.

Commenters requested that EPA provide for flexible inspection requirements and no monitoring requirements for inactive mineral mining and processing facilities, consistent with the Agency's proposed approach for metal mining sites. In response, EPA will require chemical monitoring of storm water discharges only from active sand and gravel and dimensional stone, crushed stone and non-metallic minerals facilities in this sector. The permit still requires quarterly visual examinations of all storm water discharges from active facilities but this requirement can be waived for inactive, unstaffed facilities.

The proposed mineral mining and processing sector permit required annual inspections for temporarily and permanently inactive sites, but did not allow for reduced inspection requirements for remote and inaccessible sites as EPA proposed for inactive ore mining and coal mining sites. Commenters requested that EPA provide the same relief provision for mineral mining sites as it did for coal and ore mining sites. In response, EPA has revised its inspection requirements by reducing the frequency of the comprehensive site compliance evaluation to annual for all active and inactive mineral mining and processing facilities.

Commenters felt that the requirements and conditions for termination of permit coverage would be unworkable because the "background values" for certain parameters, such as total suspended solids, would be highly variable from outfall to outfall and according to the intensity of storm events. In response, EPA has elected to delete the conditions for termination of coverage. These conditions would have been made available only if the alternative monitoring requirements were imposed in the final permit for this sector.

Hazardous Waste Treatment Storage and Disposal Facilities

One commenter questioned the definition of "treatment, storage, or disposal facility" that will be used relative to the storm water regulations. The storm water regulations published in the November 16, 1990 **Federal Register** apply to "hazardous waste treatment, storage, or disposal facilities that are operating under interim status or a permit under subtitle C of RCRA." The multi-sector permit requirements in this sector, apply to "facilities that treat, store, or dispose of hazardous wastes, including those that are operating under interim status or a permit under subtitle C." The use of the term "including" is not clear. The same commenter requested clarification regarding the inclusion of hazardous waste generators who operate storage areas (with less than 90-day accumulation) or temporary satellite accumulation areas. In addition, another commenter requested clarification on whether facilities regulated under Subpart X of 40 CFR 264 are subject to the storm water provisions.

EPA's intent regarding storm water permit coverage for facilities under this sector, is to include all treatment, storage, or disposal facilities (TSDFs) operating under interim status (40 CFR 265) and those operating under a permit issued pursuant to 40 CFR Parts 264 and 270. This includes facilities regulated under Subpart X of Part 264. It also includes recycling facilities whose operations are subject to regulation under Part 266, to the extent that these activities also are subject to interim status or permitting requirements under Subtitle C of RCRA. Used oil recycling facilities that are subject to regulations under Part 279 are included in Sector N of this permit, rather than Sector K. Sector K does not include generators who temporarily store hazardous waste pursuant to the requirements in 40 CFR 262. The permit language has been clarified to confirm that the multi-sector permit requirements in this sector apply to facilities that treat, store, or dispose of hazardous wastes and that are operating under interim status or a permit under subtitle C of RCRA.

Several questions were received regarding the parameters included in the monitoring requirements. More specifically, several commenters questioned the inclusion of Total Kjeldahl Nitrogen (TKN) and Chemical Oxygen Demand (COD) in the industry monitoring requirements in Table K–3, and the exclusion of Total Suspended Solids. The U.S. Army questioned whether the data they submitted was incorporated into Table K–1 on conventional pollutants in storm water. The Army also requested that EPA clarify the form of cyanide that is to be monitored, and suggested that a numerical detection limit should be specified for total recoverable magnesium and cyanide, rather than the words "detection limit."

The monitoring parameters and the cut-off concentrations specified by EPA for this sector primarily were based on the parameters previously established for the baseline general permit. These parameters were based on consideration of significant materials and the industrial activities of facilities in this industry. The amount of storm water data specific to TSDFs that EPA was able to evaluate was very limited; any data submitted from military organizations was evaluated separately and not included in Table K–1. Total recoverable cyanide is to be monitored by TSDFs; the commenter is referred to 40 CFR 136 regarding analytical methods to be used in the storm water program. Regarding the cut-off values for total recoverable magnesium and total cyanide, the concentration for magnesium is .0636 mg/l and the concentration of cyanide is .022 mg/l.

Some commenters questioned Region 6's assertion that storm water from hazardous waste Treatment, Storage, and Disposal Facilities (TSDFs) would not be allowed coverage under the Multi-Sector General Permit in Region 6 States (OK, NM TX, and LA). These commenters asked whether Region 6 intended to exclude only commercial facilities or all TSDFs. A few of these commenters noted that the exclusion of all TSDFs would put a financial and resource burden on both the regulated TSDFs and EPA by requiring all facilities to obtain individual permits. One commenter asked whether this applied to closed TSDFs as well.

Region 6 agrees with the commenters that it would be unduly burdensome to both the industry and the Agency to issue individual permits for all TSDFs. At this time, Region 6 would like to clarify their intent and indicate which TSD facilities would be allowed to be covered by a general permit; and those the Region specifically believe must obtain individual permits. Region 6 believes that General Permit coverage is appropriate for TSDFs that are self generating and are probably covered by the Multi-Sector General Permit via some other (primary) industrial sector. These facilities would be required to comply with the specific requirements in the Multi-Sector General Permit for their TSDF areas. The Region believes that the Multi-Sector General Permit requirements and monitoring for these facilities are appropriate. This would also apply to facilities that only store hazardous waste and do not treat or dispose of the hazardous materials. Also, the Region believes that disposal facilities that have been properly closed and capped, and have no significant materials exposed to storm water should not require permits in accordance with the description of storm water associated with industrial activity [40 CFR 122.26 (b)(14)].

However, it is Region 6's intent to issue individual permits for all commercial Treatment and Disposal Facilities. Those facilities would only be those which take commercially produced hazardous wastes (not their own) and treat or dispose of those materials. The Region has few of these, and the burden on the Regional permitting staff is small. Only six commercial facilities applied for coverage through the group application process. To date, Region 6 has required individual permit applications from all such facilities; and permits have included specific technology and water quality based limits. To allow existing facilities to obtain permit coverage under the Multi-Sector General Permit would be backsliding, and not allowable under part 402(o) of the CWA. To allow new facilities with permit conditions that are less stringent would not be consistent and would provide an economic advantage to new facilities over existing ones. In addition, Region 6 believes that more careful compliance tracking is warranted for facilities that treat and dispose of hazardous waste as a commercial operation. The Region does not believe that this would be burdensome on the few facilities that fall into this "commercial" category. These are large facilities that treat and dispose of large quantities of hazardous wastes as a service to generators. Because individual permits for these commercial hazardous waste treatment and disposal facilities has always been a priority, the Region believes it is consistent and appropriate to require all such facilities to apply for individual NPDES permits for their storm water discharges. This distinction does not apply to facilities that take and dispose of household (residentially produced) hazardous wastes. Facilities that accept, for disposal or treatment, wastes generated by private individuals at their residence are not required to submit individual applications unless they are a commercial facility for the treatment or disposal of hazardous wastes. Region 6 does not wish to discourage benevolent industry operators from offering this service and thereby discourage the proper disposal of household hazardous wastes by limiting their eligibility under this general permit.

Landfills and Land Application Sites

One commenter stated that the permit should provide reduced monitoring and pollution prevention plan requirements for landfills and land application sites that receive a homogenous waste stream. EPA agrees with the commenter that there are a wide range of industrial landfill and land application types depending on the nature of the waste received/managed. Even where the same waste categories are received by two landfills (or land application sites),. waste characteristics may be highly source-specific. For example, ash composition varies significantly depending upon the fuel type/source and the combustion process. Because of this diversity and the limited extent of monitoring data submitted with the group applications, the Agency has established broad monitoring requirements for this sector. Further, the Agency believes that quarterly monitoring during the second year of the permit is necessary to fully characterize storm water discharges from individual sites. The Agency also notes that Section 5.a.(3).(a) of the permit waives monitoring requirements during the fourth year on a pollutant-by-pollutant basis where sampling shows concentrations below the threshold levels.

Several commenters expressed concern that a wide variety of pollutants are listed in the monitoring requirements of the proposed permit. Potential source of pollutants and pollutant types vary significantly from landfill to landfill. EPA concurs with the commenter that there are a wide range of industrial landfill types depending on the nature of the waste received/managed. To address the commenter's concern, the Agency has developed the alternative certification described in Section L.5.a.(5) of the permit. This provision will allow permittees to exercise a waiver of the monitoring if they can certify that storm water will not be exposed to potential sources of pollution.

The Agency believes that permittees should implement BMPs to minimize erosion at sites (i.e., to prevent/minimize pollutant loadings to storm water). This includes stabilizing daily cover piles, wherever practicable, regardless of their locations. These measures will reduce the need to rely on other controls to manage/treat storm water runoff after contamination has occurred.

One commenter questioned the analytical monitoring requirements proposed for landfills closed prior to the effective date of 40 CFR 258.60. The commenter felt that all landfills closed in accordance with State or local regulations should be exempted from analytical monitoring. In response, the Agency believes that prior to the effective date of 40 CFR 258.60 there was significant variability in State MSWLF closure requirements. The closure provisions of State industrial landfill regulations are similarly diverse. Because of this variability, the Agency cannot be certain that landfill areas closed under State programs do not have the potential to contribute pollutants to storm water discharges (unless the requirements are equivalent to or more stringent than 40 CFR 258.60). Therefore, the Agency does not believe it is unreasonable to require monitoring for such sites. For landfills that are closed according to State or local requirements that are equal to, or more stringent than 40 CFR 258.60, the permit includes the "alternative certification" and "low concentration" waivers which should provide a means for such a landfill to forego the need to monitor.

Several commenters expressed concern that the frequency of the inspections required for storm water pollution prevention plan are excessive and impose an excessive burden upon facility operators. The Agency appreciates the commenters feedback on the inspection frequency and recognizes the potential difficulties that may arise from requiring inspections within 24 hours of a storm event. Therefore, the final permit has been revised to only include weekly inspections. The Agency believes that this frequency is appropriate for landfills and land application sites because of the nature of the BMPs typically used at these facilities. Erosion and sediment control measures often require frequent upkeep and maintenance to ensure proper operation.

One commenter requested a reduction in the monitoring requirements for facilities located in cold climates due to difficulty in collecting samples during winter periods. The Agency does not believe that monitoring requirements should be adjusted for landfills solely because they are located in cold climates. The permit provides a temporary exclusion from monitoring requirements during a quarter if sampling is unfeasible due to adverse conditions (including weather) and this provision should account for difficulties in conducting sampling due to climate. Under this exclusion, permittees are, however, required to collect two samples during the next quarter to make up for the missed sampling requirement.

Several commenters stated that the monthly visual examination requirements for this sector were excessive and burdensome. In response to these comments, today's permit requires only quarterly visual examination of storm water discharges. For active and staffed landfills and land application sites, the Agency does not believe that it is unreasonable to require sampling/visual examinations once each quarter within the first hour a storm event.

Auto Salvage Yards

A few commenters indicated that storm water runoff from automobile salvage yards is often contaminated with spilled residues of engine and transmission fluids, and battery acid saturated with lead. The Agency agrees that automobile salvage yard facilities may have many potential sources of storm water pollutants. Therefore, today's final permit incorporates permit conditions to address these potential sources. Such conditions include development of a pollution prevention plan, which includes the implementation of BMPs, regularly scheduled inspections, and visual and analytical monitoring to help assess the effectiveness of the pollution prevention plan and to identify potential problems with the plan that would lead to making plan revisions and incorporating additional control measures.

A few commenters stated that some of the conditions under the proposed multi-sector permit for automobile salvage yards are more stringent than those under the baseline general permit. In response, EPA wants to clarify that certain information, not available at the time of finalization of the baseline general permit, such as the group application information and sampling data, was used extensively in the development of the conditions in today's final permit. This information and data has identified pollutants of concern, the concentrations of these pollutants, and the industrial activities that are conducted on-site that generate these pollutants. The Agency has developed appropriate conditions in this final permit to address these storm water discharges.

Several commenters feel that the proposed semi-annual employee training requirement for facilities in the automobile salvage yard sector is too burdensome, especially considering the annual training required for most other sectors. Today's final permit requires facilities themselves to identify periodic dates for employee training in the storm water pollution prevention plan. The focus of the employee training required under the multi-sector permit is on informing personnel of the components and goals of the storm water pollution prevention plan (storm water pollution prevention plan). This includes familiarizing employees with their responsibilities under this plan. The Agency believes that periodic training programs are needed to keep employees up-to-date with the storm water pollution prevention plan but agrees that semi-annual requirements may be too burdensome for some facilities. EPA leaves the decision as to the frequency of employee training up to the facility operator because site-specific circumstances will call for different training frequencies and the facility operator is in the best position to make that decision. The frequency of training for auto salvage facilities can therefore be determined by each facility operator at the time they develop their pollution prevention plans. If additional training is necessary than what is originally identified, then the plan can be modified by the operator and the training frequency increased.

A few commenters requested that the frequency of the visual monitoring required for facilities in the automobile salvage yard sector be reduced from monthly to quarterly. In response to these comments and other comments on this issue, and given further consideration of climatic variations and the other types of inspections required under this sector, today's final permit requires facilities to conduct only quarterly visual monitoring. Visual monitoring will allow facilities to detect potential problems and evaluate the effectiveness of the pollution prevention plan more frequently than just through chemical sampling.

Several commenters indicated that existing BMPs at their facilities are sufficient or that specific BMPs listed in the proposed fact sheet are not appropriate. EPA wants to clarify that facilities with BMPs already in place are still required to develop a pollution prevention plan. Existing BMPs may, however, be used as part of the pollution prevention plan, if it is determined that the BMPs adequately address the potential pollutant sources at the site. The Agency notes that Table M-3 of the proposed fact sheet, Storm Water BMPs for Automobile Salvage Yards, is a list of BMPs to be considered when developing the pollution prevention plan. These BMPs may not, however, be appropriate under all conditions, nor may this list be all inclusive. Permittees should use this table as guidance when considering which BMPs to implement at their site.

Numerous commenters indicated that the costs for automobile salvage yard facilities to comply with the proposed multi-sector permit will be too burdensome. Several comments stated that the cost would exceed $15,000 per facility. Costs, including the time and money necessary to meet the proposed documentation and monitoring requirements, may force some facilities out of business. Several comments stated that smaller facilities would have to hire a professional engineering firm to develop the pollution prevention plan and an additional employee to perform the recordkeeping and monitoring requirements. The cost estimates referred to in these comments are based on the requirements in the proposed multi-sector permit. The Agency notes that several of these proposed requirements have been reduced in today's final permit and that these reductions will significantly reduce the cost of compliance. The reductions include requiring analytical monitoring only for certain facilities, a pollutant-by-pollutant alternative certification for those facilities that are subject to analytical monitoring, a decrease in the minimum frequency of visual examinations of storm water discharges from monthly to quarterly, and a reduction in the minimum employee training requirements. EPA believes it is feasible, even for small businesses, to fulfill the requirements of today's permit without hiring outside help. The Agency has provided guidance, such as the manual; "Storm Water Management for Industrial Activities; Developing Pollution Prevention Plans and Best Management Practices" to assist permittees with the development and implementation of pollution prevention plans.

A few commenters stated that the comprehensive site compliance evaluation for automobile salvage yard facilities should only be required once a year, not twice as was proposed in the multi-sector permit. The Agency agrees with these commenters and notes that today's final permit has been revised to require a comprehensive site compliance evaluation at a minimum of once per year in this and all other sectors.

A few commenters stated that the inspection requirements for automobile salvage yard facilities are too burdensome. In particular, commenters stated that the requirement to implement any changes in measures and controls as a result of these inspections within 12 weeks should be changed. Although 12 weeks is enough time to make management procedural changes, commenters felt it is not sufficient to implement structural changes to the facility. Commenters requested a 1 year time frame to implement such changes.

The Agency believes that the majority of the changes required as a result of the quarterly inspections will be procedural or programmatic in nature. Therefore, a 12 week time-frame should be sufficient for the implementation of the majority of the changes to the plan under this section. In the event that a permittee believes structural changes to the facility are necessary, the permittee should contact their EPA permitting authority and discuss a possible schedule for implementing the changes. Changes requiring construction are allowed additional time for implementation under the terms of the permit.

Several commenters stated that the quarterly inspections for leaks from vehicles and outdoor storage areas are too burdensome. Comprehensive site compliance evaluations and the requirement to remove fluids from vehicles when they arrive on-site, or as soon as feasible thereafter, make quarterly inspections unnecessary. One commenter questioned why quarterly inspections for leaks from vehicles is necessary if fluids must be removed from vehicles when they arrive on-site, or as soon as feasible thereafter. The Agency notes that there are certain circumstances in which fluids cannot be removed from vehicles immediately. Therefore, quarterly inspections should include checking vehicles which still have fluids for leaks. Vehicles that have been completely drained of fluids are not of concern for this inspection. EPA believes that the quarterly inspections required under the proposed permit target areas with a significant potential to contaminate storm water, such as outdoor storage of containers. Therefore, today's final permit includes quarterly inspection requirements.

A few commenters stated that EPA should allow facilities in the Automobile Salvage Yard sector additional time to construct structures needed to control contamination of storm water runoff. One suggestion was to allow these facilities 5 years to construct storm water pollution control structures, as long as the construction design and schedule is developed by a professional engineer (PE) and is 50% complete within 24 months, 75% complete within 36 months, and 100% complete within 60 months. Compliance deadlines under the multi-sector permit allow facilities up to 3 years from the effective date of the permit to construct structural BMPs that are called for in the pollution prevention plan. The Agency believes that in most cases 3 years is sufficient time to complete construction of structural BMPs. Permittees that feel they cannot complete construction within this specified time period should contact the applicable EPA Regional office.

Several commenters stated that the proposed recordkeeping requirements would be the most expensive segment for facilities subject to the Automobile Salvage Yard sector. Facilities should not be required to document the volume of fluids removed from vehicles as they are received since transporters or recyclers document the total volume of fluids removed from the site when collection is made for recyling. Commenters also indicated that reports should be prepared at the time the materials are sold or recycled, and not necessarily every month. In response, EPA has deleted these requirements from the final permit since many permittee already track such information for other purposes.

Scrap Recycling and Waste Recycling Industries

A number of commenters requested clarification on the prohibition of the discharge of washwater from tipping floor areas. To clarify, the final permit specifically prohibits the discharged of washwater from tipping floor areas to any part of a storm sewer system. This is considered a process wastewater discharge which is not authorized by this storm water permit. This permit also does not authorize discharges to the sanitary sewer system.

A substantial number of commenters expressed concerns regarding the appropriateness and costs associated with requiring the usage of structural erosion and sediment controls at scrap recycling facilities. Commenters frequently stated that such a requirement was inappropriate at this stage of the permitting process and that scrap recycling facilities should be provided the flexibility to implement a range of source control measures. Commenters frequently stated that their facilities did not have the room for structural controls such as retention ponds and sediment basins. It was further suggested that the results of monitoring data, particularly for total suspended solids (TSS), warranted a more flexible approach to the use of erosion and sediment control measures.

EPA believes that erosion and sediment controls are necessary at scrap recycling facilities due to the large amount of facility property (used for the industrial activities) which is unstabilized exposed soil and which receives large amounts of vehicular traffic similar to a construction site. For these areas, there are many types of erosion and sediment control measures that are appropriate for a recycling facility. A review of the group application information indicates that both structural and non-structural erosion & sediment control practices have been employed at scrap recycling facilities. In addition, scrap recycling facilities also commonly use spray water as a means of dust control. Regardless, EPA believes that these areas are appropriately classified as engaged in industrial activity and require storm water BMPs for controlling pollutant sources. Analysis of the part II sampling data indicates that approximately 22% of the grab samples for TSS were above 500 mg/l and, similarly for approximately 20% of the composite samples. EPA considers the use of erosion and sediment source control measures to reduce sediment loadings to be appropriate for scrap recycling facilities.

The permit does provide the flexibility for operators to select a mix of erosion and sediment control practices to reduce suspended sediment loadings. However, EPA wishes to clarify an issue with regard to requirements for the construction of permanent erosion and sediment controls such as retention ponds and sediment basins. EPA expects that these types of controls, or their equivalent, would only be constructed after the operator has had the opportunity to employ a full range of non-structural type source control measures and where substantial settleable and/or suspended solids loadings still persist. EPA is aware that site-specific conditions could exist which would preclude the siting of a structural control, i.e., a retention pond. Space restrictions caused by permanent buildings, permanently-fixed processing equipment, other semi-permanent or permanent obstructions, and/or restrictions posed by property boundaries would be considered examples where the operator could make a determination that construction of a structural control (i.e., a retention pond or its equivalent) is not a viable option. If such a determination is made by the facility operator, the operator would be required to annotate the plan accordingly. The operator would then update the plan to indicate what modified or additional or BMPs will be implemented to reduce suspended solids loadings.

Many commenters interpreted proposed permit conditions as mandating the use of permanent or semi-permanent covers over stockpiled materials. EPA is not mandating the use of covers over stockpiled materials. Because of the substantial quantities of stockpiled materials typically located at scrap recycling facilities, EPA believes that a requirement to mandate the use of covers is not appropriate and most often would be impracticable. Therefore, the decision whether to construct or install covers is left to the discretion of the facility operator. The proposed permit provides that the operator "shall consider" the use of these types of BMPs, however, the decision whether to use permanent or semi-permanent covers is left to the operator's discretion.

EPA is concerned with controlling storm water contamination from certain types of recyclable materials, specifically significant residual fluids, accumulated particulate matter and shredder fluff that could be exposed to runoff in the absence of any physical means of minimizing contact. Consequently, EPA expects that the plan will include measures to minimize exposure of these materials to surface runoff, where appropriate.

A significant number of commenters expressed concerns about proposed permit requirements that would eliminate exposure of turnings to precipitation or runoff. EPA wishes to clarify that it is primarily concerned with turnings that are produced from certain types of machine tool operations (e.g., milling machines, machine tool centers, and lathes) and which have come in contact with cutting fluids. Because of the potential for significant quantities of residual fluids associated with turnings, EPA believes they pose a substantial risk of contaminating surface runoff. EPA notes that this particular sub-section of the permit does not apply to cuttings or turnings that have not been exposed to cutting fluids.

In the draft permit, EPA required that "all turnings and cuttings shall be handled in such a manner as to prevent exposure to either precipitation or storm water runoff. . . ." Based on information provided by the industry, EPA believes that the requirement to prevent all exposure of all turning and cuttings would pose an undue burden on the scrap recycling industry. Such information demonstrated that, in most cases, turnings piles can be very large in size and are mostly stored outdoors due to size. Therefore, in the revised permit EPA is requiring scrap recycling facilities to select an appropriate BMP from either two suggested options, or employ an equivalent measure, to help minimize exposure. These options were developed based on input of current practices used by the scrap recycling industry.

The final permit identifies the discharge of fluids from containment areas, in the absence of a storm event, as a non-storm water discharge prohibited under this permit. The operator would be required to obtain a separate NPDES permit for this non-storm water discharge. Discharges from turnings containment areas to the sanitary sewer system are not covered by this permit. The operator must seek the necessary approval(s), if any, from the appropriate local pretreatment authority.

A substantial number of scrap recycling facilities requested clarification on the prohibition of non-storm water discharges from oil/water separators. EPA clarifies that in the absence of a storm event, discharges from oil/water separators to a storm sewer system are consider non-storm water discharges, which are not covered under this permit. Discharges from oil/water separators that occur as a consequence of a storm event, either a current event or past event, are permitted provided that the oil/water separator is properly maintained on a regularly scheduled basis as established in the plan.

Commenters also wanted clarification on the liquids draining requirements as they applied to "white goods," i.e., appliances. EPA clarifies that it is not requiring scrap recycling facilities to drain fluids from appliances or "white goods," oil-filled shock absorbers, and other permanently sealed containers with very small amounts of fluids, though the permittee may elect to do so.

A number of commenters requested clarification on the applicability of other sections of the permit where co-located facilities exist, e.g., equipment and vehicle maintenance in section VIII-P. Section VIII.N.1 specifically provides that scrap and waste recycling facilities that have additional facilities which satisfy the definition of an industrial activity covered by another section of this permit (e.g., equipment and vehicle maintenance facilities), must comply with the pollution prevention plan and monitoring requirements of that other section. The purpose of this requirement is to ensure that the pollution prevention plan and monitoring requirements appropriately address all aspects of regulated industrial activity that occur at a specific facility. For more explanation of this requirement, see the Co-located activities section of this summary.

Another commenter noted that differences exist between the list of BMPs identified in Table N–11 of the factsheet and section VIII.P of the permit. BMPs identified in Table N–11 were not intended to be all inclusive; rather the table identifies optional and alternative BMPs that may be used for vehicle and equipment maintenance. If scrap and waste recycling facilities have co-located facilities that meet the definition of industrial activity covered under section VIII.P, the operator is required to comply with the plan requirements for that section, including any specifically identified BMPs.

A number of commenters argued that EPA should drop the analytical monitoring requirements since many BMPs would be implemented thereby obviating the need for monitoring. In addition, these commenters said it would be more beneficial to target resources towards BMP implementation rather than to put resources towards monitoring. EPA does not agree that the implementation of BMPs at scrap recycling facilities should automatically eliminate the need to conduct monitoring. EPA is requiring monitoring primarily for purposes of demonstrating the effectiveness and adequacy of the pollution prevention plan as implemented over the term of the permit. EPA believes that the transient nature of activities at scrap recycling facilities and the results of the group application sampling effort clearly justify analytical monitoring during the permit term.

Some commenters questioned why EPA proposed to require monitoring for aluminum and iron at scrap recycles. Only 5 scrap recycling facilities sampled for these pollutants during the group application process. The limited sampling information provided by scrap recycling facilities for iron and aluminum, however, suggests that these facilities may be significant sources of iron and aluminum in storm water runoff. Given the volumes of ferrous and non-ferrous materials commonly handled at scrap recycling facilities, EPA believes that it is reasonable to monitor for these pollutants to determine if they are present and if so to provide information to the facility operator to ensure the pollution prevention plan is effective at controlling these pollutants. Therefore, EPA believes that additional data on these two pollutant parameters is needed for purposes of better characterizing pollutant sources that may be present so that pollution prevention plans may be more appropriately designed.

A number of commenters requested clarification on the use of the term "battery reclaimers" as it applies to scrap recycling and waste recycling industries. EPA agrees that scrap and waste recycling facilities which only collect and temporarily store used lead-acid batteries are not classified as battery reclaimers as described by 40 CFR Part 266. Battery reclaimers engage in the practice of breaking-up used lead-acid batteries for purposes of reclaiming the lead contained within them. During the group application process, EPA did not receive any group applications composed of battery reclaimers. Therefore, facilities which engage in the reclaiming of used, lead-acid batteries are not eligible for coverage under this permit.

EPA has reviewed a cost study provided by industry and concludes that a substantial portion of the costs arose as a consequence of unclear permit language or activities that are already substantively employed at scrap recycling facilities (i.e., not necessarily in response to the NPDES storm water program). EPA believes that the cost estimates provided in the fact sheet to the proposed permit are reasonably accurate and representative of the actual range of costs most facilities will experience to comply with the requirements of this permit (see cost of compliance discussion in this summary).

EPA is not requiring scrap recycling facilities to construct permanent or semi-permanent covers over stockpiled materials, therefore, the estimated capital costs would be substantively reduced over those calculated by industry. In addition, EPA observed during a site visit that a scrap facility with a shredder already had at least one roll-off box for collecting shredder fluff. Given the substantial volume of shredder fluff produced annually, some means of collecting and disposing of shredder fluff already exists at shredder facilities. Therefore, EPA does not agree that scrap recycling facilities are facing the additional capital expenses as reported in the industry cost report.

With regard to retention ponds, the final permit provides additional clarifying language that states that the operator is expected to employ a full range of non-structural erosion and sediment control measures to reduce sediment loadings. If substantial loadings persist after employing a full array of non-structural measures, the operator could be expected to construct a retention pond or its equivalent. However, the operator would first be expected to identify what additional measures might be taken to reduce sediment loadings before constructing a retention pond. In addition, the final permit allows the operator to make a determination that insufficient area is available to construct a pond or its equivalent. These additional provisions in the final permit are expected to dramatically reduce the likelihood that many scrap recycling facilities will be required to construct retention ponds.

Discussions with the scrap recycling industry indicate that facilities that receive substantial quantities of turnings have established appropriate containment areas with suitable berming and drainage collection (including the use of sumps and/or oil/water separators). In addition, measures to properly dispose or recycle substantial quantities of residual fluids are already in practice in response to other environmental and safety regulations at the Federal, State, and local levels. Consequently, EPA does not agree that the estimated annual operation and maintenance cost of $13,000 can be exclusively attributed to the NPDES storm water program.

The scrap recycling industry cost study estimates that berms around stockpile as will be replaced quarterly at an annual cost of $55,000. EPA has a number of concerns with regard to this estimate. The use of berms around certain stockpile areas was proposed as a BMP alternative by industry and many of its members. In addition, group applications cited the use of berms as a frequently employed best management practice. If such a cost estimate were accurate, it is unrealistic to expect that a scrap recycling facility would incur such a cost given the industry's expressed concerns about extreme competitive pressures. It is more likely that such a BMP would be considered impractical or economically infeasible by the facility operator and other BMPs would be chosen in preference.

EPA also wishes to respond to a number of other costs elements reported in the industry study. The study also identifies additional costs in response to the draft permit:

- Encourage suppliers to drain fluids.
- Inbound scrap lead acid battery control program.

• Inbound material inspection program.
• Segregate, handle and store used batteries.
• Periodic inspections of processing equipment.
• Employee and supplier training.

In discussions with industry representatives and scrap recycling facility operators during site visits, it was observed or noted that many of these practices are already commonly employed by the scrap recycling industry. In particular, manufacturer specifications on what is acceptable for scrap often dictates what materials are or are not accepted. In addition, frequent training of employees and buyers of scrap is necessary in order to ensure that only acceptable materials are received. Concerns over potential liability of accepting undetected hazardous waste within scrap necessitated the need for the industry to provide adequate training of both employees and its major suppliers. Therefore, EPA does not believe that the costs associated with these activities are overly burdensome or that they can be exclusively attributed to the NPDES storm water program.

A number of commenters expressed concerns about the appropriateness of requiring WET testing as an alternative monitoring requirement. EPA has removed any requirements to conduct whole effluent toxicity testing from this section of the permit. A substantial number of comments were received by the industry with regard to other monitoring requirements during the permit term. To a large extent, commenters disagreed that monitoring during the permit term would provide the necessary information to support EPA's goal of assessing the effectiveness of pollution prevention plans. Many commenters specifically stated that EPA's use of benchmarks was not appropriate and that, in effect, the Agency was establishing numeric effluent limits for the scrap recycling industry. Commenters added that the site-to-site and storm-to-storm variability of the data will prevent EPA from determining the effectiveness of BMPs. In sum, the excessive cost of monitoring, the lack of technical and regulatory expertise, excessive administrative burden, and the need to hire consulting engineers were cited as justified reasons for eliminating monitoring requirements.

EPA's analysis of all sampling data provided by group applicants within this sector revealed that the scrap recycling industry consistently exhibited high concentrations of metals, particularly copper, lead, and zinc. Moreover, sampling data also revealed that, in general, scrap recycling facilities were a consistent source of a wide diversity of conventional and toxic pollutants. EPA believes that the range of concentration values reported for many pollutants adequately supports the inclusion of monitoring for these pollutants in the permit.

The group application sampling was intended to demonstrate to operators of facilities and to EPA the types of pollutants typically found in industrial storm water discharges and to give, to some extent, a measure of the magnitude of those pollutants. It was not expected that sampling results would be used as a basis of establishing numeric effluent limits. The purpose of monitoring in today's final permit is to substantiate, over the long term, that scrap recycling facilities are employing the full range of BMPs and to judge the overall effectiveness of pollution prevention plan measures in controlling the pollutants of concern.

A number of commenters requested that EPA subdivide this sector to distinguish between scrap recycling facilities and municipal recycling facilities (MRF) that recycle paper, newspaper, glass, plastic containers, cardboard, and aluminum cans received primarily from residential and commercial sources. Commenters argued that MRFs are not the same as scrap recycling facilities, particularly with regard to the degree of exposure of significant materials. Commenters requested that EPA clarify its position with regard to BMP and monitoring requirements with regard to MRFs. Commenters also requested that EPA clarify any distinctions between MRFs that receive source-separated recyclable materials only (so called clean MRFs) versus those that do not receive source separated materials (so called dirty MRFs).

Based on information and data submitted in two group applications, EPA has created a separate sub-sector for recycling facilities that receive only recyclable materials (source-separated facilities) primarily from commercial and residential sources. This sub-sector excludes scrap recycling facilities and dirty MRFs. EPA concludes that source-separated recycling facilities are different in many respects from scrap and waste recycling facilities and from dirty MRFs. Source separated recycling facilities do not produce the volume of non-recyclable wastes that scrap recycling and waste recycling and dirty MRF facilities do. In addition, recycling facilities do not have heavy industrial processing equipment such as shearers or shredders.

EPA observed during one site visit to a MRF that the majority of storage occurred indoors and there were few outdoor processing operations. Outdoor storage consisted only of processed materials, e.g., compacted bundles of aluminum cans and bins containing glass cullet. Outdoor storage of processed materials tended to be for only short periods of time as compared to scrap recycling facilities where stockpiled materials may be exposed for long periods of time.

EPA also believes that recycling facilities that reject non-recyclable waste materials at the source, e.g., curb-side, also distinguishes them from scrap recycling and waste recycling facilities. This practice is an effective means of substantially reducing the potential that household hazardous wastes will be accepted. Frequent training of pickup drivers is also common to ensure that nonrecyclable materials such as paints, fluorescent tubes, used oil, and pesticides and are not accepted. EPA believes that separate pollution prevention plan and monitoring requirements are appropriate for this sub-group and has revised the final permit to reflect this.

EPA believes that municipal recycling facilities (MRFs) that receive only source-separated recyclable materials (e.g., glass, plastic, aluminum cans, paper, newspaper, tin cans, magazines, and alike) should not have the same monitoring requirements as those for scrap recycling facilities. MRFs are characterized as facilities that receive recyclable materials primarily from commercial and residential sources. In addition, MRF processing operations frequently occur indoors. EPA conducted a subsector review of sampling data submitted by four groups. These groups consist of facilities which receive source-separated recyclable wastes. EPA's analysis of median concentration data for pollutants sampled indicated that all pollutants were below the benchmarks.

EPA believes that given the nature of operations at these facilities and the implementation of BMPs, that these facilities should not be required to conduct storm water monitoring. EPA is also establishing separate pollution prevention plan requirements for recycling facilities that receive only source-separated, recyclable materials.

Steam Electric Generating Facilities

Several comments were received concerning the EPA's proposed monitoring regimen on which sector monitoring frequencies were based upon "benchmark" concentrations of pollutants, a representation of monitoring data from NURP and the Gold Book.

After reviewing the comments and data, EPA revised the "benchmark" values and the methodology used to determine which industries will monitor for their storm water. Based upon the revised methodology, steam electric facilities are required to conduct chemical monitoring of their storm water discharges for total recoverable iron. Monitoring discharges from coal piles is still required if coal is utilized or stored at the facility in conformance with 40 CFR 423.

Several commenters complained that there would be exorbitant additional costs involved with the "benchmark" monitoring requirements and/or BMP's required by and peculiar to the Multi-Sector permit. Several commenters requested justification for those requirements which they felt were unjustified and more stringent than the requirements of the general baseline permit.

Since the Multi-Sector permit was created as a result of the group application process using data supplied by and specific to each industry sector, the permit requirements have been tailored to the unique needs of each industry sector. For this reason, EPA believes that industries that obtain coverage under the Multi-Sector permit and comply with the terms of that permit will reduce pollutant discharges to waters of the United States to a greater degree than would occur under coverage of the baseline general permit. However, coverage is available to those industries under either permit upon the submission of the appropriate notice of intent (NOI). All the BMPs mentioned in the Multi-Sector permit are suggestions utilized to illustrate the intent of the permit and illustrate a method by which compliance can be achieved. Other equivalent BMPs may be implemented, at the discretion of the permittee, to attain those illustrated results. EPA realizes that the permittee is most familiar with the particular industrial site and is best qualified to determine which BMPs are equal to, or perhaps more effective in satisfying the intent of the permit. EPA encourages the use of these other BMPs or practices which attain or improve upon the Multi-Sector permit goals, especially those which are easier or less costly to implement.

Sector O of the Multi-Sector permit focuses attention on both coal pile runoff and any other storm water discharge associated with industrial activity at steam electric power generating facilities. Coal pile runoff has, however, been identified as a particularly serious threat to water quality and therefore the EPA has developed effluent guidelines (40 CFR 423) to regulate its discharge. The requirements for coal pile runoff from the guidelines have been incorporated into the multi-sector general permit.

Storm water discharges from wood-burning power plants are not covered under the Multi-Sector permit since no applications were received from wood-burning power plants under the group permit application process. EPA developed the Multi-Sector permit in response to only those facilities who applied for group permit coverage. Wood-burning plants may obtain coverage under the baseline general permit or an individual storm water permit.

For the sake of consistency with the other sectors in the multi-sector permit and to eliminate the duplication of regulation, EPA has removed reference to the requirements for permit coverage for industrial activities associated with construction. It must be noted, however, that a permit is required for storm water discharges from construction activities which additively disturb five or more acres, and such coverage is available through EPA's general permit for storm water discharges associated with construction activity.

Several comments dealt with the topic of monthly visual examination and documentation of storm water discharges as being burdensome, unjustified, and potentially impossible to comply with when dealing with the random occurrences of storm events and the numbers of outfalls to be sampled. EPA has relaxed the required frequency of visual examinations from a monthly to a quarterly basis. EPA has included the requirement for only limited analytical monitoring of storm water discharges from Sector O facilities based upon "benchmark" values. Annual compliance monitoring/reporting of runoff from coal storage areas/piles is also required as specified in 40 CFR 423. To aid in the reduction of resources necessary to comply with the visual sampling requirements for facilities with several outfalls, the permittee, if practicable, can combine and/or eliminate outfalls, apply the representative discharge provisions of VI.C.4. of the permit or utilize automatic samplers.

Motor Freight, Rail, and Passenger Transportation, Petroleum Bulk Oil Stations, and the U.S. Postal Service

There were a number of comments received regarding the requirements for the sector P, the ground transportation sector. The comments focused on grouping of facility types in the sector, eligibility under the sector, and the storm water pollution prevention plan requirements.

Several commenters, including members of the passenger bus, tank truck carrier, motor carrier, and warehouse industries, were concerned with the grouping of a range of transportation facilities in the ground transportation sector. Concern was particularly expressed regarding the "long-term implications" of this "umbrella" permitting practice. In response, EPA has retained the original grouping of transportation facilities as presented in the proposed permit. Although the gross operations of these different types of facilities may differ, EPA found that the vehicle maintenance and repair activities are remarkably similar and pose equally similar threats to storm water pollution. Further, EPA found that comparable best management practices were used at these varying facilities. In terms of the long term effect of this grouping, EPA assures the commenters any additional permitting efforts will revisit the appropriateness of sector groupings based upon information as it becomes available.

One commenter expressed particular concern about the inclusion of warehouses in the land transportation sector. EPA grouped regulated warehouse facilities in the land transportation sector because, when such facilities have exposure to storm water, it is often due to exposure of vehicle maintenance shops and equipment cleaning operations. EPA reminds the commenter that facilities are required to meet the permit conditions for all industrial activities (and hence sectors) which they may have onsite.

Several commenters, including members of the passenger bus, tank truck carrier, and warehouse industries, requested that EPA clarify its position regarding vehicle wash waters and its definition of "commingling" of storm water and vehicle wash waters. Vehicle wash waters, water discharged from a vehicle washing activity, are required to be permitted separately from the storm water discharges from such areas. Although most facilities design such wash areas to drain most, if not all, wash waters during the washing activity, some facilities may have stagnant pools of washwater that do not drain or discharge. If a storm event results in the discharge of both the remaining wash waters and storm water, the storm water permit would only cover the storm water discharges and not commingled wastes. Similarly, if vehicle washing activities are performed during a storm event or immediately preceding an event, the storm water permit only covers the portion of the discharge originating from the storm event. If, however, the washing activity is performed prior to a storm event and the washwater that is not immediately discharged is allowed to evaporate prior to being discharged with storm water, the storm water discharge that is now contaminated with the dry residue from the washwater is entirely covered by the storm water permit. Such residues would be expected to be specifically addressed in the facility's storm water pollution prevention plan.

Another commenter requested that vehicle wash waters from land-based transportation facilities be allowed to be discharged under this permit provided appropriate pollution prevention measures have been implemented to ensure that such discharges do not contain a visible sheen, detergents, or solids as was proposed for water-based transportation facilities. EPA disagrees that such discharges should be allowed. In the final permit, vehicle washwaters are not allowed from water-based transportation facilities. Such discharges must be permitted separately.

Many commenters, including members of the passenger bus, tank truck carrier, petroleum marketers, motor carrier, and warehouse industries, requested that employee training only be required to be conducted on an annual basis. In response, EPA has reduced the *required* frequency of employeetraining to once per calendar year. However, EPA would like to emphasize that more frequent training, perhaps on an informal basis, is encouraged and will most likely result in better implementation of the storm water pollution prevention plan.

Two commenters also expressed concern that the training requirements apply to all employees regardless of their effect on storm water pollution prevention and control. In response, EPA would like to clarify that only those employees that play a role in the industrial activities at the site must be trained. Because job descriptions differ tremendously from site to site, EPA has left it to the discretion of the pollution prevention team to determine who are the appropriate employees to be trained. The team is cautioned to err on the side of training too many employees rather too few. Even if an employee is remotely involved in an industrial operation that may affect the quality of the storm water discharge that employee should be included in the employee training. To demonstrate EPA's intention of who should be trained it is easier to list positions that *may* not require the employee storm water training: secretaries, administrative personnel, and salespersons. One commenter also listed executive staff as potentially not requiring training. EPA would like to emphasize that it is necessary and helpful for executive staff to fully understand what activities are taking place on site to protect water quality. As such, executive staff should be fully considered as potential trainees along with other employees.

Two commenters argued that the proposed requirement to store vehicles awaiting maintenance in designated areas only would be more effective if the requirement only applied to vehicles with actual or potential fluid leaks since it could be interpreted that all vehicles are awaiting maintenance. EPA agrees with the commenters and has altered the permit language accordingly.

Several commenters felt that the monthly inspections required in the proposed permit were too burdensome, particularly due to the required documentation of such inspections. In response, EPA has reduced the frequency of inspections to quarterly. It is EPA's intention that the quarterly inspection and the visual storm water examination requirements be coordinated into one comprehensive program. By performing the two within similar time frames, it is hoped that the facility will gain useful insight by comparing the results of the overall facility inspection and the storm water visual examination. More frequent inspections, preferable with documentation, are encouraged, but are not required.

One commenter suggested providing an alternative certification option for facilities that eliminate exposure to storm water runoff such that the facility may be exempt from the quarterly visual examinations requirements. In response, EPA disagrees that the alternative certification provided to other sectors for purposes of chemical monitoring is appropriate for quarterly visual examinations. The quarterly visual examinations are still useful in areas where exposure has been "eliminated" to ensure that exposure has not re-occurred causing a storm water contamination problem.

Many commenters, including members of the passenger bus, tank truck carrier, petroleum marketers, motor carrier, and warehouse industries concurred with EPA in not requiring chemical analysis of storm water discharges from ground transportation facilities. As such, the commenters strongly opposed the alternative monitoring requirements presented in the proposed permit. EPA has retained the proposed monitoring of quarterly visual examinations only.

Most commenters supported the quarterly visual examination requirements. A few commenters expressed concern about fulfilling the requirement on large sites where employees may be on the road a significant amount of time and where rainfall is sporadic. The commenters were also concerned about sites without a dedicated environmental staff. The commenter suggested requiring the visual examination on an annual basis or only recommending the practice on a quarterly basis. In response, EPA has retained the quarterly visual examination requirements as proposed and has added a waiver of this requirement at inactive and unstaffed sites (see discussion of monitoring requirements above). EPA reminds the commenter that visual examination may be performed by a non-technical person who has been trained as to how to collect the sample and what to observe.

Many commenters were concerned with the requirement to attain the same water quality in the storm water discharges as an oil/water separator when such technology operates with such great variability. Concern was also expressed regarding the qualifications of facility personnel to make such an engineering judgment. In response, EPA has removed this reference in the final permit due to the difficulty in determining what water quality would be achieved with an oil/water separator. EPA does however encourage permittees to strive for the pollutant removal levels referenced in the literature for oil/water separators.

Water Transportation

The comments received on Sector Q, the water transportation sector, focused on eligibility, who is responsible for permit compliance, and monitoring conditions. One commenter raised concerns that the permitting for barge discharges (including barge storm water, washwater, and wastewater) is too uncertain. In response, today's permit regulates the storm water and washwater from the maintenance and equipment cleaning areas for canal barge operations (SIC code 4449) and for barge building and repair facilities (SIC code 3731). Today's permit, however, does not regulate wastewaters, such as bilge and ballast water, washwater, sanitary wastes, and cooling water originating from vessels. The permit specifies that the operators of such discharges must obtain coverage under a separate NPDES permit if discharged to waters of the United States or through a municipal separate storm sewer system.

One commenter indicated that many Navy activities would fall under both VIII.Q. Vehicle Maintenance Shops/ Equipment Cleaning Operations and VIII.R. Ship Building and Repair and would like to see EPA establish some guidelines for sector applicability. In response, the permit does specify that when an industrial facility has industrial activities being conducted onsite that meet the description(s) of industrial activities in another sector(s), that the industrial facility must comply with any and all applicable monitoring and pollution prevention plan requirements of each of those sector(s).

One commenter explained that marine terminal and ports have a multitude of activities undertaken by many industrial facilities and contractors in the common areas of the port. This commenter wanted to know who is responsible for obtaining permit coverage for these common areas which are usually served by a common storm sewer system. The commenter suggested that EPA require the property owner (port authority) to be the primary permit holder and have each lessee or contractor become a co-permittee. In response, the property owner (port authority) is responsible for permitting the common areas of the facility, and each lessee operating an industrial activity is responsible for obtaining permit coverage for the specific operations occurring on their leased property. In today's permit, EPA does require that the co-permittee arrangement be utilized at airport facilities; however, EPA will not require this approach at marine terminals or ports. The industrial facilities and contractors located at airports generally are similar in nature, and one pollution prevention plan can more easily address the issues of concern. A marine terminal or port often has many dissimilar activities occurring within the facility lending itself to an approach which can focus on each specific industrial operation. A co-permittee approach would be acceptable to the Agency, but it is not required.

One commenter felt that facilities in this sector are being forced to monitor for parameter(s) that no one believed were of concern, were not monitored for in Part II, and are not even handled by the facility, specifically, the metals. In response, EPA has revised the monitoring requirements in the final permit for the water transportation sector based on the methodology described previously. To address the concern that some facilities would have to monitor for pollutants not found or suspected in their discharge, pollutant-by-pollutant certification will eliminate the requirement to monitor for those pollutants not present.

Ship and Boat Building or Repairing Yards

Comments received on the permit requirements included in sector R, ship and boat building or repairing yards, focused on grouping of industrial facilities, the benchmark values, and the application of multiple sectors to one facility (co-located industrial activities). Several commenters were concerned with the grouping of fiberglass and aluminum boat manufacturers into one sector. In response, EPA has evaluated the grouping of these types of boat manufacturers and has determined retain these industrial activities in one sector. EPA does not believe this will cause an undue burden on either industry given the revised monitoring requirements, which are now sub-sector specific and the flexibility of the pollution prevention plan requirements.

Two commenters took issue with the basis of the benchmark values. The benchmarks have been revised. For a full discussion of the revision see the part of the fact sheet that address the benchmark values directly.

One commenter was concerned with the burden of complying with all applicable sectors of the permit under the co-located industrial activities requirement. EPA has retained this provision in the final permit to ensure comprehensive environmental protection and does not believe this requirement is overly burdensome. This provision does not require that a separate and distinct pollution prevention plan be developed based on each applicable sector, but requires consideration of other BMPs from other sectors, and incorporation of those applicable BMPs into the pollution prevention plan for the facility. Where monitoring requirements from two or more sectors overlap, only one sample and analysis needs to be conducted (see discussion of co-located industrial activities above).

Air Transportation

Comments on Sector S, Air Transportation, primarily focused on obligations and responsibilities of the airport authority and its tenants. The storm water permit application regulations at 40 CFR 122.26(b)(14) define the storm water discharges associated with industrial activity in terms of eleven categories of industrial activities. Category (viii) includes transportation facilities classified as Standard Industrial Classification (SIC) code 45 that have vehicle and equipment maintenance (including vehicle and equipment rehabilitation, mechanical repairs, painting, fueling, and lubrication), equipment cleaning operations, or airport deicing operations (including aircraft and runway deicing). Review of the *Standard Industrial Classification Manual*, published in 1987 by the Office of Management and Budget, clarifies that SIC code 45, which addresses air transportation facilities, is not limited to the operators of airports, air terminals and flying fields. In fact, SIC code 45 also includes establishments primarily engaged in providing foreign and domestic air transportation, air courier services, and other fixed base operators who are primarily engaged in servicing, repairing, or maintaining airports and/or aircraft and these activities will also need to be permitted if they have point source discharges of storm water from regulated activities defined under 40 CFR 122.26(b)(14)(viii).

Tenants at the airport, other than the airport authority itself, who conduct industrial operations at the airport facility described at 40 CFR 122.26(b)(14)(viii), and establishments who conduct regulated industrial activities described elsewhere under 40 CFR 122.26(b)(14), and whose operations result in storm water point source discharges are also required to apply for coverage under an NPDES storm water permit for their areas of operation. EPA recognizes that airports and their tenants enter into contractual relationships, therefore, these types of tenant facilities could be co-permittees with the airport operator if both parties chose, or could be permitted separately, and thereby be responsible individually for compliance with the permit and implementation of a pollution prevention plan. EPA encourages co-permittee status because this approach to permit coverage promotes better coordination of the pollution prevention plan measures and possibly better control of the storm water discharges. However, as the owner/operator of an airport facility and the storm sewer system, airport authorities are ultimately responsible for storm water discharges from their storm sewer system to waters of the U.S. or to a municipal separate storm sewer system.

Other tenants at the airport, such as car rental and food preparation establishments, which are not defined separately as storm water discharges associated with industrial activity under 40 CFR 122.26(b)(14) must also be addressed. These tenants may chose to be co-permittees with the airport operator, or private agreements may be worked out with the airport authority through contractual, or other means, to ensure that the storm water pollution prevention plan of the airport adequately addresses storm water contamination from these types of tenants. Regardless, airport authorities are required to identify the location and activities of all airport tenants as apart of the development of the storm water pollution prevention plan for the airport. EPA would like to clarify, however, that airport authorities are not responsible for ensuring compliance with the conditions of today's permit for storm water discharges associated with industrial activities regulated under 40 CFR 122.26(b)(14) conducted by tenants of the airport that apply separately for a storm water permit and which are not co-permittees with the airport authority.

Because the applicability of Part XI.S. of today's permit extends to storm water discharges from airport facilities, and in light of the fact that industrial activities conducted by the airport authorities and tenants of the airport are similar in nature, the eligibility section of Part XI.S. has been broadened to allow coverage for both airport authorities and tenants of an airport facility who conduct industrial activities as described in Part XI.S.1.

Treatments Works

Comments on Sector T, Domestic Wastewater Treatment Plants focused on required elements of the storm water pollution prevention plan and monitoring requirements. One commenter raised an issue regarding the requirement of providing a certification that the discharge contains nothing but storm water is unrealistic and can interfere with plant operations. It makes no allowances for temporary discharges into a storm water system.

In response, the Agency wants to clarify that some non-storm water discharges may be authorized by the permit. These non-storm water discharges include: discharges from fire fighting activities, fire hydrant flushing; potable water sources including waterline flushings; irrigation drainage; lawn watering; routine external building washdown which does not use detergents or other compounds; pavement washwaters where spills or leaks of toxic or hazardous materials have not occurred (unless all spilled material has been removed) and where detergents are not used; air conditioning condensate, springs, uncontaminated ground water; foundation or footing drains where flows are not contaminated with process materials such as solvents. The Agency notes that certification that the discharge contains nothing but storm water, except as mentioned above, is consistent with similar requirements for NPDES general permit requirements for storm water discharges associated with industrial activity published September 9, 1992.

Many commenters have concerns about the excessive training required in the permit for treatment works employees. Semiannual training for employees will result in an excessive amount of employee "downtime," thereby decreasing the effectiveness of current employees to control the POTW process and may result in the need for increase staff. It is therefore very important that the training program be reasonable. An alternative would be to have employee training conducted once per year instead of every 6 months. In response, EPA agrees and the permit has been modified to require employee training only annually (at least once per calendar year).

EPA received many comments on the requirements of monthly inspections plus annual comprehensive site compliance evaluation. Commenters state that it is likely that the same person who conducts the monthly inspections will also conduct the annual comprehensive site compliance evaluation. If the facility successfully passes the monthly inspections, then there is no reason to believe that it would not pass a yearly inspection. In response, EPA wants to clarify that the monthly inspections cover specific designated equipment and areas of the facility where there is a high potential for storm water contamination. The areas to be included in all inspections include: access roads/rail lines, equipment storage and maintenance areas (both indoor and outdoor areas); fueling; material handling areas; residuals treatment, storage, and disposal areas; and waste water treatment areas. A monthly inspection can be done easily and routinely, possibly with the guidance of an inspection checklist. Whereas the comprehensive site evaluation is a full site evaluation being conducted to assess the pollution prevention plan and to determine the overall level of compliance by the permittee, and if necessary incorporation of changes or modifications to the pollution prevention plan needed as a result of the inspection.

Several commenters indicated that requiring an inventory of materials, an investigation of past practices, and a list of significant spills for the previous 3 years is an inventory accumulation of history and only generates paperwork. Commenters suggested that a pollution prevention plan should evaluate current situation and determine potential problems that may result. In response, the Agency believes that past activities may have resulted in pollutant sources for present storm water discharges, and that it is appropriate to address materials that have been exposed to storm water within the past 3 years. EPA believes that the 3-year period is reasonable and does not impose excessive burdens for collecting information on permittees. The Agency notes that the 3-year period is consistent with similar requirements for individual applications for storm water discharges associated with industrial activity at 40 CFR 122.26(c)(1)(i) (B) and (D) and general NPDES records retention requirements under 40 CFR 122.21(p) and 40 CFR 112.7(d)(8).

A number of commenters strongly supported the use of the annual monitoring of the alternative monitoring constituents requirements. Other commenters questioned the accuracy of the statistical analysis performed for the proposed permit. In response, EPA has revised the methodology for determining which facilities will be required to perform monitoring as described elsewhere in the fact sheet. Under this new methodology, domestic wastewater treatment plants are not required to perform monitoring under this permit.

Food and Kindred Products

The greatest number of commenters on Sector U, Food and Kindred Products, are concerned with the monitoring requirements described in the proposed permit. The major objections to monitoring result from the consolidation of the entire food and tobacco industry into one sector which commenters believe compromises the group process since identical monitoring requirements are inappropriate for an industry with such a wide range in process operations. Commenters argue that several subsectors conduct most activities indoors, allowing little opportunity for storm water contamination, while other subsectors perform significant operations outdoors. Commenters also point out that EPA described in the proposed rule several factors that influence the impact of storm water on water quality (e.g., geographic location, hydrogeology, etc.) yet these factors were not considered when proposing monitoring requirements for the industry.

Commenters also argued that basing the monitoring requirements on such a diminutive set of sampling data is not valid given that data for only four pollutants was collected in sufficient quantities to be analyzed. Commenters felt that insufficient samples were collected for four other pollutants. Commenters indicated that the inclusion of metals in the monitoring requirements for all sector members, when so little data was submitted for these pollutants, is not statistically valid. Commenters also took exception to EPA's decision to aggregate data for the food processing industry because lack of subsector-specific data does not substantiate monitoring requirements for these pollutants. Commenters believe that monitoring data that does exist for the sector shows no difference between industrial and residential/commercial areas. Also, commenters suggested that storm water data has shown to be very inconsistent and unrepresentative of the actual impact of discharges on receiving waters. Another common issues raised by the commenters was that the benchmark concentrations are unobtainable even with good BMPs. Commenters believe these levels are comparable to tertiary treatment standards for a full treatment system. Also, these cutoff levels appear to presage future permit limits for the industry which EPA has not demonstrated are necessary.

Several commenters believed that, if monitoring had to be conducted, the alternative monitoring is more appropriate since it more accurately reflects wastes from food and kindred products facilities. However, they suggested there should be an escape clause as with the proposed monitoring allowing facilities to only monitor for those pollutants expected to be present. Commenters felt that monitoring requirements will divert limited funds away from pollution prevention techniques needed to reduce pollutants in storm water as monitoring data show a correlation between enhanced housekeeping and preventative maintenance and reduced pollutant concentrations. Commenters concluded that combining visual examinations and a comprehensive site inspection is a much more appropriate way to evaluate storm water than monitoring.

Commenters also stated that EPA should give weight to the facilities who met Federal requirements in the application process and enforce against the thousands of facilities that ignored their obligations under the law rather than spending money on additional paperwork burdens. They suggested that sample results from the group applications should be credited towards the alternative monitoring requirements. Conversely, others commented that EPA should not provide "credit" to these groups, rather, EPA should recognize the difficulty facilities experience in collecting adequate storm water samples from acceptable rainfall events, especially small business facilities and facilities in arid climates.

Realistically, commenters stated, very few facilities will be able to obtain all four quarterly samples and almost none will be able to collect all monthly samples for visual observation without constructing automatic sampling facilities. They pointed out that EPA has previously indicated manual sampling was acceptable and automatic sampling would not be required.

Additional concerns were raised with regard to specific pollutants recommended for analysis in the proposed monitoring. For example commenters pointed out that ammonia data are not presented in the proposed permit fact sheet but the proposed permit states that ammonia exceeds benchmark values. Commenters stated that absent data to substantiate, EPA should not require food and kindred products facilities to monitor for ammonia. Also, EPA should clarify its intent in requiring ammonia monitoring. Specifically, the proposed permit does not state whether EPA is concerned with the nitrogen load (i.e., TKN) on receiving waters, making ammonia monitoring irrelevant, or with the toxic effects of ammonia, making TKN monitoring unnecessary.

Commenters also argued that EPA does not discuss iron and zinc as pollutants of concern for the industry, raising question as to why food facilities have to sample for these parameters. EPA should work with the few facilities or subsectors of the industry that are found to have metals in their discharge rather than requiring all food and kindred products facilities to monitor these pollutants. Also, the proposed cutoff for iron (0.3 mg/l) is overly protective. The gold book acute aquatic life freshwater criteria is 1.0 mg/l. Commenters also pointed out that fecal coliform data would be superfluous to BOD and TSS data for the industry and testing is much more difficult.

Based on the comments on the proposed permit, EPA has eliminated the alternative monitoring requirements and re-evaluated the proposed monitoring requirements for the sector through conducting a subsector analysis for the industry. The sub-sector analysis identified only two of the nine subsectors as having pollutants in storm water at concentrations above the revised benchmark values. As a result, most facilities in the food and kindred products sector no longer are required to collect and chemically analyze storm water samples. Only two sub-sectors will monitor: Grain Mill Products manufacturing (SIC code group 204) which will monitor for TSS and Fats and Oils manufacturing (SIC code group 207) which will monitor for TSS, BOD, COD and nitrate plus nitrite nitrogen.

Commenters in this sector also felt that additional requirements for pesticide storage were unnecessary. They contend that pesticide storage and use are currently regulated under FIFRA, State pesticide laws and the FDA. Further, anyone applying pesticides must be a certified applicator, trained in the safe and prudent use, as well as proper storage, of these products.

In response, EPA disagrees with the commenters statement that current pesticide storage and use regulations are adequate to prevent storm water contamination. Criteria for evaluating pesticide use and storage and criteria for evaluating storm water contamination from pesticide use and storage are not the same. With the increased use of pesticides at food and kindred products facilities compared to facilities in other sectors, EPA believes that the application and storage of these pesticides with storm water in mind is crucial to an effective storm water pollution prevention plan in this sector.

Textile Mill Products

Comments on Sector V, Textile Mill Products, focused primarily on the pollution prevention plan requirements and monitoring requirements. One commenter supported the permit requirement for visual examinations by indicating that visual examinations accompanied by facility-specific BMPs should most adequately address the minimal potential for controlling the contamination of storm water discharges at textile mill facilities. However, another commenter questions the usefulness of visual examinations, stating that EPA provides no justifications for such examinations.

In response, periodic inspections of controls are a requirement of the pollution prevention plan, and visual storm water runoff examinations and inspections should be treated as two distinct requirements. Visual examinations represent a minimum requirement in the assessment of the storm water discharge. The relative economic impact of the visual examination of the storm water should be minimal and, in conjunction with site specific BMPs can be used to evaluate the performance and effectiveness of best management practices employed at a particular facility. Visual examinations have been reduced to a quarterly frequency in the final permit. For more information on visual examinations see the monitoring section of this summary.

In response to the Agency's request for comments regarding proposed alternative monitoring requirements, one commenter contends that it does not believe that the annual or semiannual monitoring and reporting requirements put forth by the Agency are necessary or appropriate. In assessing this comment, it should again be noted that the Agency had only requested comments on the possibility of imposing the proposed alternative monitoring requirements on textile facilities.

Today's permit does not include the proposed alternative monitoring requirements. Based on the revised methodology for determining monitoring requirements at the industry sub-sector level, the textile industry is no longer required to conduct chemical monitoring for any specific pollutant. Due to the nature of the industry, and the fact that most operations at such facilities are conducted indoors, the contact of storm water with most pollutants typical of this industry are minimized or eliminated. The statistical analysis performed by the Agency using the Part 2 sampling data when conducted at the sub-sector level supports this conclusion.

Wood and Metal Furniture and Fixtures

Only six comments were submitted addressing the wood and metal furniture and fixtures manufacturing industry. Each of the comments supported the proposed monitoring conditions, which only requires quarterly visual examinations of storm water discharges. In today's final permit, this requirement remains unchanged. Analytical monitoring of storm water discharges will not be necessary from wood and metal furniture and fixtures manufacturing facilities, unless there are co-located activities, such as coal piles, refuse piles, landfills etc., which may be required to monitor under provisions elsewhere in the permit.

Rubber, Plastic, and Miscellaneous Products

The majority of the comments received on Sector Y, Rubber, Plastic Products, and miscellaneous manufacturing industries, pertained to the proposed monitoring requirements and the inspection and recordkeeping requirements of the permit. In addition, comments were received regarding EPA's description of the pollutant sources and the assessment of the monitoring results submitted with the group applications. The Rubber Manufacturers Association (RMA) supported the specific BMP requirements which were proposed to control zinc in storm water discharges from rubber manufacturing facilities. Concern was also expressed regarding the consolidation of group applications into the 29 industrial sectors. The proposed permit only required visual examinations of storm water samples for facilities in this sector, rather than chemical testing which was proposed for 17 of the 29 sectors. While commenters supported the absence of analytical testing requirements, they also argued that the frequency (quarterly) for the visual examinations was excessive. Commenters also opposed the proposed alternate monitoring requirements which would have required analytical testing for certain parameters.

In the final permit, EPA modified the methodology for determining the types of facilities which are required to conduct analytical testing of storm water. The revised methodology is discussed in section VI.E of the final fact sheet and also in the monitoring portion of this summary. EPA believes that the sub-sector methodology better targets the monitoring requirements toward the specific types of facilities within the 29 sectors which pose the greatest risk to the storm water quality.

Based on the sub-sector methodology, the final permit requires that manufacturers of rubber products conduct analytical testing of storm water samples for zinc. This pollutant was shown to be a pollutant of concern from the monitoring data which were submitted by rubber products manufacturers (i.e., the median concentration was above the EPA benchmark concentration of 0.065 mg/l for zinc). Testing of grab samples is required quarterly during the second and fourth years of the permit. However, permittees may omit the testing during the fourth year if the second year results are below the benchmark concentration. In addition, the final permit provides for "alternate certification" in lieu of monitoring (see section VI.E.3 of the fact sheet) on a pollutant-by-pollutant basis as well as on an outfall-by-outfall basis. As such, analytical testing for zinc would not be required for facilities which do not use zinc, or for facilities where industrial activities are not exposed to storm water.

The final permit only requires analytical testing of storm water samples for rubber products manufacturers. However, the final permit does retain the requirement for a quarterly visual examination for all facilities (including rubber manufacturers) in this sector. This requirement is also standard for all sectors of the permit. EPA believes that the quarterly frequency appropriately balances the costs associated with the visual examinations with the need to periodically assess any pollutant loadings in the discharges and the effectiveness of the storm water pollution prevention plan.

A commenter in this sector also expressed concern that analytical testing for a number of parameters in storm water had been a requirement of EPA's baseline general permit of September 9, 1992 for facilities in major SIC group 30. EPA recognizes that there are differences in the requirements between today's multi-sector general permit and the previous baseline general permit. These differences are the result of the additional information concerning these facilities obtained during the group application process. However, concerns regarding the requirements of the baseline general permit are outside the scope of the present permitting action.

The proposed permit would have required a comprehensive site compliance evaluation at "appropriate" intervals, but not less than once per year. A commenter argued that this was too vague and should be clarified. In response, the final permit now simply requires a comprehensive site compliance evaluation at a minimum of once per year for all facilities covered by the permit.

The commenter was also unclear regarding the "qualified" personnel who are required to conduct the comprehensive site compliance evaluations. In discussing the requirements for a comprehensive site compliance evaluation, section VI.C.4 of the fact sheet notes that inspectors should be members of the pollution prevention team. Such individuals should be familiar with the potential pollutant sources at the facility, and the control measures developed for the storm water pollution prevention plan to control pollutant discharges. EPA believes that facilities should be able to identify appropriate individuals for the necessary site evaluations. The commenter also requested that the permit provide that the facility inspections (required by Part XI.Y.3.d of the permit) would be conducted at appropriate intervals as stated in the storm water pollution prevention plan. Such a requirement was included in the proposed permit and has been retained in the final permit. The commenter objected to the requirement that facilities maintain records of inspections and visual examinations.

EPA disagrees with the commenter on this issue and believes that such records are necessary for EPA to verify compliance with the requirements of the permit. Therefore, the records retention requirements were retained in final permit basically as proposed. One relatively minor change was made which standardizes the records retention period for all sectors to 3 years, which is the minimum required by NPDES regulations at 40 CFR 122.42(j). Additional information concerning issues associated with inspections and recordkeeping can be found in the reporting and record keeping portion of this summary.

Leather Tanning

In response to comments that the leather tanning industry was required to monitor in error and that manganese and aluminum should not be included in the list of monitoring parameters, the final multi-sector permit does not require leather tanning facilities to conduct chemical monitoring. However, the industry must still perform visual examinations. More discussion of the revised monitoring requirements under today's final permit can be found in the monitoring section of this summary.

In response to a comment that EPA should simply adopt the model permit and pollution prevention plan submitted by one industry organization, EPA has determined that the proposed leather tanning permit and pollution prevention plan with BMPs which was published in the **Federal Register** on November 19, 1993, is best suited to control storm water discharges from this industry.

In response to the comment that facilities submitted chromium data because they were required to (as a categorical pollutant), EPA clarifies that chromium is limited in an effluent guideline for leather tanning process wastewater. The industry was therefore required to submit monitoring data for chromium. The leather industry was also required to submit monitoring data for "those pollutants that they knew or had reason to believe were present." These pollutants were shown in tables which listed conventional and nonconventional pollutants, toxic pollutants and hazardous pollutants. These tables were included in the permit application Form 2–F.

Fabricated Metal Products Industry

Many commenters stated that the fabricated metal industry should be further divided into dry and wet fabricating industries. Most explained that the processes and practices vary widely between these two types of fabricating industries. In particular, many pollutants vary between these groups due to the fact that each of these industries require very different chemicals in their processes. The main concern expressed by commenters was that monitoring for the entire group was based on a wide range of chemicals for both industrial processes that may not be present at a facility if only one process is conducted at the facility.

EPA agrees that the industries covered under this section of the permit should be re-evaluated to examine more carefully inherent differences between subgroups in the industry. As a result, today's rule has identified industry subgroups using the three and four-digit SIC classification for the purposes of determining which industries will conduct monitoring in this sector. Industry subgroups will monitor for specific pollutants where the median value exceeds the revised benchmark levels. EPA has also expanded the flexibility of the monitoring requirement by allowing facilities to certify on a pollutant-by-pollutant basis to no exposure to storm water in lieu of monitoring for that chemical. This can result in some facilities not monitoring and others limiting the number of pollutants required to be monitored.

Several commenters requested that the fabricated metal industry be required to conduct visual examinations and annual site compliance evaluations only. EPA does not agree. Chemical monitoring is still necessary, given the results of the data evaluation conducted on the subsectors. Visual examinations in combination with chemical monitoring and site compliance evaluations will help assess the presence of pollutants of concern in the discharges and the effectiveness of the pollution prevention plan at controlling these.

A commenter requested that EPA clarify whether all of SIC code group 34 is covered in Sector 29, such as the forgings industry. They pointed out a discrepancy between the preamble language and the permit language relating to coverage. In response, EPA inadvertently left out certain SIC code group 34 industries in the proposed permit. The fact sheet contained the entire list of industries covered under this section. EPA has clarified the permit language to correct this omission.

Several commenters suggested that EPA differentiate between dry fabricators and others by adding a definition that placed a qualifier "Metal Treatment Only" to the terms and conditions that apply only to metal treatment operations. Commenters also suggested the permit should require dry fabricators to certify to no metal treatment operations or other operations likely to result in discharges of the pollutants of concern.

EPA has not placed a qualifier on the terms and conditions of the permit. However, using the revised analysis to determine monitoring, addresses some of the concerns about the grouping of sectors. Also, determining site-specific BMPs and certifying, on a pollutant-by-pollutant basis to no exposure to storm water will add more flexibility in determining monitoring requirements.

A commenter requested that EPA expand the definition of fabricated metal industries in the permit language. EPA has not expanded the definition of fabricated metal industries other than including the other industries identified in the proposed fact sheet that were inadvertently left out of the permit language. Other industries that could be related to this sector are covered under the Primary Metals Industry section of the permit. EPA believes that it has listed as eligible for coverage, all industries that participated in the group application process.

Commenters stated that the list of options for controlling pollutants can be expensive and uneconomical. Many thought that the BMPs may later become mandatory and do not allow for alternative measures to control pollutants at a given site.

To clarify, EPA has only provided a list of potential BMPs to be considered by each facility operator when preparing a pollution prevention plan. This list is neither totally inclusive nor mandatory. Permittees are free to determine the most economical and effective BMPs specific for a given facility and activity.

Commenters felt that most fabricators do not have process wastewater discharges. Because of this, they requested a waiver on requiring proof of no commingling of process waste water with storm water. Today's permit does not change this requirement. Some fabricators employ acid baths, wash waters and other process wastewater related activities. Certification of no commingling remains an important part of the permit requirements to be included with the storm water pollution prevention plan certification to ensure that storm water discharges are not contaminated by these discharges.

A commenter pointed out that the description of the materials used at facilities in this sector should have noted that many of these materials are not necessarily used at all types of facilities within the sector. The commenter was apparently concerned that this description could erroneously suggest that the runoff from certain types of facilities in the sector could be contaminated with pollutants which are not used at all facilities. In response, EPA has modified the final fact sheet to clarify that the list of materials is a cumulative list gathered from all the types of facilities in the sector, and that individual facilities may not use all materials which are listed.

A commenter also disagreed with EPA's assessment in the draft fact sheet for this sector that the monitoring results which were submitted with the group applications may not be inclusive of all the pollutants which could be present in the runoff. In response, EPA has deleted the discussion in question from the final fact sheet.

Transportation Equipment, and Industrial or Commercial Machinery

One commenter was concerned with the grouping of facilities in Sector AB. The commenter felt that it is inappropriate to regulate commercial machine manufacturing facilities with other miscellaneous machinery manufacturing facilities. In response, EPA has retained the proposed grouping of the transportation equipment, industrial, or commercial machinery manufacturing sector. Although the specific processes that occur indoors and the final products produced will vary at the different facilities, the group application data indicated that the industrial activities and significant materials that may be exposed to storm water are similar. In addition, today's final permit includes flexible requirements for this sector which allow operators to implement controls based upon site-specific activities and materials.

The same commenter also expressed concern over the use of such sector groupings in the future. In response, EPA is making use of these industrial groupings only for the development of this storm water general permit. Future uses of these industrial groupings will be reevaluated by EPA based upon all available information at the time and based upon the intended usage.

Electronic and Electrical Equipment, Photographic and Optical Goods

EPA received a total of 6 comments on the multi-sector permit from facilities in sector AC, facilities which manufacture electronic and electrical equipment and components, photographic and optical goods. Comments addressed the proposed monitoring requirements and the proposed requirements for the storm water pollution prevention plan. The proposed permit only required visual examinations of storm water samples for facilities in sector AC, rather than analytical testing which was proposed for certain other sectors. Commenters supported these proposed monitoring requirements and opposed the proposed alternate monitoring requirements which would have required analytical testing for certain parameters. Like the proposed permit, the final permit does not require analytical testing of storm water samples for facilities in sector AC. A more detailed discussion of EPA's responses to the monitoring issues overall is found in the portion of the response to comments which addresses monitoring. The proposed permit required that facilities in sector AC develop and implement a storm water pollution prevention plan and did not include any industry-specific numeric effluent limits. Commenters supported these provisions and the final permit has not been changed in this regard.

Authorization to Discharge Under the National Pollution Discharge Elimination System

In compliance with the provisions of the Clean Water Act, as amended, (33 U.S.C. 1251 et seq., the "Act") except as provided in Part I.B.3. of this storm water multi-sector general permit, operators of point source discharges of storm water associated with industrial activity that discharge into waters of the United States, represented by the industry sectors identified in Part XI. of this permit, are authorized to discharge in the areas of coverage listed below in accordance with the conditions and requirements set forth herein.

Operators of storm water discharges from the industrial activities covered under this permit who intend to be authorized by this permit must submit a Notice of Intent (NOI) in accordance with Part II.B. of this permit. Operators of storm water discharges associated with industrial activity who fail to submit an NOI in accordance with Part II.B. of this permit are not authorized under this general multi-sector permit.

This permit shall become effective on October 1, 1995, and shall expire at midnight on October 1, 2000.

Region I

Signed this 28th day of August, 1995.

David Fierra,

Water Management Division Director.

Areas of coverage	Permit No.
Connecticut Federal Indian Reservations.	CTR05*##F
Maine	MER05*###
Federal Indian Reservations.	MER05*##F
Massachusetts	MAR05*###
Federal Indian Reservations.	MAR05*##F
New Hampshire	NHR05*###
Federal Indian Reservations.	NHR05*##F
Rhode Island Federal Indian Reservations.	RIR05*##F
Vermont Federal Indian Reservations.	VTR05*##F
Vermont Federal Facilities	VTR05*##F

Region II

Signed this 16th day of August, 1995.

Richard L. Caspe,

Water Management Division Director.

Areas of coverage	Permit No.
Puerto Rico	PRR05*###
Federal Facilities	PRR05*##F

Region III

Signed this 11th day of September, 1995.

Alvin R. Morris,

Water Management Division Director.

Areas of coverage	Permit No.
District of Columbia	DCR05*###
Federal Facilities	DCR05*##F
Delaware Federal Facilities	DER05*##F

Region IV

Signed this 11th day of September, 1995.

Robert F. McGhee,

Acting Water Management Division Director.

Areas of coverage	Permit No.
Florida	FLR05*###

Region VI

Signed this 11th day of September, 1995.

William B. Hathaway,

Water Management Division Director.

Areas of coverage	Permit No.
Louisiana	LAR05*###
Federal Indian Reservations.	LAR05*##F
New Mexico	NMR05*###
Federal Indian Reservations (except Navajo and Ute Mountain Reservation lands).	NMR05*##F
Oklahoma	OKR05*###
Federal Indian Reservations.	OKR05*##F
Texas	TXR05*###
Federal Indian Reservations.	TXR05*##F

Region IX

Signed this 24th day of August, 1995.

Felicia Marcus,

Water Management Division Director.

Areas of coverage	Permit No.
Arizona	AZR05*###
Federal Indian Reservations.	AZR05*##F
Federal Facilities	AZR05*##F
California:	
Federal Indian Reservations.	CAR05*##F
Idaho:	
Duck Valley Reservation	NVR05*##F
Nevada Federal Indian Reservations.	NVR05*##F
New Mexico:	
Navajo Reservation	AZR05*##F
Oregon:	
Fort McDermitt Reservation.	NVR05*##F
Utah:	
Goshute Reservation	NVR05*##F
Navajo Reservation	AZR05*##F
Johnston Atoll	JAR05*###
Federal Facilities	JAR05*##F
Midway Island and Wake Island.	MWR05*###
Federal Facilities	MWR05*##F

Region X

Signed this 12th day of September, 1995.

David H. Teeter,

Acting Water Management Division Director.

Areas of coverage	Permit No.
Alaska Federal Indian Reservations.	AKR05*##F
Idaho	IDR05*###
Federal Indian Reservations (except Duck Valley Reservation lands).	IDR05*##F
Federal Facilities	IDR05*##F
Oregon Federal Indian Reservations (except for Fort McDermitt Reservation lands).	ORR05*##F
Washington Federal Indian Reservations.	WAR05*##F
Washington Federal Facilities.	WAR05*##F

NPDES General Permit for Storm Water Discharges From Industrial Activities Table of Contents

I. Coverage Under This Permit

A. Permit Area

The permit is being issued in the following areas:

Region I—the States of Maine, Massachusetts, and New Hampshire; Federal Indian Reservations located in Connecticut, Massachusetts, New Hampshire, Maine, Rhode Island, and Vermont; and Federal facilities located in Vermont.

Region II—the Commonwealth of Puerto Rico; and Federal facilities located in Puerto Rico.

Region III—the District of Columbia and Federal facilities located in Delaware and the District of Columbia.

Region IV—the State of Florida.

Region V—no areas.

Region VI—the States of Louisiana, New Mexico, Oklahoma, and Texas and Federal Indian Reservations located in Louisiana, New Mexico (except Navajo Reservation lands, which are handled by Region IX, and Ute Mountain Reservation lands, which are handled by Region VIII and are not being covered by this permit), Oklahoma, and Texas.

Region VII—no areas.

Region VIII—no areas.

Region IX—the State of Arizona; the Territories of Johnston Atoll, and Midway and Wake Island; all Federal Indian Reservations located in Arizona, California, and Nevada; those portions of the Duck Valley, Fort McDermitt, and Goshute Reservations located outside Nevada, those portions of the Navajo Reservation located outside Arizona; and Federal facilities located in Arizona, Johnston Atoll, and Midway and Wake Islands.

Region X—the State of Idaho; Federal Indian Reservations located in Alaska, Oregon (except for Fort McDermitt Reservation lands which are handled by Region IX), Idaho (except Duck Valley Reservation lands which are handled by Region IX), and Washington; and for Federal facilities located in Alaska, Idaho and Washington.

B. Eligibility

1. *Discharges Covered.* Except for storm water discharges identified under paragraph I.B.3., this permit may cover all new and existing point source discharges of storm water to waters of the United States that are associated with industrial activity identified under the coverage sections contained in Part XI. (see Table 1). Military installations must comply with the permit and monitoring requirements for all sectors that describe industrial activities that such installations perform.

TABLE 1

Storm water discharges from	Are covered if listed in part
Timber Products Facilities	XI.A.1.
Paper and Allied Products Manufacturing Facilities	XI.B.1.
Chemical and Allied Products Manufacturing Facilities	XI.C.1.
Asphalt Paving, Roofing Materials, and Lubricant Manufacturing Facilities	XI.D.1.
Glass, Clay, Cement, Concrete, and Gypsum Product Manufacturing Facilities	XI.E.1.
Primary Metals Facilities	XI.F.1.
Metal Mines (Ore Mining and Dressing)	XI.G.1.
Coal Mines and Coal Mine-Related Facilities	XI.H.1.
Oil or Gas Extraction Facilities	XI.I.1.
Mineral Mining and Processing Facilities	XI.J.1.
Hazardous Waste Treatment Storage or Disposal Facilities	XI.K.1.
Landfills and Land Application Sites	XI.L.1.
Automobile Salvage Yards	XI.M.1.
Scrap Recycling and Waste and Recycling Facilities	XI.N.1.
Steam Electric Power Generating Facilities	XI.O.1.

TABLE 1—Continued

Storm water discharges from	Are covered if listed in part
Vehicle Maintenance or Equipment Cleaning areas at Motor Freight Transportation Facilities, Passenger Transportation Facilities, Petroleum Bulk Oil Stations and Terminals, the United States Postal Service, or Railroad Transportation Facilities.	XI.P.1.
Vehicle Maintenance Areas and Equipment Cleaning Areas of Water Transportation Facilities	XI.Q.1.
Ship or Boat Building and Repair Yards	XI.R.1.
Vehicle Maintenance Areas, Equipment Cleaning Areas or From Airport Deicing Operations located at Air Transportation Facilities.	XI.S.1.
Wastewater Treatment Works	XI.T.1.
Food and Kindred Products Facilities	XI.U.1.
Textile Mills, Apparel and other Fabric Product Manufacturing Facilities	XI.V.1.
Furniture and Fixture Manufacturing Facilities	XI.W.1.
Printing and Publishing Facilities	XI.X.1.
Rubber and Miscellaneous Plastic Product Manufacturing Facilities	XI.Y.1.
Leather Tanning and Finishing Facilities	XI.Z.1.
Facilities That Manufacture Metal Products including Jewelry, Silverware and Plated Ware	XI.AA.1.
Facilities That Manufacture Transportation Equipment, Industrial or Commercial Machinery	XI.AB.1.
Facilities That Manufacture Electronic and Electrical Equipment and Components, Photographic and Optical Goods	XI.AC.1.

2. *Construction.* This permit may authorize storm water discharges associated with industrial activity that are mixed with storm water discharges associated with industrial activity from construction activities provided that the storm water discharge from the construction activity is authorized by and in compliance with the terms of a different NPDES general permit or individual permit authorizing such discharges.

3. *Limitations on Coverage.* The following storm water discharges associated with industrial activity are not authorized by this permit:

a. Storm water discharges associated with industrial activities that are not listed under the coverage sections contained in Part XI. (see Table 1).

b. Storm water discharges subject to New Source Performance Standards except as provided in Part I.B.7. below.

c. Storm water discharges associated with industrial activity that are mixed with sources of non-storm water other than non-storm water discharges that are:

(1) In compliance with a different NPDES permit; or

(2) Identified by and in compliance with Part III.A. (Prohibition of Non-storm Water Discharges) of this permit.

d. Storm water discharges associated with industrial activity that are subject to an existing NPDES individual or general permit (except storm water discharges subject to the NPDES General Permit for Storm Water Discharges Associated With Industrial Activity published September 9, 1992 [57 FR 41297], or September 25, 1992 [57 FR 44438]).

e. Are located at a facility where an NPDES permit has been terminated (other than at the request of the permittee) or denied, or that are issued a permit in accordance with Part VII.M (Requirements for Individual or Alternative General Permits) of this permit;

f. Storm water discharges associated with industrial activity that the Director [U.S. Environmental Protection Agency (EPA)] has determined to be or may reasonably be expected to be contributing to a violation of a water quality standard.

g. Discharges subject to storm water effluent guidelines, not described under Part XI.

h. Storm water discharges associated with industrial activity from inactive mining, inactive landfills, or inactive oil and gas operations occurring on Federal lands where an operator cannot be identified.

4. *Storm Water Not Associated With Industrial Activity.* Storm water discharges associated with industrial activity that are authorized by this permit may be combined with other sources of storm water that are not classified as associated with industrial activity pursuant to 40 CFR 122.26(b)(14).

5. *Endangered Species Protection.*

a. Permit Coverage Restrictions: In order to be eligible for coverage under this permit, the applicant must comply with the Endangered Species Act. A discharge of storm water associated with industrial activity may be covered under this permit only if either:

(1) The storm water discharge(s), and the construction of BMPs to control storm water runoff, are not likely to adversely affect species identified in Addendum H of this permit; or

(2) The applicant's activity has received previous authorization under the Endangered Species Act and established an environmental baseline that is unchanged; or,

(3) The applicant is implementing appropriate measures as required by the Director to address adverse affects.

b. All dischargers applying for coverage under this multi-sector storm water general permit must certify that their storm water discharge(s), and the construction of BMPs to control storm water runoff, are not likely to adversely affect species identified in Addendum H of this permit.

6. *National Historic Preservation Act.* In order to be eligible for coverage under this permit, the applicant must be in compliance with the National Historic Preservation Act. A discharge of storm water associated with industrial activity may be covered under this permit only if:

(i) The discharge does not affect a property that is listed or is eligible for listing in the National Historic Register maintained by the Secretary of Interior; or,

(ii) The applicant has obtained and is in compliance with a written agreement between the applicant and the State Historic Preservation Officer (SHPO) that outlines all measures to be undertaken by the applicant to mitigate or prevent adverse effects to the historic property.

7. *Discharges Subject to New Source Performance Standards.* Operators of facilities with storm water discharges subject to New Source Performance Standards [1] shall have documentation of

[1] Storm water discharges subject to New Source Performance Standards (NSPS) and that may be covered under this permit include: runoff from material storage piles at cement manufacturing facilities [40 CFR Part 411 Subpart C (established February 23, 1977)]; contaminated runoff from phosphate fertilizer manufacturing facilities [40 CFR Part 418 Subpart A (established April 8, 1974)]; coal pile runoff at steam electric generating facilities [40 CFR Part 423 (established November 19, 1982)]; and runoff from asphalt emulsion

a final EPA decision indicating that the Agency has determined that the storm water discharge has no direct or indirect impact. This documentation shall be obtained and retained on site prior to the submittal of the Notice of Intent. Operators of these facilities shall not be authorized under the terms and conditions of this permit until the submittal of a Notice of Intent to gain coverage under this permit. Where documentation of the Agency's decision has not been obtained for a facility subject to New Source Performance Standards, the operator must obtain such documentation prior to submitting a NOI. The permittee may use the format in Addendum E to submit information to EPA to initiate the process of the environmental review. The information shall be sent to the appropriate address listed in Part VI.B. of this permit. In order to maintain eligibility, the permittee must implement any mitigation required of the facility as a result of the National Environmental Policy Act (NEPA) review process. Failure to implement mitigation measures upon which the Agency's NEPA finding is based is grounds for termination of permit coverage.

C. Authorization

Dischargers of storm water associated with industrial activity must submit a complete NOI in accordance with the requirements of Part II of this permit, using an NOI form as found in Addendum B (or photocopy thereof), to be authorized to discharge under this general permit. Unless notified by the Director to the contrary, owners or operators who submit such notification are authorized to discharge storm water associated with industrial activity under the terms and conditions of this permit 2 days after the date that the NOI is postmarked. The Director may deny coverage under this permit and require submittal of an application for an individual NPDES permit based on a review of the NOI or other information.

D. Overview of the Multisector General Permit

Parts I.–X. apply to all facilities. Parts I. and II. describe eligibility requirements and the process for obtaining permit coverage. Parts III.–X. contain "basic" permit requirements.

Part XI. provides additional requirements for particular sectors of industrial activity. For example, primary metal facilities add Part XI.F., to the "universal" Parts I.–X. requirements.

Some facilities may have "co-located" activities that are described in more than one sector and need to comply with applicable conditions of each sector. For example, a chemical manufacturing facility could have a land application site and be subject to Part XI.C.—Chemical and Allied products Manufacturing sector (primary activity), with runoff from the land application site (co-located activity) also subject to conditions in the Part XI.L.—Landfills and Land Application Sites sector.

Part XII of the permit contains conditions (e.g., effluent limitations or special reporting requirements) that only apply to facilities located in a particular State, EPA Region, or other area. Those special conditions are in addition to, or in lieu of, the "generic" Parts I.–XI. permit requirements.

Part XII of the permit also contains differences in permit eligibility and availability. For example, only the permits for Louisiana, New Mexico, Oklahoma, and Texas allow coverage of certain mine dewatering discharges from construction sand and gravel, industrial sand, and crushed stone mines (subject to additional permit conditions) under Sector J.—Mineral Mining and Processing.

Addendum D. lists large and medium municipal separate storm sewer systems (MS4s). Facilities located in these jurisdictions have special responsibilities (described in the permit) with regard to compliance with local requirements and providing information to the operator of the MS4).

II. Notification Requirements

A. Deadlines for Notification

1. *Existing Facility.* Except as provided in paragraphs II.A.4. (New Operator), and II.A.5. (Late Notification), individuals who intend to obtain coverage for an existing storm water discharge associated with industrial activity under this general permit shall submit an NOI in accordance with the requirements of this part on or before [insert date 90 days after permit finalization];

2. *New Facility.* Except as provided in paragraphs II.A.3. (Oil and Gas Operations), II.A.4. (New Operator), and II.A.5. (Late Notification), operators of facilities that begin industrial activity after [insert date 90 days after permit finalization] shall submit an NOI in accordance with the requirements of this part at least 2 days prior to the commencement of the industrial activity at the facility;

3. *Oil and Gas Operations.* Operators of oil and gas exploration, production, processing, or treatment operations or transmission facilities, that are not required to submit a permit application as of [insert date 90 days after permit finalization] in accordance with 40 CFR 122.26(c)(1)(iii), but that after [insert date 90 days after permit finalization] have a discharge of a reportable quantity of oil or a hazardous substance for which notification is required pursuant to either 40 CFR 110.6, 40 CFR 117.21, or 40 CFR 302.6, must submit an NOI in accordance with the requirements of Part II.C. of this permit within 14 calendar days of the first knowledge of such release.

4. *New Operator.* Where the operator of a facility with a storm water discharge associated with industrial activity that is covered by this permit changes, the new operator of the facility must submit an NOI in accordance with the requirements of this part at least 2 days prior to the change.

5. *Late Notification.* An operator of a storm water discharge associated with industrial activity is not precluded from submitting an NOI in accordance with the requirements of this part after the dates provided in Parts II.A.1., 2., 3., or 4. (above) of this permit.

6. *Part II.A.6 Facilities Previously Subject to the Baseline General Permit.* Eligible facilities previously covered by EPA's 1992 Baseline General Permits for Storm Water Discharges Associated with Industrial Activity (57 FR 41297 or 57 FR 44438) may elect to be covered by this permit by submitting an NOI in accordance with the requirements of this Part within [insert date 90 days after permit finalization]. To avoid a lapse in permit coverage should reissuance or termination of the 1992 Baseline General Permits eliminate coverage for certain industries under those permits, NOIs from eligible facilities may also be submitted during the period 90 days prior to the expiration date of the applicable Baseline General Permit.

B. Contents of Notice of Intent

The NOI shall be signed in accordance with Part VII.G. (Signatory Requirements) of this permit and shall include the following information:

1. *Permit.* An indication of which NPDES storm water general permit is being applied for (either baseline general, baseline construction, or multi-sector);

2. *Name.* The operator's name, address, telephone number, and status

facilities (40 CFR Part 443 Subpart A (established July 24, 1975)). NSPS apply only to discharges from those facilities or installations that were constructed after the promulgation of NSPS. For example, storm water discharges from areas where the production of asphalt paving and roofing emulsions occurs are subject to NSPS only if the asphalt emulsion facility was constructed after July 24, 1975.

as Federal, State, private, public, or other entity;

3. Location. The street address of the facility for which the notification is submitted. Also describe the location of the approximate center of the facility in terms of the latitude and longitude to the nearest 15 seconds, or the quarter section, township and range (to the nearest quarter section);

4. Federal Indian Reservations. An indication of whether the facility is located on Federal Indian Reservations;

Receiving Water. The name of the receiving water(s), or if the discharge is through a municipal separate storm sewer, the name of the municipal operator of the storm sewer and the ultimate receiving water(s) for the discharge through the municipal separate storm sewer;

6. Co-permittee. The storm water general permit number if such a number has been issued to a co-permittee;

7. Monitoring. The monitoring status of the facility;

8. SIC Code. Up to four 4-digit Standard Industrial Classification (SIC) codes that best represent the principal products produced or services rendered, or for hazardous waste treatment, storage or disposal facilities, land/disposal facilities that receive or have received any industrial waste, steam electric power generating facilities, or treatment works treating domestic sewage, a narrative identification of those activities;

9. Other Permits. The permit number(s) of additional NPDES permit(s) for any discharge(s) (including non-storm water discharges) from the site that are currently authorized by an NPDES permit;

10. Presence of Endangered Species. Based on the instructions in Addendum H, no species identified in Addendum H are in proximity to the storm water discharges to be covered under this permit, or the areas of BMP construction to control those storm water discharges.

11. National Historic Preservation Act Compliance. A yes or no response to the following statement: Applicant has obtained and is in compliance with Historic Preservation Agreement.

12. Eligibility Certification. The following certifications shall be signed in accordance with Part VII.G.

I certify under penalty of law that I have read and understand the Part I.B. eligibility requirements for coverage under the multi-sector storm water general permit including those requirements relating to the protection of species identified in Addendum H.

To the best of my knowledge the discharges covered under this permit, and the construction of BMPs to control storm water runoff, are not likely and will not likely, adversely affect any species identified in Addendum H of this permit, or are otherwise eligible for coverage due to previous authorization under the Endangered Species Act.

To the best of my knowledge, I further certify that such discharges, and construction of BMPs to control storm water runoff, do not have an effect on properties listed or eligible for listing on the National Register of Historic Places under the National Historic Preservation Act, or are otherwise eligible for coverage due to a previous agreement under the National Historic Preservation Act.

I understand that continued coverage under the multi-sector storm water general permit is contingent upon maintaining eligibility as provided for in Part I.B.

13. Pollution Prevention Plan Certification. For any facility that begins to discharge storm water associated with industrial activity after [insert date 270 days after permit finalization], a certification that a storm water pollution prevention plan has been prepared for the facility in accordance with Part IV. of this permit must be included on the NOI. (Do not include a copy of the plan with the NOI submission.)

C. Where To Submit

Facilities that discharge storm water associated with industrial activity must use an NOI form provided by the Director (or photocopy thereof). NOIs must be signed in accordance with Part VII.G. (Signatory Requirements) of this permit. NOIs are to be submitted to the Director of the NPDES program at the following address: Storm Water Notice of Intent (4203), 401 M Street, S.W., Washington, D.C. 20460.

D. Additional Notification

Facilities that discharge storm water associated with industrial activity through large or medium municipal separate storm sewer systems (systems located in an incorporated city with a population of 100,000 or more, or in a county identified as having a large or medium system (see definition in Part X. of this permit and Addendum D of this notice)), or into a municipal separate storm sewer that has been designated by the permitting authority shall, in addition to filing copies of the NOI in accordance with paragraph II.C., submit signed copies of the NOI to the operator of the municipal separate storm sewer through which they discharge in accordance with the deadlines in Part II.A. (Deadlines for Notification) of this permit.

III. Special Conditions

A. Prohibition of Non-storm Water Discharges

1. Storm Water Discharges. Except as provided in paragraph III.A.2 (below), all discharges covered by this permit shall be composed entirely of storm water.

2. Non-storm Water Discharges. a. Except as provided in paragraph III.A.2.b (below), discharges of material other than storm water must be in compliance with an NPDES permit (other than this permit) issued for the discharge.

b. The following non-storm water discharges may be authorized by this permit provided the non-storm water component of the discharge is in compliance with Part IV and Part XI: discharges from fire fighting activities; fire hydrant flushings; potable water sources including waterline flushings; drinking fountain water, uncontaminated compressor condensate, irrigation drainage; lawn watering; routine external building washdown that does not use detergents or other compounds; pavement washwaters where spills or leaks of toxic or hazardous materials have not occurred (unless all spilled material has been removed) and where detergents are not used; air conditioning condensate; compressor condensate; uncontaminated springs; uncontaminated ground water; and foundation or footing drains where flows are not contaminated with process materials such as solvents.

B. Releases in Excess of Reportable Quantities

1. Hazardous Substances or Oil. The discharge of hazardous substances or oil in the storm water discharge(s) from a facility shall be prevented or minimized in accordance with the applicable storm water pollution prevention plan for the facility. This permit does not relieve the permittee of the reporting requirements of 40 CFR Part 117 and 40 CFR Part 302. Except as provided in paragraph III.B.2 (Multiple Anticipated Discharges) of this permit, where a release containing a hazardous substance in an amount equal to or in excess of a reporting quantity established under either 40 CFR Part 117 or 40 CFR Part 302, occurs during a 24-hour period:

a. The discharger is required to notify the National Response Center (NRC) (800–424–8802; in the Washington, DC metropolitan area 202–426–2675) in accordance with the requirements of 40 CFR Part 117 and 40 CFR Part 302 as soon as he or she has knowledge of the discharge;

b. The storm water pollution prevention plan required under Part IV. (Storm Water Pollution Prevention Plans) of this permit must be modified within 14 calendar days of knowledge of the release to: provide a description of the release, the circumstances leading to the release, and the date of the release. In addition, the plan must be reviewed by the permittee to identify measures to prevent the reoccurrence of such releases and to respond to such releases, and the plan must be modified where appropriate; and

c. The permittee shall submit within 14 calendar days of knowledge of the release a written description of: the release (including the type and estimate of the amount of material released), the date that such release occurred, the circumstances leading to the release, and steps to be taken in accordance with paragraph III.B.1.b. (above) of this permit to the appropriate EPA Regional Office at the address provided in Part VI.B. (Reporting: Where to Submit) of this permit.

2. *Multiple Anticipated Discharges.* Facilities that have more than one anticipated discharge per year containing the same hazardous substance in an amount equal to or in excess of a reportable quantity established under either 40 CFR Part 117 or 40 CFR Part 302, that occurs during a 24-hour period, where the discharge is caused by events occurring within the scope of the relevant operating system shall:

a. Submit notifications in accordance with Part III.B.1.b. (above) of this permit for the first such release that occurs during a calendar year (or for the first year of this permit, after submittal of an NOI); and

b. Shall provide in the storm water pollution prevention plan required under Part IV. (Storm Water Pollution Prevention Plans) a written description of the dates on which all such releases occurred, the type and estimate of the amount of material released, and the circumstances leading to the releases. In addition, the plan must be reviewed to identify measures to prevent or minimize such releases and the plan must be modified where appropriate.

3. *Spills.* This permit does not authorize the discharge of hazardous substances or oil resulting from an onsite spill.

C. Co-located Industrial Activity

In the case where a facility has industrial activities occurring onsite which are described by any of the activities in other sections of Part XI, those industrial activities are considered to be co-located industrial activities. Storm water discharges from co-located industrial activities are authorized by this permit, provided that the permittee complies with any and all additional pollution prevention plan and monitoring requirements from other sections of Part XI applicable to the co-located industrial activity. The operator of the facility shall determine which additional pollution prevention plan and monitoring requirements are applicable to the co-located industrial activity by examining the narrative descriptions of each coverage section (Discharges Covered Under This Section) in Part XI of this permit.

IV. Storm Water Pollution Prevention Plans

A storm water pollution prevention plan shall be developed for each facility covered by this permit. Storm water pollution prevention plans shall be prepared in accordance with good engineering practices and in accordance with the factors outlined in 40 CFR 125.3(d)(2) or (3) as appropriate. The plan shall identify potential sources of pollution that may reasonably be expected to affect the quality of storm water discharges associated with industrial activity from the facility. In addition, the plan shall describe and ensure the implementation of practices that are to be used to reduce the pollutants in storm water discharges associated with industrial activity at the facility and to assure compliance with the terms and conditions of this permit. Facilities must implement the provisions of the storm water pollution prevention plan required under this part as a condition of this permit.

A. Deadlines for Plan Preparation and Compliance

1. *Existing Facilities.* Except as provided in paragraphs 3., 4., and 5. (below), all existing facilities and new facilities that begin operation on or before [insert date 270 days after permit finalization] shall prepare and implement the plan by [insert date 270 days after permit finalization].

2. *New Facilities.* Facilities that begin operation after [insert date 270 days after permit finalization] shall prepare and implement the plan prior to submitting the Notice of Intent.

3. *Oil and Gas Facilities.* Oil and gas exploration, production, processing or treatment facilities that are not required to submit a permit application on or before [insert date 90 days after permit finalization] in accordance with 40 CFR 122.26(c)(1)(iii), but after [insert date 270 days after permit finalization] have a discharge of a reportable quantity of oil or a hazardous substance for which notification is required pursuant to either 40 CFR 110.6 or 40 CFR 302.6, shall prepare and implement the plan on or before the date 60 calendar days after first knowledge of such release.

4. *Facilities Switching From the Baseline General Permit to This Permit.* Facilities previously subject to the NPDES General Permit for Storm Water Discharges Associated With Industrial Activity (57 FR 41297 or 57 FR 44438) that switch to coverage under this permit shall continue to implement the storm water pollution prevention plan required by that permit. The plan shall be revised as necessary to address requirements under Part XI. of this permit no later than [insert date 270 days after permit finalization]. The revisions made to the plan shall be implemented on or before [insert date 270 days after permit finalization].

5. *Facilities Electing Multi-Sector General Permit Upon Expiration of the Baseline General Permit.* Facilities electing to obtain coverage under this permit during the period 90 days prior to expiration of the Baseline General Permit shall revise the pollution prevention plan required by that permit as necessary to address requirements under Part X.I. of this permit and implement the revised plan prior to submittal of the NOI.

6. *Measures That Require Construction.* In cases where construction is necessary to implement measures required by the plan, the plan shall contain a schedule that provides compliance with the plan as expeditiously as practicable, but no later than [insert date 3 years after permit finalization]. Where a construction compliance schedule is included in the plan, the schedule shall include appropriate non-structural and/or temporary controls to be implemented in the affected portion(s) of the facility prior to completion of the permanent control measure.

7. *Extensions.* Upon a showing of good cause, the Director may establish a later date in writing for preparing and compliance with a plan for a storm water discharge associated with industrial activity.

B. Signature and Plan Review

1. *Signature/Location.* The plan shall be signed in accordance with Part VII.G. (Signatory Requirements), and be retained onsite at the facility that generates the storm water discharge in accordance with Part VII.P.2. (Retention of Records) of this permit. For inactive facilities, the plan may be kept at the nearest office of the permittee.

2. *Availability.* The permittee shall make the storm water pollution prevention plan, annual site compliance inspection report, or other information available upon request to the Assistant Administrator for Fisheries for the National Oceanic and Atmospheric

Administration; the U.S. Fisheries and Wildlife Service Regional Director; or authorized representatives of these officials.

3. *Required Modifications.* The Director, or authorized representative, may notify the permittee at any time that the plan does not meet one or more of the minimum requirements of this part. Such notification shall identify those provisions of the permit that are not being met by the plan, and identify which provisions of the plan requires modifications in order to meet the minimum requirements of this part. Within 30 days of such notification from the Director, (or as otherwise provided by the Director), or authorized representative, the permittee shall make the required changes to the plan and shall submit to the Director a written certification that the requested changes have been made.

C. Keeping Plans Current

The permittee shall amend the plan whenever there is a change in design, construction, operation, or maintenance, that has a significant effect on the potential for the discharge of pollutants to the waters of the United States or if the storm water pollution prevention plan proves to be ineffective in eliminating or significantly minimizing pollutants from sources identified under Part IV.D. (Contents of the Plan) of this permit, or in otherwise achieving the general objectives of controlling pollutants in storm water discharges associated with industrial activity. New owners shall review the existing plan and make appropriate changes: Amendments to the plan may be reviewed by EPA in the same manner as Part IV.B. (above).

D. Contents of the Plan

The contents of the pollution prevention plan shall comply with the requirements listed in the appropriate section of Part XI. (Specific Requirements for Industrial Activities). Table 2 lists the location of the plan requirements for the respective industrial activities. These requirements are cumulative. If a facility has co-located activities that are covered in more than one section of Part XI., that facility's pollution prevention plan must comply with the requirements listed in all applicable sections of this permit.

TABLE 2.—POLLUTION PREVENTION PLAN REQUIREMENTS

Storm water discharges from	Are subject to pollution prevention plan requirements listed in part
Timber Products Facilities	XI.A.3
Paper and Allied Products Manufacturing Facilities.	XI.B.3
Chemical and Allied Products Manufacturing Facilities.	XI.C.4
Asphalt Paving, Roofing Materials, and Lubricant Manufacturing Facilities.	XI.D.3
Glass, Clay, Cement Concrete and Gypsum Product Manufacturing Facilities.	XI.E.3
Primary Metals Facilities	XI.F.3.
Metal Mines (Ore Mining and Dressing).	XI.G.3
Coal Mines and Coal Mine-Related Facilities.	XI.H.3
Oil or Gas Extraction Facilities	XI.I.3
Mineral Mining and Processing Facilities.	XI.J.3
Hazardous Waste Treatment Storage or Disposal Facilities.	XI.K.3
Landfills and Land Application Sites.	XI.L.3
Automobile Salvage Yards	XI.M.2
Scrap and Waste Recycling Facilities.	XI.N.3
Steam Electric Power Generating Facilities.	XI.O.3
Vehicle Maintenance or Equipment Cleaning areas at Motor Freight Transportation Facilities, Passenger Transportation Facilities, Petroleum Bulk Oil Stations and Terminals, the United States Postal Service, or Railroad Transportation Facilities.	XI.P.3
Vehicle Maintenance Areas and Equipment Cleaning Areas of Water Transportation Facilities.	XI.Q.3
Ship or Boat Building and Repair Yards.	XI.R.3
Vehicle Maintenance Areas, Equipment Cleaning Areas or From Airport Deicing Operations located at Air Transportation Facilities.	XI.S.3
Wastewater Treatment Works	XI.T.3
Food and Kindred Products Facilities.	XI.U.3
Textile Mills, Apparel and other Fabric Product Manufacturing Facilities.	XI.V.3
Furniture and Fixture Manufacturing Facilities.	XI.W.3
Printing and Publishing Facilities.	XI.X.3
Rubber and Miscellaneous Plastic Product Manufacturing Facilities.	XI.Y.3
Leather Tanning and Finishing Facilities.	XI.Z.3
Facilities That Manufacture Metal Products including Jewelry, Silverware and Plated Ware.	XI.AA.3
Facilities That Manufacture Transportation Equipment, Industrial or Commercial Machinery.	XI.AB.3
Facilities That Manufacture Electronic and Electrical Equipment and Components, Photographic and Optical Goods.	XI.AC.3.

E. Special Pollution Prevention Plan Requirements

In addition to the minimum standards listed in Part XI. of this permit (Specific Requirements for Industrial Activities), the storm water pollution prevention plan shall include a complete discussion of measures taken to conform with the following applicable guidelines, other effective storm water pollution prevention procedures, and applicable State rules, regulations and guidelines:

1. *Additional Requirements for Storm Water Discharges Associated With Industrial Activity that Discharge Into or Through Municipal Separate Storm Sewer Systems Serving a Population of 100,000 or More. a.* In addition to the applicable requirements of this permit, facilities covered by this permit must comply with applicable requirements in municipal storm water management programs developed under NPDES permits issued for the discharge of the municipal separate storm sewer system that receives the facility's discharge, provided the discharger has been notified of such conditions.

b. Permittees that discharge storm water associated with industrial activity through a municipal separate storm sewer system serving a population of 100,000 or more, or a municipal system designated by the Director shall make plans available to the municipal operator of the system upon request.

2. *Additional Requirements for Storm Water Discharges Associated With Industrial Activity From Facilities Subject to EPCRA Section 313 Requirements.* In addition to the requirements of Part XI. of this permit and other applicable conditions of this permit, storm water pollution prevention plans for facilities subject to

reporting requirements under EPCRA Section 313 for chemicals that are classified as 'Section 313 water priority chemicals' in accordance with the definition in Part X. of this permit, except as provided in paragraph IV.E.2.c.(below), shall describe and ensure the implementation of practices that are necessary to provide for conformance with the following guidelines:

a. In areas where Section 313 water priority chemicals are stored, processed or otherwise handled, appropriate containment, drainage control and/or diversionary structures shall be provided unless otherwise exempted under Part IV.E.2.c. At a minimum, one of the following preventive systems or its equivalent shall be used:

(1) Curbing, culverting, gutters, sewers, or other forms of drainage control to prevent or minimize the potential for storm water runon to come into contact with significant sources of pollutants; or

(2) Roofs, covers or other forms of appropriate protection to prevent storage piles from exposure to storm water and wind.

b. In addition to the minimum standards listed under Part IV.E.2.a. (above) of this permit, except as otherwise exempted under Part IV.E.2.c (below) of this permit, the storm water pollution prevention plan shall include a complete discussion of measures taken to conform with other effective storm water pollution prevention procedures, and applicable State rules, regulations, and guidelines:

(1) Liquid Storage Areas Where Storm Water Comes Into Contact With Any Equipment, Tank, Container, or Other Vessel Used for Section 313 Water Priority Chemicals. (a) No tank or container shall be used for the storage of a Section 313 water priority chemical unless its material and construction are compatible with the material stored and conditions of storage such as pressure and temperature, etc.

(b) Liquid storage areas for Section 313 water priority chemicals shall be operated to minimize discharges of Section 313 chemicals. Appropriate measures to minimize discharges of Section 313 chemicals may include secondary containment provided for at least the entire contents of the largest single tank plus sufficient freeboard to allow for precipitation, a strong spill contingency and integrity testing plan, and/or other equivalent measures.

(2) Material Storage Areas for Section 313 Water Priority Chemicals Other Than Liquids. Material storage areas for Section 313 water priority chemicals other than liquids that are subject to runoff, leaching, or wind shall incorporate drainage or other control features that will minimize the discharge of Section 313 water priority chemicals by reducing storm water contact with Section 313 water priority chemicals.

(3) Truck and Rail Car Loading and Unloading Areas for Liquid Section 313 Water Priority Chemicals. Truck and rail car loading and unloading areas for liquid Section 313 water priority chemicals shall be operated to minimize discharges of Section 313 water priority chemicals. Protection such as overhangs or door skirts to enclose trailer ends at truck loading/unloading docks shall be provided as appropriate. Appropriate measures to minimize discharges of Section 313 chemicals may include: the placement and maintenance of drip pans (including the proper disposal of materials collected in the drip pans) where spillage may occur (such as hose connections, hose reels and filler nozzles) for use when making and breaking hose connections; a strong spill contingency and integrity testing plan; and/or other equivalent measures.

(4) Areas Where Section 313 Water Priority Chemicals Are Transferred, Processed, or Otherwise Handled. Processing equipment and materials handling equipment shall be operated so as to minimize discharges of Section 313 water priority chemicals. Materials used in piping and equipment shall be compatible with the substances handled. Drainage from process and materials handling areas shall minimize storm water contact with Section 313 water priority chemicals. Additional protection such as covers or guards to prevent exposure to wind, spraying or releases from pressure relief vents from causing a discharge of Section 313 water priority chemicals to the drainage system shall be provided as appropriate. Visual inspections or leak tests shall be provided for overhead piping conveying Section 313 water priority chemicals without secondary containment.

(5) Discharges From Areas Covered by Paragraphs (1), (2), (3), or (4). (a) Drainage from areas covered by paragraphs (1), (2), (3), or (4) of this part should be restrained by valves or other positive means to prevent the discharge of a spill or other excessive leakage of Section 313 water priority chemicals. Where containment units are employed, such units may be emptied by pumps or ejectors; however, these shall be manually activated.

(b) Flapper-type drain valves shall not be used to drain containment areas. Valves used for the drainage of containment areas should, as far as is practical, be of manual, open-and-closed design.

(c) If facility drainage is not engineered as above, the final discharge of all in-facility storm sewers shall be equipped to be equivalent with a diversion system that could, in the event of an uncontrolled spill of Section 313 water priority chemicals, return the spilled material to the facility.

(d) Records shall be kept of the frequency and estimated volume (in gallons) of discharges from containment areas.

(6) Facility Site Runoff Other Than From Areas Covered By (1), (2), (3), or (4). Other areas of the facility (those not addressed in paragraphs (1), (2), (3), or (4)), from which runoff that may contain Section 313 water priority chemicals or spills of Section 313 water priority chemicals could cause a discharge shall incorporate the necessary drainage or other control features to prevent discharge of spilled or improperly disposed material and ensure the mitigation of pollutants in runoff or leachate.

(7) Preventive Maintenance and Housekeeping. All areas of the facility shall be inspected at specific intervals identified in the plan for leaks or conditions that could lead to discharges of Section 313 water priority chemicals or direct contact of storm water with raw materials, intermediate materials, waste materials or products. In particular, facility piping, pumps, storage tanks and bins, pressure vessels, process and material handling equipment, and material bulk storage areas shall be examined for any conditions or failures that could cause a discharge. Inspection shall include examination for leaks, wind blowing, corrosion, support or foundation failure, or other forms of deterioration or noncontainment. Inspection intervals shall be specified in the plan and shall be based on design and operational experience. Different areas may require different inspection intervals. Where a leak or other condition is discovered that may result in significant releases of Section 313 water priority chemicals to waters of the United States, action to stop the leak or otherwise prevent the significant release of Section 313 water priority chemicals to waters of the United States shall be immediately taken or the unit or process shut down until such action can be taken. When a leak or noncontainment of a Section 313 water priority chemical has occurred, contaminated soil, debris, or other material must be promptly removed and disposed in accordance with Federal, State, and local requirements and as described in the plan.

(8) Facility Security. Facilities shall have the necessary security systems to prevent accidental or intentional entry that could cause a discharge. Security systems described in the plan shall address fencing, lighting, vehicular traffic control, and securing of equipment and buildings.

(9) Training. Facility employees and contractor personnel that work in areas where Section 313 water priority chemicals are used or stored shall be trained in and informed of preventive measures at the facility. Employee training shall be conducted at intervals specified in the plan, but not less than once per year. Training shall address: pollution control laws and regulations, the storm water pollution prevention plan and the particular features of the facility and its operation that are designed to minimize discharges of Section 313 water priority chemicals. The plan shall designate a person who is accountable for spill prevention at the facility and who will set up the necessary spill emergency procedures and reporting requirements so that spills and emergency releases of Section 313 water priority chemicals can be isolated and contained before a discharge of a Section 313 water priority chemical can occur. Contractor or temporary personnel shall be informed of facility operation and design features in order to prevent discharges or spills from occurring.

c. Facilities subject to reporting requirements under EPCRA Section 313 for chemicals that are classified as "Section 313 water priority chemicals" in accordance with the definition in Part X. of this permit that are handled and stored onsite only in gaseous or non-soluble liquid or solid (at atmospheric pressure and temperature) forms may provide a certification as such in the pollution prevention plan in lieu of the additional requirements in Part IV.E.2. Such certification shall include a narrative description of all water priority chemicals and the form in which they are handled and stored, and shall be signed in accordance with Part VII.G. (Signatory Requirements) of this permit.

d. The storm water pollution prevention plan shall be certified in accordance with Section VII.G (Signatory Requirements) of this permit.

3. Additional Requirements for Salt Storage. Storage piles of salt used for deicing or other commercial or industrial purposes and that generate a storm water discharge associated with industrial activity that is discharged to waters of the United States shall be enclosed or covered to prevent exposure to precipitation, except for exposure resulting from adding or removing materials from the pile. Dischargers shall demonstrate compliance with this provision as expeditiously as practicable, but in no event later than [insert date 3 years after permit finalization]. Dischargers with previous coverage under the Baseline general permit for storm water shall be compliant with this provision upon submittal of the NOI. Piles do not need to be enclosed or covered where storm water from the pile is not discharged to waters of the United States.

4. Consistency With Other Plans. Storm water pollution prevention plans may reference the existence of other plans for Spill Prevention Control and Countermeasure (SPCC) plans developed for the facility under Section 311 of the CWA or Best Management Practices (BMP) Programs otherwise required by an NPDES permit for the facility as long as such requirement is incorporated into the storm water pollution prevention plan.

V. Numeric Effluent Limitations

A. Discharges Associated With Specific Industrial Activity

Numeric effluent limitations for storm water discharges associated with a specific industrial activity are described in Part XI. of this permit.

B. Coal Pile Runoff

Any discharge composed of coal pile runoff shall not exceed a-maximum concentration for any time of 50 mg/L total suspended solids. Coal pile runoff shall not be diluted with storm water or other flows in order to meet this limitation. The pH of such discharges shall be within the range of 6.0 to 9.0. Runoff from coal piles located at steam electric generating facilities shall be in compliance with these limits upon submittal of the Notice of Intent (NOI). Runoff from coal piles at all other types of facilities shall comply with these limitations as expeditiously as practicable, but in no case later than [insert date 3 years after permit finalization]. Dischargers with previous coverage under the Baseline general permit for storm water shall be compliant with this provision upon submittal of the NOI. Any untreated overflow from facilities designed, constructed and operated to treat the volume of coal pile runoff that is associated with a 10-year, 24-hour rainfall event shall not be subject to the 50 mg/L limitation for total suspended solids.

VI. Monitoring and Reporting Requirements

A. Monitoring Requirements

1. Limitations on Monitoring Requirements. a. Except as required by paragraph b., only those facilities with discharges or activities identified in Part VI.C. and Part XI. are required to conduct sampling of their storm water discharges associated with industrial activity. Monitoring requirements under parts VI.C. and XI. are additive. Facilities with discharges or activities described in more than one monitoring section are subject to all applicable monitoring requirements from each section.

b. The Director can provide written notice to any facility otherwise exempt from the sampling requirements of Parts VI.C. and XI. that it shall conduct discharge sampling for a specific monitoring frequency for specific parameters.

B. Reporting: Where To Submit

1. Location. Signed copies of discharge monitoring reports required under Parts XI. and VI.C., individual permit applications, and all other reports required herein, shall be submitted to the Director of the NPDES program at the address of the appropriate Regional Office:

a. CT, MA, ME, NH, RI, VT

EPA, Region I, Water Management Division, (WCP), Storm Water Staff, JFK Federal Building, Boston, MA 02203

b. PR

EPA, Region II, Water Management Division, (2WM–WPC), Storm Water Staff, 290 Broadway, New York, NY 10007–1866

c. DE, DC

EPA, Region III, Water Management Division, (3WM55), Storm Water Staff, 841 Chestnut Building, Philadelphia, PA 19107

d. FL

EPA, Region IV, Water Management Division, Permits Section (WPEB–7), 345 Courtland Street, NE., Atlanta, GA 30365

e. LA, NM (except see Region IX for Navajo lands), OK, TX

EPA, Region VI, Enforcement and Compliance Assurance Division (GEN–WC), EPA SW MSGP, First Interstate Bank Tower at Fountain Place, P.O. Box 50625, Dallas, TX 75205

f. AZ, CA, NV, Johnson Atoll, Midway Island, Wake Island, the Goshute Reservation in UT and NV, the Navajo Reservation in UT, NM, and AZ, the Fort McDermitt Reservation *in OR, the Duck Valley Reservation in NV and ID*

EPA, Region IX, Water Management Division, (W–5–3), Storm Water Staff, 75 Hawthorne Street, San Francisco, CA 94105

g. AK Indian Reservations, ID (except see Region IX for Duck Valley Reservation lands), OR (except see Region IX for Fort McDermitt Reservation lands), WA

EPA, Region X, Water Division, (WD–134), Storm Water Staff, 1200 Sixth Avenue, Seattle, WA 98101

For each outfall, one Discharge Monitoring Report form must be submitted per storm event sampled.

2. Additional Notification. In addition to filing copies of discharge monitoring reports in accordance with Part VI.B. (Reporting: Where to Submit), facilities with at least one storm water discharge associated with industrial activity through a large or medium municipal separate storm sewer system (systems serving a population of 100,000 or more) or a municipal system designated by the Director must submit signed copies of discharge monitoring reports to the operator of the municipal separate storm sewer system in accordance with the dates provided in Part XI. Facilities not required to report monitoring data under Part XI. and facilities that are not otherwise required to monitor their discharges, need not comply with this provision.

C. Special Monitoring Requirements for Coal Pile Runoff

During the period beginning on the effective date and lasting through the expiration date of this permit, permittees with storm water discharges containing coal pile runoff shall monitor such storm water for: pH and TSS (mg/l) at least annually (1 time per year). Permittees with discharges containing coal pile runoff must report in accordance with Part V.B (Numeric Effluent Limitations) and Part VI.B. (Reporting: Where to Submit). In addition to the parameters listed above, the permittee shall provide the date and duration (in hours) of the storm event(s) samples; rainfall measurements or estimates (in inches) of the storm event that generated the sampled runoff; the duration between the storm event samples and the end of the previous measurable (greater than 0.1 inch rainfall) storm event; and an estimate of the total volume (in gallons) of the discharge samples.

1. Sample Type. For discharges containing coal pile runoff from holding ponds or other impoundments with a retention period greater than 24 hours (estimated by dividing the volume of the detention pond by the estimated volume of water discharged during the 24 hours previous to the time that the sample is collected), a minimum of one grab sample may be taken. For all other discharges containing coal pile runoff, data shall be reported for a grab sample. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The required 72-hour storm event interval is waived where the preceding measurable storm event did not result in a measurable discharge from the facility. The required 72-hour storm event interval may also be waived where the permittee documents that less than a 72-hour interval is representative for local storm events during the season when sampling is being conducted. The grab sample shall be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable.

2. Sampling Waiver. When a discharger is unable to collect samples of coal pile runoff due to adverse climatic conditions, the discharger shall collect a substitute sample from a separate qualifying event in the next period and submit this data along with the data for the routine sample in that period. Adverse weather conditions that may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

3. Representative Discharge. When a facility has two or more outfalls containing coal pile runoff that, based on a consideration of the other industrial activity, and significant materials, and upon management practices and activities within the area drained by the outfall, and the permittee reasonably believes substantially identical effluents are discharged, the permittee may test the effluent of one of such outfalls and report that the quantitative data also applies to the substantially identical outfalls provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area (e.g., low (under 40 percent), medium (40 to 65 percent) or high (above 65 percent)) shall be provided in the plan. Permittees required to submit monitoring information under Part VIII. of this permit shall include the description of the location of the outfalls, explanation of why outfalls are expected to discharge substantially identical effluents, and estimate of the size of the drainage area and runoff coefficient with the Discharge Monitoring Report. This representative discharge provision is not applicable to storm water discharges from coal piles regulated under the national effluent limitations guidelines.

4. Alternative Certification. Facilities with storm water discharges containing coal pile runoff may not submit alternative certification in lieu of the required monitoring data.

5. When to Submit. Permittees with discharges containing coal pile runoff shall submit monitoring results annually no later than the 28th day of [insert month following permit finalization].

VII. Standard Permit Conditions

A. Duty to Comply

1. Permittee's Duty to Comply. The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Clean Water Act (CWA) and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or for denial of a permit renewal application.

2. Penalties for Violations of Permit Conditions.

a. Criminal.

(1) Negligent Violations. The CWA provides that any person who negligently violates permit conditions implementing Sections 301, 302, 306, 307, 308, 318, or 405 of the Act is subject to a fine of not less than $2,500 nor more than $25,000 per day of violation, or by imprisonment for not more than 1 year, or both.

(2) Knowing Violations. The CWA provides that any person who knowingly violates permit conditions implementing Sections 301, 302, 306, 307, 308, 318, or 405 of the Act is subject to a fine of not less than $5,000 nor more than $50,000 per day of violation, or by imprisonment for not more than 3 years, or both.

(3) Knowing Endangerment. The CWA provides that any person who

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knowingly violates permit conditions implementing Sections 301, 302, 306, 307, 308, 318, or 405 of the Act and who knows at that time that he is placing another person in imminent danger of death or serious bodily injury is subject to a fine of not more than $250,000, or by imprisonment for not more than 15 years, or both.

(4) False Statement. The CWA provides that any person who knowingly makes any false material statement, representation, or certification in any application, record, report, plan, or other document filed or required to be maintained under the Act or who knowingly falsifies, tampers with, or renders inaccurate, any monitoring device or method required to be maintained under the Act, shall upon conviction, be punished by a fine of not more than $10,000 or by imprisonment for not more than 2 years, or by both. If a conviction is for a violation committed after a first conviction of such person under this paragraph, punishment shall be by a fine of not more than $20,000 per day of violation, or by imprisonment of not more than 4 years, or by both. (See Section 309(c)(4) of the Clean Water Act).

b. Civil Penalties. The CWA provides that any person who violates a permit condition implementing Sections 301, 302, 306, 307, 308, 318, or 405 of the Act is subject to a civil penalty not to exceed $25,000 per day for each violation.

c. Administrative Penalties. The CWA provides that any person who violates a permit condition implementing Sections 301, 302, 306, 307, 308, 318, or 405 of the Act is subject to an administrative penalty, as follows:

(1) Class I Penalty. Not to exceed $10,000 per violation nor shall the maximum amount exceed $25,000.

(1) Class II Penalty. Not to exceed $10,000 per day for each day during which the violation continues nor shall the maximum amount exceed $125,000.

B. Continuation of the Expired General Permit

This permit expires on [insert date 5 years after permit finalization]. However, an expired general permit continues in force and effect until a new general permit is issued. Permittees that choose, or are required, to obtain an individual permit must submit an application (Forms 1 and 2F and any other applicable forms) 180 days prior to expiration of this permit. Permittees that are eligible and choose to be covered by a new general permit must submit an NOI by the date specified in that permit.

C. Need to Halt or Reduce Activity Not a Defense

It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit.

D. Duty to Mitigate

The permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this permit that has a reasonable likelihood of adversely affecting human health or the environment.

E. Duty to Provide Information

The permittee shall furnish to the Director, within a time specified by the Director, any information that the Director may request to determine compliance with this permit. The permittee shall also furnish to the Director upon request, copies of records required to be kept by this permit.

F. Other Information

When the permittee becomes aware that he or she failed to submit any relevant facts or submitted incorrect information in the NOI or in any other report to the Director, he or she shall promptly submit such facts or information.

G. Signatory Requirements

All Notices of Intent, Notices of Termination, storm water pollution prevention plans, reports, certifications or information either submitted to the Director (and/or the operator of a large or medium municipal separate storm sewer system), or that this permit requires be maintained by the permittee, shall be signed.

1. Signature. All reports required by the permit and other information requested by the Director shall be signed as follows:

a. For a corporation: by a responsible corporate officer. For the purpose of this section, a responsible corporate officer means: (1) a president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision-making functions for the corporation; or (2) the manager of one or more manufacturing, production or operating facilities employing more than 250 persons or having gross annual sales or expenditures exceeding $25,000,000 (in second-quarter 1980 dollars) if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures;

b. For a partnership or sole proprietorship: by a general partner or the proprietor, respectively; or

c. For a municipality, State, Federal, or other public facility: by either a principal executive officer or ranking elected official. For purposes of this section, a principal executive officer of a Federal agency includes (1) the chief executive officer of the agency, or (2) a senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency (e.g., Regional Administrators of EPA).

2. Authorized Representative. All reports required by the permit and other information requested by the Director shall be signed by a person described in Section VII.G.1. above or be signed by a duly authorized representative of that person. A person is a duly authorized representative only if:

a. The authorization is made in writing by a person described above and submitted to the Director.

b. The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of manager, operator, superintendent, or position of equivalent responsibility or an individual or position having overall responsibility for environmental matters for the company. (A duly authorized representative may thus be either a named individual or any individual occupying a named position).

c. Changes to Authorization. If an authorization under paragraph VII.G.2. is no longer accurate because a different individual or position has responsibility for the overall operation of the facility, a new NOI satisfying the requirements of paragraph II.B. (Contents of NOI) must be submitted to the Director prior to or together with any reports, information, or applications to be signed by an authorized representative.

d. Certification. Any person signing documents under this section shall make the following certification:

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gathered and evaluated the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

H. Penalties for Falsification of Reports

Section 309(c)(4) of the Clean Water Act provides that any person who knowingly makes any false material statement, representation, or certification in any record or other document submitted or required to be maintained under this permit, including reports of compliance or noncompliance shall, upon conviction, be punished by a fine of not more than $10,000, or by imprisonment for not more than 2 years, or by both.

I. Penalties for Falsification of Monitoring Systems

The CWA provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by fines and imprisonment described in Section 309 of the CWA.

J. Oil and Hazardous Substance Liability

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under Section 311 of the CWA or Section 106 of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA).

K. Property Rights

The issuance of this permit does not convey any property rights of any sort, nor any exclusive privileges, nor does it authorize any injury to private property nor any invasion of personal rights, nor any infringement of Federal, State, or local laws or regulations.

L. Severability

The provisions of this permit are severable, and if any provision of this permit, or the application of any provision of this permit to any circumstance, is held invalid, the application of such provision to other circumstances, and the remainder of this permit shall not be affected thereby.

M. Requiring an Individual Permit or an Alternative General Permit

1. *Director Designation.* The Director may require any person authorized by this permit to apply for and/or obtain either an individual NPDES permit or an alternative NPDES general permit. Any interested person may petition the Director to take action under this paragraph. The Director may require any owner or operator authorized to discharge under this permit to apply for an individual NPDES permit only if the owner or operator has been notified in writing that a permit application is required. This notice shall include a brief statement of the reasons for this decision, an application form, a statement setting a deadline for the owner or operator to file the application, and a statement that on the effective date of issuance or denial of the individual NPDES permit or the alternative general permit as it applies to the individual permittee, coverage under this general permit shall automatically terminate. Individual permit applications shall be submitted to the address of the appropriate Regional Office shown in Part VI.B. (Reporting: Where to Submit) of this permit. The Director may grant additional time to submit the application upon request of the applicant. If an owner or operator fails to submit in a timely manner an individual NPDES permit application as required by the Director, then the applicability of this permit to the individual NPDES permittee is automatically terminated at the end of the day specified for application submittal.

2. *Individual Permit Application.* Any owner or operator authorized by this permit may request to be excluded from the coverage of this permit by applying for an individual permit. The owner or operator shall submit an individual application (Form 1 and Form 2F) with reasons supporting the request to the Director. Individual permit applications shall be submitted to the address of the appropriate Regional Office shown in Part VI.B. of this permit. The request may be granted by the issuance of any individual permit or an alternative general permit if the reasons cited by the owner or operator are adequate to support the request.

3. *Individual/Alternative General Permit Issuance.* When an individual NPDES permit is issued to an owner or operator otherwise subject to this permit, or the owner or operator is authorized for coverage under an alternative NPDES general permit, the applicability of this permit to the individual NPDES permittee is automatically terminated on the effective date of the individual permit or the date of authorization of coverage under the alternative general permit, whichever the case may be. When an individual NPDES permit is denied to an owner or operator otherwise subject to this permit, or the owner or operator is denied for coverage under an alternative NPDES general permit, the applicability of this permit to the individual NPDES permittee is automatically terminated on the date of such denial, unless otherwise specified by the Director.

N. State/Environmental Laws

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable State law or regulation under authority preserved by Section 510 of the Act.

No condition of this permit shall release the permittee from any responsibility or requirements under other environmental statutes or regulations.

O. Proper Operation and Maintenance

The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) that are installed or used by the permittee to achieve compliance with the conditions of this permit and with the requirements of storm water pollution prevention plans. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. Proper operation and maintenance requires the operation of backup or auxiliary facilities or similar systems, installed by a permittee only when necessary to achieve compliance with the conditions of the permit.

P. Monitoring and Records

1. *Representative Samples/Measurements.* Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity.

2. *Retention of Records.*

a. The permittee shall retain records of all monitoring information, copies of all reports required by this permit, and records of all data used to complete the application of this permit for a period of at least three (3) years from the date of sample, measurement, evaluation or inspection, report, or application. This period may be extended by request of the Director at any time. Permittees must submit any such records to the Director upon request.

b. The permittee shall retain the pollution prevention plan developed in accordance with Parts IV. and XI. of this permit until a date 3 years after the last modification or amendment is made to the plan, and at least 1 year after coverage under this permit terminates.

3. *Records Contents.* Records of monitoring information shall include:

a. The date, exact place, and time of sampling or measurements;

b. The initials or name(s) of the individual(s) who performed the sampling or measurements;

c. The date(s) analyses were performed;

d. The time(s) analyses were initiated;

e. The initials or name(s) of the individual(s) who performed the analyses;

f. References and written procedures, when available, for the analytical techniques or methods used; and

g. The results of such analyses, including the bench sheets, instrument readouts, computer disks or tapes, etc., used to determine these results.

4. *Approved Monitoring Methods.* Monitoring must be conducted according to test procedures approved under 40 CFR Part 136, unless other test procedures have been specified in this permit.

Q. Inspection and Entry

The permittee shall allow the Director or an authorized representative of EPA, the State environmental agency, or, in the case of a facility that discharges through a municipal separate storm sewer, an authorized representative of the municipal operator or the separate storm sewer receiving the discharge, upon the presentation of credentials and other documents as may be required by law, to: enter upon the permittee's premises where a regulated facility or activity is located or conducted or where records must be kept under the conditions of this permit; have access to and copy at reasonable times, any records that must be kept under the conditions of this permit; and inspect at reasonable times any facilities or equipment (including monitoring and control equipment).

R. Permit Actions

This permit may be modified, revoked and reissued, or terminated for cause. The filing of a request by the permittee for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance does not stay any permit condition.

S. Bypass of Treatment Facility

1. *Notice.*

a. Anticipated Bypass. If a permittee subject to the numeric effluent limitations of Parts V. and XI. of this permit knows in advance of the need for a bypass, he or she shall submit prior notice, if possible, at least 10 days before the date of the bypass; including an evaluation of the anticipated quality and effect of the bypass.

b. Unanticipated Bypass. The permittee subject to the numeric effluent limitations of Parts V. and XI. of this permit shall submit notice of an unanticipated bypass. Any information regarding the unanticipated bypass shall be provided orally within 24 hours from the time the permittee became aware of the circumstances. A written submission shall also be provided within 5 days of the time the permittee became aware of the circumstances. The written submission shall contain a description of the bypass and its cause; the period of the bypass; including exact dates and times, and if the bypass has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the bypass.

2. *Prohibition of Bypass.*

a. Bypass is prohibited and the Director may take enforcement action against a permittee for a bypass. Unless:

(1) The bypass was unavoidable to prevent loss of life, personal injury, or severe property damage;

(2) There were no feasible alternatives to the bypass, such as the use of auxiliary facilities, retention of untreated wastes, or maintenance during normal periods of equipment downtime. This condition is not satisfied if the permittee should, in the exercise of reasonable engineering judgement, have installed adequate backup equipment to prevent a bypass that occurred during normal periods of equipment downtime or preventive maintenance; and

(3) The permittee submitted notices of the bypass.

b. The Director may approve an anticipated bypass after considering its adverse effects, if the Director determines that it will meet the three conditions listed in Part VII.S.2.a.

T. Upset Conditions

1. *Affirmative Defense.* An upset constitutes an affirmative defense to an action brought for noncompliance with technology-based numeric effluent limitations in Parts V. and XI. of this permit if the requirements of paragraph 2 below are met. No determination made during administrative review of claims that noncompliance was caused by upset, and before an action for noncompliance, is final administrative action subject to judicial review.

2. *Required Defense.* A permittee who wishes to establish the affirmative defense of an upset shall demonstrate, through properly signed, contemporaneous operating logs, or other relevant evidence, that:

a. An upset occurred and that the permittee can identify the specific cause(s) of the upset:

b. The permitted facility was at the time being properly operated; and

c. The permittee provided oral notice of the upset to EPA within 24 hours from the time the permittee became aware of the circumstances. A written submission shall also be provided within 5 days of the time the permittee became aware of the circumstances. The written submission shall contain a description of the upset and its cause; the period of the upset; including exact dates and times, and if the upset has not been corrected, the anticipated time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent reoccurrence of the upset.

3. *Burden of Proof.* In any enforcement proceeding the permittee seeking to establish the occurrence of an upset has the burden of proof.

VIII. Reopener Clause

A. Potential or Realized Impacts on Water Quality

If there is evidence indicating potential or realized impacts on water quality or on a listed endangered species due to any storm water discharge associated with industrial activity covered by this permit, the owner or operator of such discharge may be required to obtain an individual permit or an alternative general permit in accordance with Part VII.M. (Requiring an Individual Permit or an Alternative General Permit) of this permit or the permit may be modified to include different limitations and/or requirements.

B. Applicable Regulations

Permit modification or revocation will be conducted according to 40 CFR 122.62, 122.63, 122.64, and 124.5.

IX. Termination of Coverage

A. Notice of Termination

Where all storm water discharges associated with industrial activity that are authorized by this permit are eliminated, or where the operator of storm water discharges associated with industrial activity at a facility changes, the operator of the facility may submit a Notice of Termination that is signed in accordance with Part VII.G. (Signatory Requirements) of this permit. The Notice of Termination shall include the following information:

1. *Facility Information.* Name, mailing address, and location of the facility for which the notification is submitted.Describe the location of the approximate center of the site in terms of the latitude and longitude to the nearest 15 seconds, or the section,

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township and range to the nearest quarter section;

2. *Operator Information.* The name, address, and telephone number of the operator addressed by the Notice of Termination;

3. *Permit Number.* The NPDES permit number for the storm water discharge associated with industrial activity identified by the Notice of Termination;

4. *Reason for Termination.* An indication of whether the storm water discharges associated with industrial activity have been eliminated or the operator of the discharges has changed; and

5. *Certification.* The following certification signed in accordance with Part VII.G. (Signatory Requirements) of this permit:

I certify under penalty of law that all storm water discharges associated with industrial activity from the identified facility that are authorized by an NPDES general permit have been eliminated or that I am no longer the operator of the industrial activity. I understand that by submitting this notice of termination, that I am no longer authorized to discharge storm water associated with industrial activity under this general permit, and that discharging pollutants in storm water associated with industrial activity to waters of the United States is unlawful under the Clean Water Act where the discharge is not authorized by an NPDES permit. I also understand that the submittal of this notice of termination does not release an operator from liability for any violations of this permit or the Clean Water Act.

B. Addresses

All Notices of Termination are to be sent, using the form provided by the Director (or a photocopy thereof),[2] to the Director of the NPDES program at the following address: Storm Water Notice of Termination (4203), 401 M Street, S.W., Washington, D.C. 20460.

X. Definitions

Best Management Practices ("BMPs") means schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of waters of the United States. BMPs also include treatment requirements, operating procedures, and practices to control facility site runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

Bypass means the intentional diversion of waste streams from any portion of a treatment facility.

Coal pile runoff means the rainfall runoff from or through any coal storage pile

Co-located industrial activity means when a facility has industrial activities being conducted onsite that are described under more than one of the coverage sections of Part XI in this permit (Discharges Covered Under This Section). Facilities with co-located industrial activities shall comply with all applicable monitoring and pollution prevention plan requirements of each section in which a co-located industrial activity is described.

CWA means Clean Water Act (formerly referred to as the Federal Water Pollution Control Act or Federal Water Pollution Control Act Amendments of 1972).

Commercial Treatment and Disposal Facilities means facilities that receive, on a commercial basis, any produced hazardous waste (not their own) and treat or dispose of those wastes as a service to the generators. Such facilities treating and/or disposing exclusively residential hazardous wastes are not included in this definition.

Director means the Regional Administrator or an authorized representative.

Flow-weighted composite sample means a composite sample consisting of a mixture of aliquots collected at a constant time interval, where the volume of each aliquot is proportional to the flow rate of the discharge.

Landfill means an area of land or an excavation in which wastes are placed for permanent disposal, and that is not a land application unit, surface impoundment, injection well, or waste pile.

Land application unit means an area where wastes are applied onto or incorporated into the soil surface (excluding manure spreading operations) for treatment or disposal.

Large and medium municipal separate storm sewer system means all municipal separate storm sewers that are either:

(i) located in an incorporated place (city) with a population of 100,000 or more as determined by the latest Decennial Census by the Bureau of Census (these cities are listed in Appendices F and G of 40 CFR Part 122); or

(ii) located in the counties with unincorporated urbanized populations of 100,000 or more, except municipal separate storm sewers that are located in the incorporated places, townships or towns within such counties (these counties are listed in Appendices H and I of 40 CFR Part 122); or

(iii) owned or operated by a municipality other than those described in paragraph (i) or (ii) and that are designated by the Director as part of the large or medium municipal separate storm sewer system.

NOT means notice of termination (see Part IX.A. of this permit.)

Point source means any discernible, confined, and discrete conveyance, including but not limited to, any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, vessel or other floating craft from which pollutants are or may be discharged. This term does not include return flows from irrigated agriculture or agricultural storm water runoff.

Section 313 water priority chemical means a chemical or chemical categories that: (1) Are listed at 40 CFR 372.65 pursuant to Section 313 of the Emergency Planning and Community Right-to-Know Act (EPCRA) (also known as Title III of the Superfund Amendments and Reauthorization Act (SARA) of 1986); (2) are present at or above threshold levels at a facility subject to EPCRA Section 313 reporting requirements; and (3) meet at least one of the following criteria: (i) are listed in Appendix D of 40 CFR Part 122 on either Table II (organic priority pollutants), Table III (certain metals, cyanides, and phenols) or Table V (certain toxic pollutants and hazardous substances); (ii) are listed as a hazardous substance pursuant to Section 311(b)(2)(A) of the CWA at 40 CFR 116.4; or (iii) are pollutants for which EPA has published acute or chronic water quality criteria. See Addendum A of this permit. This addendum was revised based on final rulemaking EPA published in the **Federal Register** November 30, 1994.

Significant materials includes, but is not limited to: raw materials; fuels; materials such as solvents, detergents, and plastic pellets; finished materials such as metallic products; raw materials used in food processing or production; hazardous substances designated under Section 101(14) of CERCLA; any chemical the facility is required to report pursuant to EPCRA Section 313; fertilizers; pesticides; and waste products such as ashes, slag and sludge that have the potential to be released with storm water discharges.

Significant spills includes, but is not limited to: releases of oil or hazardous substances in excess of reportable quantities under Section 311 of the Clean Water Act (see 40 CFR 110.10 and CFR 117.21) or Section 102 of CERCLA (see 40 CFR 302.4).

Storm water means storm water runoff, snow melt runoff, and surface runoff and drainage.

[2] A copy of the approved NOT form is provided in Addendum C of this notice.

Storm water associated with industrial activity means the discharge from any conveyance that is used for collecting and conveying storm water and that is directly related to manufacturing, processing or raw materials storage areas at an industrial plant. The term does not include discharges from facilities or activities excluded from the NPDES program. For the categories of industries identified in paragraphs (i) through (x) of this definition, the term includes, but is not limited to, storm water discharges from industrial plant yards; immediate access roads and rail lines used or traveled by carriers of raw materials, manufactured products, waste material, or by-products used or created by the facility; material handling sites; refuse sites; sites used for the application or disposal of process waste waters (as defined at 40 CFR Part 401); sites used for the storage and maintenance of material handling equipment; sites used for residual treatment, storage, or disposal; shipping and receiving areas; manufacturing buildings; storage areas (including tank farms) for raw materials, and intermediate and finished products; and areas where industrial activity has taken place in the past and significant materials remain and are exposed to storm water. For the categories of industries identified in paragraph (xi) of this definition, the term includes only storm water discharges from all areas (except access roads and rail lines) listed in the previous sentence where material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, or industrial machinery are exposed to storm water. For the purposes of this paragraph, material handling activities include the storage, loading and unloading, transportation, or conveyance of any raw material, intermediate product, finished product, by-product or waste product. The term excludes areas located on plant lands separate from the plant's industrial activities, such as office buildings and accompanying parking lots as long as the drainage from the excluded areas is not mixed with storm water drained from the above described areas. Industrial facilities (including industrial facilities that are Federally, State, or municipally owned or operated that meet the description of the facilities listed in paragraphs (i) to (xi) of this definition) include those facilities designated under 122.26(a)(1)(v). The following categories of facilities are considered to be engaging in "industrial activity" for purposes of this subsection:

(i) Facilities subject to storm water effluent limitations guidelines, new source performance standards, or toxic pollutant effluent standards under 40 CFR Subchapter N (except facilities with toxic pollutant effluent standards that are exempted under category (xi) of this definition);

(ii) Facilities classified as Standard Industrial Classifications 24 (except 2434), 26 (except 265 and 267), 28 (except 283 and 285), 29, 311, 32 (except 323), 33, 3441, 373;

(iii) Facilities classified as Standard Industrial Classifications 10 through 14 (mineral industry) including active or inactive mining operations (except for areas of coal mining operations no longer meeting the definition of a reclamation area under 40 CFR 434.11(l) because the performance bond issued to the facility by the appropriate SMCRA authority has been released, or except for areas of noncoal mining operations that have been released from applicable State or Federal reclamation requirements after December 17, 1990) and oil and gas exploration, production, processing, or treatment operations, or transmission facilities that discharge storm water contaminated by contact with or that has come into contact with, any overburden, raw material, intermediate products, finished products, byproducts or waste products located on the site of such operations; inactive mining operations are mining sites that are not being actively mined, but that have an identifiable owner/operator;

(iv) Hazardous waste treatment, storage, or disposal facilities, including those that are operating under interim status or a permit under Subtitle C of RCRA;

(v) Landfills, land application sites, and open dumps that have received any industrial wastes (waste that is received from any of the facilities described under this subsection) including those that are subject to regulation under Subtitle D of RCRA;

(vi) Facilities involved in the recycling of materials, including metal scrapyards, battery reclaimers, salvage yards, and automobile junkyards, including but limited to those classified as Standard Industrial Classification 5015 and 5093;

(vii) Steam electric power generating facilities, including coal handling sites;

(viii) Transportation facilities classified as Standard Industrial Classifications 40, 41, 42 (except 4221–25), 43, 44, 45 and 5171 that have vehicle maintenance shops, equipment cleaning operations, or airport deicing operations. Only those portions of the facility that are either involved in vehicle maintenance (including vehicle rehabilitation, mechanical repairs, painting, fueling, and lubrication), equipment cleaning operations, airport deicing operations, or that are otherwise identified under paragraphs (i) to (vii) or (ix) to (xi) of this subsection are associated with industrial activity;

(ix) Treatment works treating domestic sewage or any other sewage sludge or wastewater treatment device or system, used in the storage treatment, recycling, and reclamation of municipal or domestic sewage, including land dedicated to the disposal of sewage sludge that are located within the confines of the facility, with a design flow of 1.0 mgd or more, or required to have an approved pretreatment program under 40 CFR Part 403. Not included are farm lands, domestic gardens or lands used for sludge management where sludge is beneficially reused and that are not physically located in the confines of the facility, or areas that are in compliance with 40 CFR Part 503;

(x) Construction activity including clearing, grading and excavation activities except: operations that result in the disturbance of less than 5 acres of total land area that are not part of a larger common plan of development or sale;

(xi) Facilities under Standard Industrial Classifications 20, 21, 22, 23, 2434, 25, 265, 267, 27, 283, 285, 30, 31 (except 311), 323, 34 (except 3441), 35, 36, 37 (except 373), 38, 39, 4221–25, (and that are not otherwise included within categories (i) to (x)).[3]

Time-weighted composite means a composite sample consisting of a mixture of equal volume aliquots collected at a constant time interval.

Upset means an exceptional incident in which there is unintentional and temporary noncompliance with the numeric effluent limitations of Parts V. and XI. of this permit because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

Waste pile means any noncontainerized accumulation of solid, nonflowing waste that is used for treatment or storage.

Waters of the United States means:

[3] On June 4, 1992, the United States Court of Appeals for the Ninth Circuit remanded the exclusion for manufacturing facilities in category (xi) that do not have materials or activities exposed to storm water to the EPA for further rulemaking. (Nos. 90–70671 and 91–70200.)

a. All waters that are currently used, were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters that are subject to the ebb and flow of the tide;

b. All interstate waters, including interstate wetlands;

c. All other waters such as interstate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds the use, degradation, or destruction of which would affect or could affect interstate or foreign commerce including any such waters:

1. That are or could be used by interstate or foreign travelers for recreational or other purposes;

2. From which fish or shellfish are or could be taken and sold in interstate or foreign commerce; or

3. That are used or could be used for industrial purposes by industries in interstate commerce;

d. All impoundments of waters otherwise defined as waters of the United States under this definition;

e. Tributaries of waters identified in paragraphs (a) through (d) of this definition;

f. The territorial sea; and

g. Wetlands adjacent to waters (other than waters that are themselves wetlands) identified in paragraphs (a) through (f) of this definition.

(Waste treatment systems, including treatment ponds or lagoons designed to meet the requirements of CWA are not waters of the United States.)

Specific Requirements for Industrial Activities

A. Storm Water Discharges Associated With Industrial Activity From Timber Products Facilities

1. Discharges Covered Under This Section. The requirements listed under this section shall apply to storm water discharges from the following activities: establishments [generally classified under Standard Industrial Classification (SIC) Major Group 24] that are engaged in cutting timber and pulpwood, merchant sawmills, lath mills, shingle mills, cooperage stock mills, planing mills, and plywood and veneer mills engaged in producing lumber and wood basic materials; and establishments engaged in wood preserving or in manufacturing finished articles made entirely of wood or related materials, except for wood kitchen cabinet manufacturers (SIC Code 2434), which are addressed under Part XI.W. of this permit.

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

2. *Special Conditions.*

a. *Prohibition of Non-storm Water Discharges.*

(1) Discharges of boiler blowdown and water treatment wastewaters, noncontact and contact cooling waters, wash down waters from treatment equipment, and storm water that has come in contact with areas where spraying of chemical formulations designed to provide surface protection, to waters of the United States, or through municipal separate storm sewer systems are not authorized by this permit. The operators of such discharges must obtain coverage under a separate NPDES discharge permit.

(2) In addition to the discharges described in part III.A.2., the following non-storm water discharges may be authorized by this permit provided the non-storm water component of the discharge is in compliance with paragraph XI.A.3.a.(3)(g)(i) (Measures and Controls for Non-storm Water Discharges): discharges from the spray down of lumber and wood product storage yards where no chemical additives are used in the spray down waters and no chemicals are applied to the wood during storage.

3. Storm Water Pollution Prevention Plan Requirements.

a. Contents of Plan. The plan shall include, at a minimum, the following items:

(1) Pollution Prevention Team. Each plan shall identify a specific individual or individuals within the facility organization as members of a storm water Pollution Prevention Team that are responsible for developing the storm water pollution prevention plan and assisting the facility or plant manager in its implementation, maintenance, and revision. The plan shall clearly identify the responsibilities of each team member. The activities and responsibilities of the team shall address all aspects of the facility's storm water pollution prevention plan.

(2) Description of Potential Pollutant Sources. Each plan shall provide a description of potential sources that may reasonably be expected to add significant amounts of pollutants to storm water discharges or that may result in the discharge of pollutants during dry weather from separate storm sewers draining the facility. Each plan shall identify all activities and significant materials that may potentially be significant pollutant sources. Each plan shall include, at a minimum:

(a) Drainage.

(i) A site map indicating the location of outfalls covered by the permit, the types of discharges contained in the drainage areas of the outfalls, an outline of the portions of the drainage area of each storm water outfall that are within the facility boundaries, each existing structural control measure to reduce pollutants in storm water runoff, surface water bodies, locations where significant materials are exposed to precipitation, locations where major spills or leaks identified under Part XI.A.3.a.(2)(c) (Spills and Leaks) of this permit have occurred, and the locations of the following activities where such activities are exposed to precipitation: fueling stations; vehicle and equipment maintenance and/or cleaning areas; loading/unloading areas; material handling areas; locations used for the treatment, storage, or disposal of wastes; liquid storage tanks; processing areas; treatment chemical storage areas; treated wood and residue storage areas; wet decking areas; dry decking areas; untreated wood and residue storage areas; and treatment equipment storage areas.

(ii) For each area of the facility that generates storm water discharges associated with industrial activity with a reasonable potential for containing significant amounts of pollutants, a prediction of the direction of flow, and an identification of the types of pollutants that are likely to be present in storm water discharges associated with industrial activity. Factors to consider include the toxicity of chemicals; quantity of chemicals used, produced or discharged; the likelihood of contact with storm water; and history of significant leaks or spills of toxic or hazardous pollutants. Flows with a significant potential for causing erosion shall be identified.

(b) Inventory of Exposed Materials—An inventory of the types of materials handled at the site that potentially may be exposed to precipitation. Such inventory shall include a narrative

description of significant materials that have been handled, treated, stored or disposed in a manner to allow exposure to storm water between the time of 3 years prior to the date of submission of a Notice of Intent (NOI) to be covered under this permit and the present; method and location of onsite storage or disposal; materials management practices employed to minimize contact of materials with storm water runoff between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; the location and a description of existing structural and nonstructural control measures to reduce pollutants in storm water runoff; and a description of any treatment the storm water receives. The inventory of exposed materials shall include, but shall not be limited to the significant materials stored exposed to storm water and material management practices employed that were listed for the facility in the approved group application. Where information is available, facilities that have used chlorophenolic, creosote, or chromium-copper-arsenic formulations for wood surface protection or wood preserving activities onsite in the past should identify in the inventory the following: areas where contaminated soils, treatment equipment, and stored materials still remain and management practices employed to minimize the contact of these materials with storm water runoff.

(c) Spills and Leaks—A list of significant spills and significant leaks of toxic or hazardous pollutants that occurred at areas that are exposed to precipitation or that otherwise drain to a storm water conveyance at the facility after the date of 3 years prior to the date of submission of a Notice of Intent (NOI) to be covered under this permit. Such list shall be updated as appropriate during the term of the permit.

(d) Sampling Data—A summary of existing discharge sampling data describing pollutants in storm water discharges from the facility, including a summary of sampling data collected during the term of this permit.

(e) Risk Identification and Summary of Potential Pollutant Sources—A narrative description of the potential pollutant sources from the following activities: loading and unloading operations; outdoor storage activities; outdoor manufacturing or processing activities; significant dust or particulate generating processes; and onsite waste disposal practices. The description shall specifically list any significant potential source of pollutants at the site and for each potential source, any specific pollutant or pollutant parameter (e.g., total suspended solids, biochemical oxygen demand, chemical oxygen demand, oil and grease, arsenic, copper, chromium, pentachlorophenol, other specific metals, toxicity, etc.) of concern shall be identified.

(3) Measures and Controls. Each facility covered by this permit shall develop a description of storm water best management practices (BMPs) and controls appropriate for the facility and implement such controls. The appropriateness of controls in a plan shall reflect identified potential sources of pollutants at the facility. The description of storm water management controls shall address the following areas of the site: log, lumber and other wood product storage areas; residue storage areas, loading and unloading areas; material handling areas; chemical storage areas; and equipment/vehicle maintenance, storage and repair areas. Facilities that surface protect and/or preserve wood products should address specific BMPs for wood surface protection and preserving activities. The pollution prevention plan should address the following minimum components, including a schedule for implementing such controls:

(a) Good Housekeeping—Good housekeeping requires the maintenance of areas that may contribute pollutants to storm water discharges in a clean, orderly manner. Good housekeeping measures in storage areas, loading and unloading areas, and material handling areas should be designed to: 1) limit the discharge of wood debris; 2) minimize the leachate generated from decaying wood materials; and 3) minimize the generation of dust.

(b) Preventive Maintenance—A preventive maintenance program shall involve timely inspection and maintenance of storm water management devices (e.g., cleaning oil/water separators, catch basins) as well as inspecting and testing facility equipment and systems to uncover conditions that could cause breakdowns or failures resulting in discharges of pollutants to surface waters, and ensuring appropriate maintenance of such equipment and systems. Periodic removal of debris from ditches, swales, diversions, containment basins, sediment ponds and infiltration measures should be performed to limit discharges of solids and to maintain the effectiveness of the controls.

(c) Spill Prevention and Response Procedures—Areas where potential spills that can contribute pollutants to storm water discharges can occur, and their accompanying drainage points shall be identified clearly in the storm water pollution prevention plan. Where appropriate, specifying material handling procedures, storage requirements, and use of equipment such as diversion valves in the plan should be considered. Procedures for cleaning up spills shall be identified in the plan and made available to the appropriate personnel. The necessary equipment to implement a cleanup should be available to personnel. Response schedules should be developed to limit tracking of spilled materials to other areas of the site. Leaks or spills of wood surface protection or preservation chemicals shall be cleaned up immediately in accordance with applicable RCRA regulations at 40 CFR Part 264 and 40 CFR Part 265.

(d) Inspections—In addition to or as part of the comprehensive site evaluation required under paragraph XI.A.3.a.(4) of this section, qualified facility personnel shall be identified to inspect designated equipment and areas of the facility at appropriate intervals specified in the plan. Operators of facilities are required to conduct quarterly visual inspections of BMPs. The inspections shall include: 1) an assessment of the integrity of storm water discharge diversions, conveyance systems, sediment control and collection systems, and containment structures; 2) visual inspection of sediment and erosion BMPs to determine if soil erosion has occurred; and 3) visual inspections of storage areas and other potential sources of pollution for evidence of actual or potential pollutant discharges of contaminated storm water.

Material handling, and unloading and loading areas should be inspected daily whenever industrial activities occur in those areas. If no activities are occurring, no inspection is required.

Inspections at processing areas, transport areas, and treated wood storage areas of facilities performing wood surface protection and preservation activities should be performed monthly to assess the usefulness of practices in minimizing drippage of treatment chemicals on unprotected soils and in areas that will come in contact with storm water discharges.

A set of tracking or follow-up procedures shall be used to ensure that appropriate actions are taken in response to the inspections. Records of inspections shall be maintained.

(e) Employee Training—Employee training programs shall inform personnel responsible for implementing activities identified in the storm water pollution prevention plan or otherwise responsible for storm water management

at all levels of responsibility of the components and goals of the storm water pollution prevention plan. Training should address topics such as spill response, good housekeeping and material management practices. The pollution prevention plan shall identify periodic dates for such training.

(f) Recordkeeping and Internal Reporting Procedures—A description of incidents (such as spills, or other discharges), along with other information describing the quality and quantity of storm water discharges shall be included in the plan required under this part. Inspections and maintenance activities shall be documented and records of such activities shall be incorporated into the plan.

(g) Non-storm Water Discharges.

(i) The plan shall include a certification that the discharge has been tested or evaluated for the presence of non-storm water discharges. The certification shall include the identification of potential significant sources of non-storm water at the site, a description of the results of any test and/or evaluation for the presence of non-storm water discharges, the evaluation criteria or testing method used, the date of any testing and/or evaluation, and the onsite drainage points that were directly observed during the test. Certifications shall be signed in accordance with Part VII.G. of this permit. Such certification may not be feasible if the facility operating the storm water discharge associated with industrial activity does not have access to an outfall, manhole, or other point of access to the ultimate conduit that receives the discharge. In such cases, the source identification section of the storm water pollution prevention plan shall indicate why the certification required by this part was not feasible, along with the identification of potential significant sources of non-storm water at the site. A discharger that is unable to provide the certification required by this paragraph must notify the Director in accordance with paragraph XI.A.3.a.(3)(g)(iii) (below).

(ii) Except for flows from fire fighting activities, sources of non-storm water listed in Part III.A.2. (Prohibition of Non-storm Water Discharges) of this permit that are combined with storm water discharges associated with industrial activity must be identified in the plan. The plan shall identify and ensure the implementation of appropriate pollution prevention measures for the non-storm water component(s) of the discharge.

(iii) Failure to Certify—Any facility that is unable to provide the certification required (testing for non-storm water discharges), must notify the Director by [Insert date 270 days after permit issuance] or, for facilities that begin to discharge storm water associated with industrial activity after [Insert date of permit issuance], 180 days after submitting an NOI to be covered by this permit. If the failure to certify is caused by the inability to perform adequate tests or evaluations, such notification shall describe: the procedure of any test conducted for the presence of non-storm water discharges; the results of such test or other relevant observations; potential sources of non-storm water discharges to the storm sewer; and why adequate tests for such storm sewers were not feasible. Non-storm water discharges to waters of the United States that are not authorized by an NPDES permit are unlawful, and must be terminated.

(h) Sediment and Erosion Control—The plan shall identify areas that, due to topography, activities, or other factors, have a high potential for significant soil erosion, and identify structural, vegetative, and/or stabilization measures to be used to limit erosion. When developing the plan, the following areas of the site should be considered: loading and unloading areas, access roads, material handling areas, storage areas, and any other areas where heavy equipment and vehicle use is prevalent. The following erosion and sediment controls shall be considered to minimize the discharge of sediments from the site: stabilization measures such as seeding, mulching, contouring, porous pavement, paving and sodding or its equivalent and structural measures such as sediment traps and silt fences or other equivalent measures.

(i) Management of Runoff—The plan shall contain a narrative consideration of the appropriateness of traditional storm water management practices (practices other than those that control the generation or source(s) of pollutants) used to divert, infiltrate, reuse, or otherwise manage storm water runoff in a manner that reduces pollutants in storm water discharges from the site. The plan shall provide that measures that the permittee determines to be reasonable and appropriate shall be implemented and maintained. The potential of various sources at the facility to contribute pollutants to storm water discharges associated with industrial activity [see paragraph XI.A.3.a.(2) of this section (Description of Potential Pollutant Sources)] shall be considered when determining reasonable and appropriate measures. Appropriate measures may include: vegetative swales and practices, reuse of collected storm water (such as for a process or as an irrigation source), inlet controls (such as oil/water separators), snow management activities, infiltration devices, and wet detention/retention devices or other equivalent measures.

(4) Comprehensive Site Compliance Evaluation. Personnel knowledgeable about storm water management as it relates to the facility shall conduct site compliance evaluations at appropriate intervals specified in the plan, but in no case less than once a year. Such evaluations shall include the following:

(a) Areas contributing to a storm water discharge associated with industrial activity such as loading/unloading areas, material handling areas, locations used for the treatment, storage or disposal of wastes, liquid storage tanks, processing areas, treatment chemical storage areas, treated wood and residue storage areas, wet decking areas, dry decking areas, untreated wood and residue storage areas, and treatment equipment storage areas shall be visually inspected for evidence of, or the potential for, pollutants entering the drainage system. Measures to reduce pollutant loadings shall be evaluated to determine whether they are adequate and properly implemented in accordance with the terms of the permit or whether additional control measures are needed. Structural storm water management measures, sediment and erosion control measures, and other structural pollution prevention measures identified in the plan shall be observed to ensure that they are operating correctly. A visual inspection of equipment needed to implement the plan, such as spill response equipment, shall be made.

(b) Based on the results of the evaluation, the description of potential pollutant sources identified in the plan in accordance with paragraph XI.A.3.a.(2) of this section (Description of Potential Pollutant Sources) and pollution prevention measures and controls identified in the plan in accordance with paragraph XI.A.3.a.(3) of this section (Measures and Controls) sball be revised as appropriate within 2 weeks of such evaluation and shall provide for implementation of any changes to the plan in a timely manner, but in no case more than 12 weeks after the evaluation.

(c) A report summarizing the scope of the evaluation, personnel making the evaluation, the date(s) of the evaluation, major observations relating to the implementation of the storm water pollution prevention plan, and actions taken in accordance with paragraph XI.A.3.a.(4)(b) (above) of the permit shall be made and retained as part of the

storm water pollution prevention plan for at least 3 years from the date of the evaluation. The report shall identify any incidents of noncompliance. Where a report does not identify any incidents of noncompliance, the report shall contain a certification that the facility is in compliance with the storm water pollution prevention plan and this permit. The report shall be signed in accordance with Part VII.G. (Signatory Requirements) of this permit.

(d) Where compliance evaluation schedules overlap with inspections required under 3.a.(3)(d), the compliance evaluation may be conducted in place of one such inspection.

4. *Numeric Effluent Limitations.* There are no additional numeric effluent limitations beyond those described in Part V.B. of this permit.

5. *Monitoring and Reporting Requirements.*

a. Analytical Monitoring Requirements. During the period beginning [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] and the period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance], permittees with timber product facilities must monitor their storm water discharges associated with industrial activity at least quarterly (4 times per year) during years 2 and 4 except as provided in paragraphs 5.a.(3) (Sampling Waiver), 5.a.(4) (Representative Discharge), and 5.a.(5) (Alternative Certification). Timber product facilities are required to monitor their storm water discharges for the pollutants of concern listed in the appropriate table (Tables A–1, A–2, A–3 or A–4). Facilities must report in accordance with 5.b. (Reporting). In addition to the parameters listed in Tables A–1, A–2, A–3 and A–4 below, the permittee shall provide the date and duration (in hours) of the storm event(s) sampled; rainfall measurements or estimates (in inches) of the storm event that generated the sampled runoff; the duration between the storm event sampled and the end of the previous measurable (greater than 0.1 inch rainfall) storm event; and an estimate of the total volume (in gallons) of the discharge sampled.

TABLE A–1.—MONITORING REQUIREMENTS FOR GENERAL SAWMILLS AND PLANNING MILLS FACILITIES

Pollutants of concern	Monitoring cut-off concentration
Chemical Oxygen Demand	120.0 mg/L
Total Suspended Solids	100 mg/L
Total Recoverable Zinc, ...	0.117 mg/L

TABLE A–2.—MONITORING REQUIREMENTS FOR WOOD PRESERVING FACILITIES

Pollutant of concern	Monitoring cut-off concentration
Total Recoverable Arsenic	0.16854 mg/L
Total Recoverable Copper	0.0636 mg/L

TABLE A–3.—MONITORING FOR LOG STORAGE AND HANDLING FACILITIES

Pollutant of concern	Monitoring cut-off concentration
Total Suspended Solids	100 mg/L

TABLE A–4.—MONITORING REQUIREMENTS FOR HARDWOOD DIMENSION AND FLOORING MILLS; SPECIAL PRODUCTS SAWMILLS, NOT ELSEWHERE CLASSIFIED; MILLWORK, VENEER, PLYWOOD AND STRUCTURAL WOOD; WOOD CONTAINERS; WOOD BUILDINGS AND MOBILE HOMES; RECONSTITUTED WOOD PRODUCTS; AND WOOD PRODUCTS FACILITIES NOT ELSEWHERE CLASSIFIED

Pollutants of concern	Monitoring cut-off concentration
Chemical Oxygen Demand	120 mg/L
Total Suspended Solids	100 mg/L

(1) Monitoring Periods. Facilities required to perform monitoring shall monitor samples collected during the sampling periods of: January through March, April through June, July through September, and October through December for the years specified in paragraph a. (above).

(2) Sample Type. A minimum of one grab sample shall be taken. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The required 72-hour storm event interval is waived where the preceding measurable storm event did not result in a measurable discharge from the facility. The required 72-hour storm event interval may also be waived where the permittee documents that less than a 72-hour interval is representative for local storm events during the season when sampling is being conducted. The grab sample shall be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable. If storm water discharges associated with industrial activity commingle with process or nonprocess water, then where practicable permittees must attempt to sample the storm water discharge before it mixes with the non-storm water discharge.

(3) Sampling Waiver.

(a) Adverse Conditions—When a discharger is unable to collect samples within a specified sampling period due to adverse climatic conditions, the discharger shall collect a substitute sample from a separate qualifying event in the next monitoring period and submit the data along with the data for the routine sample in that period. Adverse weather conditions that may prohibit the collection of samples include weather conditions that create dangerous or inaccessible conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(b) Low Concentration Waiver—When the average concentration for a pollutant calculated from all monitoring data collected from an outfall during the monitoring period [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] is less than the corresponding value for that pollutant listed in Table A–1 under the column Monitoring Cut-off Concentration, a facility may waive monitoring and reporting requirements in the monitoring period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance]. The facility must submit to the Director, in lieu of the monitoring data, a certification that there has not been a significant change in industrial activity or the pollution prevention measures in area of the facility that drains to the outfall for which sampling was waived.

(c) When a discharger is unable to conduct quarterly chemical storm water sampling at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirements as long as the facility remains inactive and unstaffed. The facility must submit to the Director, in lieu of monitoring data, a certification statement on the DMR stating that the site is inactive and unstaffed so that collecting a sample during a qualifying event is not possible.

(4) Representative Discharge. When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may test the effluent of one of such outfalls and report that the quantitative data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan. The permittee shall include the description of the location of the outfalls, explanation of why outfalls are expected to discharge substantially identical effluents, and estimate of the size of the drainage area and runoff coefficient with the Discharge Monitoring Report.

(5) Alternative Certification. A discharger is not subject to the monitoring requirements of this section provided the discharger makes a certification for a given outfall, or on a pollutant-by-pollutant basis in lieu of monitoring reports required under paragraph *(b)* below, under penalty of law, signed in accordance with Part VII.G. (Signatory Requirements), that material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, industrial machinery or operations, or significant materials from past industrial activity that are located in areas of the facility within the drainage area of the outfall are not presently exposed to storm water and are not expected to be exposed to storm water for the certification period. Such certification must be retained in the storm water pollution prevention plan, and submitted to EPA in accordance with Part VI.C. of this permit. In the case of certifying that a pollutant is not present, the permittee must submit the certification along with the monitoring reports required under paragraph *(b)* below. If the permittee cannot certify for an entire period, they must submit the date exposure was eliminated and any monitoring required up until that date. This certification option is not applicable to compliance monitoring requirements associated with effluent limitations.

(b). Reporting. Permittees shall submit monitoring results for each outfall associated with industrial activity [or a certification in accordance with Sections (3), (4), or (5) above] obtained during the reporting period beginning [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] on Discharge Monitoring Report Form(s) postmarked no later than the 31st day of the following March [insert the date 2 years after permit issuance]. Monitoring results [or a certification in accordance with Sections (3), (4), or (5) above] obtained during the period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance] shall be submitted on Discharge Monitoring Report Form(s) postmarked no later than the 31st day of the following March. For each outfall, one signed Discharge Monitoring Report form must be submitted to the Director per storm event sampled. Signed copies of Discharge Monitoring Reports, or said certifications, shall be submitted to the Director of the NPDES program at the address of the appropriate Regional Office listed in Part VI.G. of the fact sheet to this permit.

(1) Additional Notification. In addition to filing copies of discharge monitoring reports in accordance with paragraph b (above), facilities engaged in wood preservation and/or surface protection with at least one storm water discharge associated with industrial activity through a large or medium municipal separate storm sewer system (systems serving a population of 100,000 or more) must submit signed copies of discharge monitoring reports to the operator of the municipal separate storm sewer system in accordance with the dates provided in paragraph b (above).

c. Quarterly Visual Examination of Storm Water Quality. All timber products facilities shall perform and document a visual examination of a storm water discharge associated with industrial activity from each outfall, except discharges exempted below. The examination(s) must be made at least once in each of the following three-month periods: January through March, April through June, July through September, and October through December. The examination shall be made during daylight hours unless there is insufficient rainfall or snow melt to produce a runoff event.

(1) Examinations shall be made of samples collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 1 hour) of when the runoff or snowmelt begins discharging. The examination shall document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on the samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. Where practicable, the same individual should carry out the collection and examination of discharges for the entire permit term.

(2) Visual examination reports must be maintained onsite in the pollution prevention plan. The report shall include the examination date and time, examination personnel, the nature of the discharge (i.e., runoff or snow melt), visual quality of the storm water discharge (including observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution), and probable sources of any observed storm water contamination.

(3) When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may collect a sample of effluent of one of such outfalls and report that the examination data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an

estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

(4) When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the records of the visual examinations. Adverse weather conditions that may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(5) When a discharger is unable to conduct visual storm water examinations at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirement as long as the facility remains inactive and unstaffed. The facility must maintain a certification with the pollution prevention plan stating that the site is inactive and unstaffed so that performing visual examinations during a qualifying event is not feasible.

B. Storm Water Discharges Associated With Industrial Activity From Paper And Allied Products Manufacturing Facilities

1. Discharges Covered Under This Section. The requirements listed under this section shall apply to storm water discharges from the following activities: facilities engaged in the manufacture of pulps from wood and other cellulose fibers and from rags; the manufacture of paper and paperboard into converted products, such as paper coated off the paper machine, paper bags, paper boxes and envelopes; and establishments primarily engaged in manufacturing bags of plastic film and sheet. These facilities are commonly identified by Standard Industrial Classification (SIC) Major Group 26.

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

2. Special Conditions.

a. Prohibition of Non-storm Water Discharges. There are no additional requirements beyond those in Part III.A. of this permit.

3. Storm Water Pollution Prevention Plan Requirements.

a. Contents of Plan. The plan shall include, at a minimum, the following items:

(1) Pollution Prevention Team. Each plan shall identify a specific individual or individuals within the facility organization as members of a storm water Pollution Prevention Team that are responsible for developing the storm water pollution prevention plan and assisting the facility or plant manager in its implementation, maintenance, and revision. The plan shall clearly identify the responsibilities of each team member. The activities and responsibilities of the team shall address all aspects of the facility's storm water pollution prevention plan.

(2) Description of Potential Pollutant Sources. Each plan shall provide a description of potential sources that may reasonably be expected to add significant amounts of pollutants to storm water discharges or that may result in the discharge of pollutants during dry weather from separate storm sewers draining the facility. Each plan shall identify all activities and significant materials that may potentially be significant pollutant sources. Each plan shall include, at a minimum:

(a) Drainage.

(i) A site map indicating an outline of the portions of the drainage area of each storm water outfall that are within the facility boundaries, each existing structural control measure to reduce pollutants in storm water runoff, surface water bodies, locations where significant materials are exposed to precipitation, locations where major spills or leaks identified under Part XI.B.3.a.(2)(c) (Spills and Leaks) of this permit have occurred, and the locations of the following activities where such activities are exposed to precipitation: fueling stations, vehicle and equipment maintenance and/or cleaning areas, loading/unloading areas, locations used for the treatment, storage or disposal of wastes and wastewaters, locations used for the treatment, filtration, or storage of water supplies, liquid storage tanks, processing areas, and storage areas. The map must indicate the outfall locations and the types of discharges contained in the drainage areas of the outfalls.

(ii) For each area of the facility that generates storm water discharges associated with industrial activity with a reasonable potential for containing significant amounts of pollutants, a prediction of the direction of flow, and an identification of the types of pollutants that are likely to be present in storm water discharges associated with industrial activity. Factors to consider include the toxicity of chemical; quantity of chemicals used, produced or discharged; the likelihood of contact with storm water; and history of significant leaks or spills of toxic or hazardous pollutants. Flows with a significant potential for causing erosion shall be identified.

(b) Inventory of Exposed Materials—An inventory of the types of materials handled at the site that potentially may be exposed to precipitation. Such inventory shall include a narrative description of significant materials that have been handled, treated, stored or disposed in a manner to allow exposure to storm water between the time of 3 years prior to the date of submission of a Notice of Intent (NOI) to be covered under this permit and the present; method and location of onsite storage or disposal; materials management practices employed to minimize contact of materials with storm water runoff between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; the location and a description of existing structural and nonstructural control measures to reduce pollutants in storm water runoff; and a description of any treatment the storm water receives. The inventory of exposed materials shall include, but shall not be limited to the significant materials stored exposed to storm water and material management practices employed that were listed for the facility in the approved group application.

(c) Spills and Leaks—A list of significant spills and significant leaks of toxic or hazardous pollutants that occurred at areas that are exposed to precipitation or that otherwise drain to a storm water conveyance at the facility after the date of 3 years prior to the date of submission of a Notice of Intent (NOI) to be covered under this permit. Such list shall be updated as appropriate during the term of the permit.

(d) Sampling Data—A summary of existing discharge sampling data describing pollutants in storm water

discharges from the facility, including a summary of sampling data collected during the term of this permit.

(e) Risk Identification and Summary of Potential Pollutant Sources—A narrative description of the potential pollutant sources from the following activities: loading and unloading operations; outdoor storage activities; outdoor manufacturing or processing activities; significant dust or particulate generating processes; and onsite waste disposal practices, and wastewater treatment activities to include sludge drying, storage, application or disposal activities. The description shall specifically list any significant potential source of pollutants at the site and for each potential source, any pollutant or pollutant parameter (e.g., biochemical oxygen demand, etc.) of concern shall be identified.

(3) Measures and Controls. Each facility covered by this permit shall develop a description of storm water management controls appropriate for the facility, and implement such controls. The appropriateness and priorities of controls in a plan shall reflect identified potential sources of pollutants at the facility. The description of storm water management controls shall address the following minimum components, including a schedule for implementing such controls:

(a) Good Housekeeping—Good housekeeping requires the maintenance of areas that may contribute pollutants to storm water discharges in a clean, orderly manner. The plan shall describe procedures performed to minimize contact of materials with storm water runoff. Examples include cleaning of lots and roofs that collect debris; routine cleaning of wastewater treatment, and other waste disposal (such as sludge handling) locations.

(b) Preventive Maintenance—A preventive maintenance program shall involve timely inspection and maintenance of storm water management devices (e.g., cleaning oil/water separators, catch basins) as well as inspecting and testing facility equipment and systems to uncover conditions that could cause breakdowns or failures resulting in discharges of pollutants to surface waters, and ensuring appropriate maintenance of such equipment and systems.

(c) *Spill Prevention and Response Procedures*—Areas where potential spills that can contribute pollutants to storm water discharges can occur, and their accompanying drainage points shall be identified clearly in the storm water pollution prevention plan. Where appropriate, specifying material handling procedures, storage requirements, and use of equipment such as diversion valves in the plan should be considered. Procedures for cleaning up spills shall be identified in the plan and made available to the appropriate personnel. The necessary equipment to implement a clean up should be available to personnel.

(d) Inspections—Qualified facility personnel shall be identified to inspect designated equipment and areas of the facility at appropriate intervals specified in the plan. A set of tracking or follow-up procedures shall be used to ensure that appropriate actions are taken in response to the inspections. Records of inspections shall be maintained.

(e) Employee Training—Employee training programs shall inform personnel responsible for implementing activities identified in the storm water pollution prevention plan or otherwise responsible for storm water management at all levels of responsibility of the components and goals of the storm water pollution prevention plan. Training should address topics such as spill response, good housekeeping and material management practices. The pollution prevention plan shall identify periodic dates for such training.

(f) Recordkeeping and Internal Reporting Procedures—A description of incidents (such as spills, or other discharges), along with other information describing the quality and quantity of storm water discharges shall be included in the plan required under this part. Inspections and maintenance activities shall be documented and records of such activities shall be incorporated into the plan.

(g) Non-storm Water Discharges.

(i) The plan shall include a certification that the discharge has been tested or evaluated for the presence of non-storm water discharges. The certification shall include the identification of potential significant sources of non-storm water at the site, a description of the results of any test and/or evaluation for the presence of non-storm water discharges, the evaluation criteria or testing method used, the date of any testing and/or evaluation, and the onsite drainage points that were directly observed during the test. Certifications shall be signed in accordance with Part VII.G. of this permit. Such certification may not be feasible if the facility operating the storm water discharge associated with industrial activity does not have access to an outfall, manhole, or other point of access to the ultimate conduit that receives the discharge. In such cases, the source identification section of the storm water pollution prevention plan shall indicate why the certification required by this part was not feasible, along with the identification of potential significant sources of non-storm water at the site. A discharger that is unable to provide the certification required by this paragraph must notify the Director in accordance with paragraph (iii) (below).

(ii) Except for flows from fire fighting activities, sources of non-storm water listed in Part III.A.2. of this permit that are combined with storm water discharges associated with industrial activity must be identified in the plan. The plan shall identify and ensure the implementation of appropriate pollution prevention measures for the non-storm water component(s) of the discharge.

(iii) Failure to Certify—Any facility that is unable to provide the certification required (testing for non-storm water discharges), must notify the Director by [Insert date 270 days after permit issuance] or, for facilities that begin to discharge storm water associated with industrial activity after [Insert date of permit issuance], 270 days after submitting an NOI to be covered by this permit. If the failure to certify is caused by the inability to perform adequate tests or evaluations, such notification shall describe: the procedure of any test conducted for the presence of non-storm water discharges; the results of such test or other relevant observations; potential sources of non-storm water discharges to the storm sewer; and why adequate tests for such storm sewers were not feasible. Non-storm water discharges to waters of the United States that are not authorized by an NPDES permit are unlawful, and must be terminated.

(h) Sediment and Erosion Control—The plan shall identify areas that, due to topography, activities, or other factors, have a high potential for significant soil erosion, and identify structural, vegetative, and/or stabilization measures to be used to limit erosion.

(i) Management of Runoff—The plan shall contain a narrative consideration of the appropriateness of traditional storm water management practices (practices other than those that control the generation or source(s) of pollutants) used to divert, infiltrate, reuse, or otherwise manage storm water runoff in a manner that reduces pollutants in storm water discharges from the site. The plan shall provide that measures that the permittee determines to be reasonable and appropriate shall be implemented and maintained. The potential of various sources at the facility to contribute pollutants to storm water discharges associated with industrial activity (see Part XI.B.3.a.(2)

of this permit (Description of Potential Pollutant Sources)] shall be considered when determining reasonable and appropriate measures. Appropriate measures may include: vegetative swales and practices; reuse of collected storm water (such as for a process or as an irrigation source); inlet controls (such as oil/water separators); snow management activities; infiltration devices, and wet detention/retention devices; screens or fences used to protect dust and particulate collection activities from wind or to minimize the effects of wind on material loading and storage, and processing activities to eliminate or reduce windblown or airborne pollutants; secondary containment of storage areas such as berms and dikes; diversionary structures to direct storm water away from areas of potential contamination; and tarpaulins, roofs, or other coverings of outdoor storage or industrial activities or other equivalent measures.

(4) Comprehensive Site Compliance Evaluation. Qualified personnel shall conduct site compliance evaluations at appropriate intervals specified in the plan, but in no case less than once a year. Such evaluations shall provide:

(a) Areas contributing to a storm water discharge associated with industrial activity such as material storage, handling, and disposal activities shall be visually inspected for evidence of, or the potential for, pollutants entering the drainage system. Measures to reduce pollutant loadings shall be evaluated to determine whether they are adequate and properly implemented in accordance with the terms of the permit or whether additional control measures are needed. Structural storm water management measures sediment and erosion control measures, and other structural pollution prevention measures identified in the plan shall be observed to ensure that they are operating correctly. A visual inspection of equipment needed to implement the plan, such as spill response equipment, shall be made.

(b) Based on the results of the evaluation, the description of potential pollutant sources identified in the plan in accordance with Part XI.B.3.a.(2) of this permit (Description of Potential Pollutant Sources) and pollution prevention measures and controls identified in the plan in accordance with Part XI.B.3.a.(3) of this permit (Measures and Controls) shall be revised as appropriate within 2 weeks of such evaluation and shall provide for implementation of any changes to the plan in a timely manner, but in no case more than 12 weeks after the evaluation.

(c) A report summarizing the scope of the evaluation, personnel making the evaluation, the date(s) of the evaluation, major observations relating to the implementation of the storm water pollution prevention plan, and actions taken in accordance with paragraph (4)(b) (above) of the permit shall be made and retained as part of the storm water pollution prevention plan for at least 3 years from the date of the evaluation. The report shall identify any incidents of noncompliance. Where a report does not identify any incidents of noncompliance, the report shall contain a certification that the facility is in compliance with the storm water pollution prevention plan and this permit. The report shall be signed in accordance with Part VII.G. (Signatory Requirements) of this permit.

(d) Where compliance evaluation schedules overlap with inspections required under 3.a.(3)(d), the compliance evaluation may be conducted in place of one such inspection.

4. Numeric Effluent Limitations

There are no additional numeric effluent limitations beyond those described in Part V.B. of this permit.

5. Monitoring and Reporting Requirements

a. Analytical Monitoring Requirements.

During the period beginning [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] and the period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance], permittees with paperboard mills must monitor their storm water discharges associated with industrial activity at least quarterly (4 times per year) during years 2 and 4 except as provided in paragraphs 5.a.(3) (Sampling Waiver), 5.a.(4) (Representative Discharge), and 5.a.(5) (Alternative Certification). Paperboard mills are required to monitor their storm water discharges for the pollutant of concern listed in Table B–1 below. Facilities must report in accordance with 5.b. (Reporting). In addition to the parameters listed in Table B–1 below, the permittee shall provide the date and duration (in hours) of the storm event(s) sampled; rainfall measurements or estimates (in inches) of the storm event that generated the sampled runoff; the duration between the storm event sampled and the end of the previous measurable (greater than 0.1 inch rainfall) storm event; and an estimate of the total volume (in gallons) of the discharge sampled.

TABLE B–1.—MONITORING REQUIREMENTS

Pollutants of concern	Cut-off concentration
Chemical Oxygen Demand	120 mg/L

(1) Monitoring Periods. Paperboard mills shall monitor samples collected during the sampling periods of: January through March, April through June, July through September, and October through December for the years specified in paragraph a. (above).

(2) Sample Type. A minimum of one grab sample shall be taken. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The required 72-hour storm event interval is waived where the preceding measurable storm event did not result in a measurable discharge from the facility. The required 72-hour storm event interval may also be waived where the permittee documents that less than a 72-hour interval is representative for local storm events during the season when sampling is being conducted. The grab sample shall be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable. If storm water discharges associated with industrial activity commingle with process or nonprocess water, then where practicable permittees must attempt to sample the storm water discharge before it mixes with the non-storm water discharge.

(3) Sampling Waiver.

(a) Adverse Conditions—When a discharger is unable to collect samples within a specified sampling period due to adverse climatic conditions, the discharger shall collect a substitute sample from a separate qualifying event in the next period and submit the data along with data for the routine sample in that period. Adverse weather conditions that may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricanes, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(b) Low Concentration Waiver—When the average concentration for a pollutant calculated from all monitoring data collected from an outfall during the monitoring period [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] is less than the corresponding value for that pollutant listed in Table B–1 under the column Monitoring Cut-off Concentration, a facility may waive monitoring and reporting requirements in the monitoring period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance]. The facility must submit to the Director, in lieu of the monitoring data, a certification that there has not been a significant change in industrial activity or the pollution prevention measures in area of the facility that drains to the outfall for which sampling was waived.

(c) When a discharger is unable to conduct quarterly chemical storm water sampling at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirements as long as the facility remains inactive and unstaffed. The facility must submit to the Director, in lieu of monitoring data, a certification statement on the DMR stating that the site is inactive and unstaffed so that collecting a sample during a qualifying event is not possible.

(4) Representative Discharge. When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may test the effluent of one of such outfalls and report that the quantitative data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan. The permittee shall include the description of the location of the outfalls, explanation of why outfalls are expected to discharge substantially identical effluents, and estimate of the size of the drainage area and runoff coefficient with the Discharge Monitoring Report.

(5) Alternative Certification. A discharger is not subject to the monitoring requirements of this section provided the discharger makes a certification for a given outfall or on a pollutant-by-pollutant basis in lieu of monitoring reports required under paragraph *(b)* below, under penalty of law, signed in accordance with Part VII.G. (Signatory Requirements), that material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, industrial machinery or operations, or significant materials from past industrial activity that are located in areas of the facility within the drainage area of the outfall are not presently exposed to storm water and are not expected to be exposed to storm water for the certification period. Such certification must be retained in the storm water pollution prevention plan, and submitted to EPA in accordance with Part VI.C. of this permit. In the case of certifying that a pollutant is not present, the permittee must submit the certification along with the monitoring reports required under paragraph (b) below. If the permittee cannot certify for an entire period, they must submit the date exposure was eliminated and any monitoring required up until that date. This certification option is not applicable to compliance monitoring requirements associated with effluent limitations.

b. Reporting. Permittees with paperboard mills shall submit monitoring results for each outfall associated with industrial activity [or a certification in accordance with Sections (3), (4), or (5) above] obtained during the reporting period beginning [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] on Discharge Monitoring Report Form(s) postmarked no later than the 31st day of the following March [insert the date 2 years after permit issuance]. Monitoring results [or a certification in accordance with Sections (3), (4), or (5) above] obtained during the period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance] shall be submitted on Discharge Monitoring Report Form(s) postmarked no later than the 31st day of the following March. For each outfall, one signed Discharge Monitoring Report Form must be submitted per storm event completed. Signed copies of Discharge Monitoring Reports, or said certifications, shall be submitted to the Director of the NPDES program at the address of the appropriate Regional Office listed in Part VI.G. of the fact sheet.

(1) Additional Notification. In addition to filing copies of discharge monitoring reports in accordance with paragraph b (above), paperboard mills with at least one storm water discharge associated with industrial activity through a large or medium municipal separate storm sewer system (systems serving a population of 100,000 or more) must submit signed copies of discharge monitoring reports to the operator of the municipal separate storm sewer system in accordance with the dates provided in paragraph b (above).

c. Quarterly Visual Examination of Storm Water Quality. Facilities shall perform and document a visual examination of a storm water discharge associated with industrial activity from each outfall, except discharges exempted below. The examination must be made at least once in each designated period (described in (1), below) during daylight hours unless there is insufficient rainfall or snow melt to produce a runoff event.

(1) Examinations shall be conducted in each of the following periods for the purposes of visually inspecting storm water quality associated with storm water runoff or snow melt: January through March; April through June; July through September; and October through December.

(2) Examinations shall be made of samples collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed one hour) of when the runoff or snowmelt begins discharging. The examinations shall document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on the samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. Where practicable, the same individual will carry out the collection and examination of discharges for the life of the permit.

(3) When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the records of the visual examination. Adverse

weather conditions that may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricanes, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(4) When a discharger is unable to conduct visual storm water examinations at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirement as long as the facility remains inactive and unstaffed. The facility must maintain a certification with the pollution prevention plan stating that the site is inactive and unstaffed so that performing visual examinations during a qualifying event is not feasible.

(5) Visual examination reports must be maintained onsite in the pollution prevention plan. The report shall include the examination date and time, examination personnel, the nature of the discharge (i.e., runoff or snow melt), visual quality of the storm water discharge (including observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution), and probable sources of any observed storm water contamination.

(6) When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may collect a sample of effluent of one of such outfalls and report that the examination data also applies to the substantially identical outfalls provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explaining in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

C. Storm Water Discharges Associated With Industrial Activity From Chemical and Allied Products Manufacturing Facilities

1. Discharges Covered Under This Section

The requirements listed under this section shall apply to storm water discharges associated with industrial activity from a facility engaged in manufacturing the following products and generally described by the SIC code shown:

a. Basic industrial inorganic chemicals (including SIC 281).

b. Plastic materials and synthetic resins, synthetic rubbers, and cellulosic and other humanmade fibers, except glass (including SIC 282).

c. Soap and other detergents and in producing glycerin from vegetable and animal fats and oils; specialty cleaning, polishing, and sanitation preparations; surface active preparations used as emulsifiers, wetting agents, and finishing agents, including sulfonated oils; and perfumes, cosmetics, and other toilet preparations (including SIC 284).

d. Paints (in paste and ready-mixed form); varnishes; lacquers; enamels and shellac; putties, wood fillers, and sealers; paint and varnish removers; paint brush cleaners; and allied paint products (including SIC 285).

e. Industrial organic chemicals (including SIC 286).

f. Nitrogenous and phosphatic basic fertilizers, mixed fertilizer, pesticides, and other agricultural chemicals (including SIC 287).

g. Industrial and household adhesives, glues, caulking compounds, sealants, and linoleum, tile, and rubber cements from vegetable, animal, or synthetic plastics materials; explosives; printing ink, including gravure ink, screen process ink, and lithographic; miscellaneous chemical preparations, such as fatty acids, essential oils, gelatin (except vegetable), sizes, bluing, laundry sours, writing and stamp pad ink, industrial compounds, such as boiler and heat insulating compounds, metal, oil, and water treatment compounds, waterproofing compounds, and chemical supplies for foundries (including facilities with SIC 289).

h. Ink and paints, including china painting enamels, india ink, drawing ink, platinum paints for burnt wood or leather work, paints for china painting, artists' paints and artists' water colors (SIC 3952, limited to those listed).

i. Co-located Industrial Activities. When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

2. Discharges Not Covered By This Section

a. Storm water discharges from drug manufacturing facilities and other establishments classified as SIC Code 283.

3. Special Conditions

a. Prohibition of Non-storm Water Discharges. In addition to those non-storm water discharges prohibited under section III.A.2, this section does not authorize the discharge of:

(1) Inks, paints, or substances (hazardous, nonhazardous, etc.) resulting from an onsite spill, including materials collected in drip pans.

(2) Washwaters from material handling and processing areas. This includes areas where containers, equipment, industrial machinery, and any significant materials are exposed to storm water.

(3) Washwaters from drum, tank, or container rinsing and cleaning.

4. Storm Water Pollution Prevention Plan Requirements

a. Contents of Plan. The plan shall include, at a minimum, the following items:

(1) Pollution Prevention Team. Each plan shall identify a specific individual or individuals within the facility organization as members of a storm water Pollution Prevention Team. The team will be responsible for developing the storm water pollution prevention plan and assisting the facility or plant manager in its implementation, maintenance, and revision. The plan shall clearly identify the responsibilities of each team member. The activities and responsibilities of the team shall address all aspects of the facility's plan.

(2) Description of Potential Pollutant Sources. Each plan shall provide a description of potential sources of pollutants to storm water discharges and sources of discharges of pollutants during dry weather. Each plan shall

identify all activities and materials that may be pollutant sources. Each plan shall include, at a minimum:

(a) Drainage and Site Plan—A site map shall be developed for the facility. This map shall include, at a minimum: the location of all structures (manufacturing buildings, garages, etc.), impervious areas, the location of each storm water outfall and/or connection to municipal storm sewer; types of discharges included in each discharge; an outline of the portions of the drainage area of each outfall within the facility boundaries and a prediction of the direction of flow in each area; each existing structural control measure to reduce pollutants in storm water runoff; surface water bodies; locations where materials are exposed to precipitation; and locations where major spills or leaks identified under Part XI.C.4.a.(2)(c) (below) of this permit have occurred. The map shall also indicate the locations of the following outdoor activities: fueling stations; vehicle and equipment maintenance and/or cleaning areas; loading/unloading areas; locations used for the treatment, storage or disposal of wastes; storage tanks and other containers; processing and storage areas; access roads, rail cars and tracks; the location of transfer of substances in bulk; and machinery.

(b) Inventory of Exposed Materials and Management Practices—An inventory of the types of materials handled at the site that may be exposed to precipitation shall be collected. Such inventory shall include: a narrative description of materials that have been handled, treated, stored or disposed in a manner to allow exposure to storm water between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; method and location of onsite storage or disposal; materials management practices employed to minimize contact of materials with storm water runoff between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; the location and a description of existing structural and nonstructural control measures to reduce pollutants in storm water runoff; and a description of any treatment the storm water receives.

(c) Spills and Leaks—A list of significant spills and leaks of material that occurred at areas that are exposed to precipitation or that otherwise drain to a storm water conveyance after the date of 3 years prior to the date of submission of a Notice of Intent (NOI) to be covered under this permit. The list shall be updated as appropriate to include any significant spills and leaks during the term of the permit.

(d) Sampling Data—A summary of existing storm water sampling data describing pollutants discharged from the facility, including a summary of sampling data collected during the term of this permit. In addition, the report of monitoring data that is submitted to EPA pursuant to Part VI. of this permit shall be maintained with the pollution prevention plan.

(e) Risk Identification and Summary of Potential Pollutant Sources.

(i) A narrative description of the potential pollutant sources from the following: loading, unloading, and transfer of chemicals; outdoor storage of salt, pallets, coal, drums, containers, fuels, or other materials; outdoor manufacturing or processing activities; significant dust or particulate generating processes; fueling stations; vehicle and equipment maintenance and/or cleaning areas; locations used for the treatment, storage or disposal (on or off site) of wastes and wastewaters; storage tanks and other containers; processing and storage areas; access roads, rail cars and tracks; the location of transfer of substances in bulk; and machinery.

(ii) The description shall specifically list any significant potential source of pollutants at the site and for each potential source, any pollutant or pollutant parameter (e.g., chemical oxygen demand, etc.) of concern shall be identified.

(iii) Factors to consider include: quantity of chemicals used, produced or discharged; the likelihood of contact with storm water; and history of significant leaks or spills. In addition, flows with a significant potential for causing erosion shall be identified.

(3) Measures and Controls. Each facility covered by this permit shall develop a description of storm water management controls appropriate for the facility, and implement such controls. The appropriateness and priorities of controls in a plan shall reflect identified potential sources of pollutants at the facility. The description of storm water management controls shall address the following minimum components, including a reasonable schedule for implementing such controls:

(a) Nonstructural Controls.

(i) Good Housekeeping—Good housekeeping requires that areas that may contribute pollutants to storm water discharges are maintained in a clean, orderly manner. At a minimum, the permittee shall:

(a) Schedule regular pickup and disposal of garbage and waste materials, or use other appropriate measures to reduce the potential for the discharge of storm water that has come into contact with garbage or waste materials. This schedule shall be included in the plan. Individuals responsible for waste management and disposal shall be informed of the procedures established under the plan.

(b) Routinely inspect for leaks and the condition of drums, tanks and containers. Ensure that spill cleanup procedures are understood by employees.

(c) Keep an up-to-date inventory of all materials present at the facility. While preparing the inventory, all containers should be clearly labeled. Hazardous containers that requires special handling, storage, use and disposal shall be clearly marked.

(d) Maintain clean ground surfaces.

(ii) Preventive Maintenance—A preventive maintenance program shall be developed and shall involve timely inspection and maintenance of storm water management devices (e.g., oil/water separators, catch basins, dikes, storm sewer, basins, pipes). Also, preventive maintenance includes inspecting and testing facility equipment and systems to uncover conditions that could cause breakdowns or failures, and ensuring appropriate maintenance of such equipment and systems.

(iii) Spill Prevention and Response Procedures—Spill prevention and response procedures shall be developed. Areas where potential spills (that can contribute pollutants to storm water discharges) can occur and their accompanying drainage points shall be identified clearly in the storm water pollution prevention plan. Where appropriate, specifying material handling procedures, storage requirements, and use of equipment such as diversion valves in the plan should be considered. Procedures for cleaning up spills shall be identified in the plan and made available to the appropriate personnel. The necessary equipment to implement a clean up (e.g., absorbent materials) should be available to personnel.

(iv) Inspections—Qualified personnel shall conduct quarterly inspections. A wet weather inspection (during a rainfall event) shall be conducted in the second (April to June) and third quarters (July to September) of each year. A dry weather inspection (no precipitation) shall be conducted in the first (January to March) and fourth quarters (October to December). Such inspections shall be documented and this documentation shall be retained as part of the pollution prevention plan. Changes based on the

results of the quarterly inspections shall be made in a timely manner.

(a) When a seasonal dry period is sustained for more than 3 months, a dry weather inspection will satisfy the wet weather inspection requirement.

(b) All areas exposed to precipitation at the facilities shall be visually inspected for evidence of, or the potential for, pollutants entering the drainage system. Measures to reduce pollutant loadings shall be evaluated to determine whether they are adequate and properly implemented or whether additional control measures are needed. Structural storm water management measures (diking, berming, curbing, sediment and erosion control measures, stabilization controls, etc.) required under this section shall be observed to ensure that they are operating correctly. A visual inspection of equipment needed to implement the plan, such as spill response equipment, shall be made.

(v) Employee Training—Employee training programs shall inform personnel responsible for implementing activities identified in the storm water pollution prevention plan or otherwise responsible for storm water management at all levels of responsibility of the components and goals of the storm water pollution prevention plan. Training should address topics such as spill response, good housekeeping, material management practices and procedures for equipment and container cleaning and washing. The pollution prevention plan shall identify periodic dates for such training of at least once per year.

(vi) Recordkeeping and Internal Reporting Procedures—A description of incidents (such as spills, or other discharges), along with other information describing the quality and quantity of storm water discharges shall be included in the plan required under this part. Inspections and maintenance activities shall be documented and records of such activities shall be incorporated into the plan.

(vii) Facility Security—Facilities shall have the necessary security systems to prevent accidental or intentional entry that could cause a discharge. Security systems described in the plan shall address fencing, lighting, vehicular traffic control, and securing of equipment and buildings.

(b) Structural Practices—The potential of various sources at the facility to contribute pollutants to storm water discharges associated with industrial activity [see Part XI.C.4.a.(2) (Description of Potential Pollutant Sources) of this permit] shall be considered when determining reasonable and appropriate structural measures. The plan shall provide that measures that the permittee determines to be reasonable and appropriate shall be implemented and maintained.

(i) Practices for Material Handling and Storage Areas—Permittees shall ensure the implementation of practices that conform with the following:

(a) In areas where liquid or powdered materials are stored, facilities shall provide either diking, curbing, berms, or other appropriate measures to reduce the potential of discharge of liquid or powdered materials in storm water.

(b) In all other outside storage areas including storage of used containers, machinery, scrap and construction materials, and pallets, facilities shall prevent or minimize storm water runon to the storage area by using curbing, culverting, gutters, sewers or other forms of drainage control.

(c) In all storage areas, roofs, covers or other forms of appropriate protection shall be used to prevent storage areas from exposure to storm water and wind. For the purpose of this paragraph, tanks would be considered to be appropriate protection.

(d) In areas where liquid or powdered materials are transferred in bulk from truck or rail cars, permittees shall provide appropriate measures to minimize contact of material with precipitation. Permittees shall consider providing for hose connection points at storage containers to be inside containment areas, and drip pans to be used in areas that are not in a containment area, where spillage may occur (e.g., hose reels, connection points with rail cars or trucks) or equivalent measures.

(e) In areas of transfer of contained or packaged materials and loading/unloading areas, permittee shall consider providing appropriate protection such as overhangs or door skirts to enclose trailer ends at truck loading/unloading docks or an equivalent.

(f) Drainage from areas covered by paragraph XI.C.4.a.(3)(b)(i) of this section should be restrained by valves or other positive means to prevent the discharge of a spill or leak. Containment units may be emptied by pumps or ejectors; however, these shall be manually activated.

(g) Flapper-type drain valves shall not be used to drain containment areas. Valves used for the drainage of containment areas should, as far as is practical, be of manual, open-or-closed design.

(h) If facility drainage is not engineered as above, the final discharge point of all in-facility sewers should be equipped to prevent or divert the discharge, in the event of an uncontrolled spill of materials, return the spilled material to the facility.

(c) Management of Runoff—The plan shall contain a description of storm water management practices used and/or to be used to divert, infiltrate, reuse, or otherwise manage storm water runoff in a manner that reduces pollutants in storm water discharges from the site. Appropriate measures may include: vegetative swales, ripraps, reuse of collected storm water (such as for a process or as an irrigation source), inlet controls (such as oil/water separators), snow management activities, infiltration devices, use of porous pavements, and wet detention/retention devices.

(d) Sediment and Erosion Control—The plan shall identify areas that, due to topography, activities, or other factors, have a potential for significant soil erosion. Plans shall describe permanent stabilization practices and shall ensure that disturbed portions of the site are stabilized. Stabilization practices may include: permanent seeding, mulching, geotextiles, sod stabilization, vegetative buffer strips, protection of trees, preservation of mature vegetation, and other appropriate measures.

(e) Non-storm Water Discharges.

(i) The plan shall include a certification that the discharge has been tested or evaluated for the presence of non-storm water discharges. The certification shall include the identification of potential significant sources of non-storm water at the site, a description of the results of any test and/or evaluation for the presence of non-storm water discharges, the evaluation criteria or testing method used, the date of any testing and/or evaluation, and the onsite drainage points that were directly observed during the test. Certifications shall be signed in accordance with Part VII.G. of this permit. Such certification may not be feasible if the facility operating the storm water discharge associated with industrial activity does not have access to an outfall, manhole, or other point of access to the ultimate conduit that receives the discharge. In such cases, the source identification section of the storm water pollution prevention plan shall indicate why the certification required by this part was not feasible, along with the identification of potential significant sources of non-storm water at the site. A discharger that is unable to provide the certification required by this paragraph must notify the Director in accordance with paragraph (iii) (below).

(ii) Except for flows from fire fighting activities, sources of non-storm water

listed in Part III.A.2. (Prohibition of Non-storm Water Discharges) of this permit that are combined with storm water discharges associated with industrial activity must be identified in the plan. The plan shall identify and ensure the implementation of appropriate pollution prevention measures for the non-storm water component(s) of the discharge.

(iii) Failure to Certify—Any facility that is unable to provide the certification required (testing for non-storm water discharges), must notify the Director by [insert date 270 days after permit issuance] or, for facilities that begin to discharge storm water associated with industrial activity after [insert date 270 days after permit issuance] 180 days after submitting an NOI to be covered by this permit. If the failure to certify is caused by the inability to perform adequate tests or evaluations, such notification shall describe: the procedure of any test conducted for the presence of non-storm water discharges; the results of such test or other relevant observations; potential sources of non-storm water discharges to the storm sewer; and why adequate tests for such storm sewers were not feasible. Non-storm water discharges to waters of the United States that are not authorized by an NPDES permit are unlawful, and must be terminated.

(4) Comprehensive Site Compliance Evaluation. A member(s) of the pollution prevention team or a qualified professional designated by the team shall conduct, at a minimum, annual site compliance evaluations.

(a) Areas contributing to a storm water discharge associated with industrial activity such as material storage and handling, loading and unloading, process activities, and plant yards shall be visually inspected for evidence of, or the potential for, pollutants entering the drainage system. Measures to reduce pollutant loadings shall be evaluated to determine whether they are adequate and properly implemented in accordance with the terms of the permit or whether additional control measures are needed. Structural storm water management measures, sediment and erosion control measures, other structural pollution prevention measures identified in the plan, as well as process related pollution control equipment shall be observed or tested to ensure that they are operating correctly. A visual inspection of equipment needed to implement the plan, such as spill response equipment, shall be made.

(b) Based on the results of the evaluation, the description of potential pollutant sources (see Part XI.C.4.a.(2)) and pollution prevention measures and controls (see Part XI.C.4.a.(3)) identified in the plan shall be revised as appropriate within 2 weeks of such evaluation. In addition, it shall provide for implementation of any changes to the plan in a timely manner, but in no case more than 12 weeks after the evaluation.

(c) A report summarizing the scope of the evaluation, personnel making the evaluation, the date(s) of the evaluation, observations relating to the implementation of the plan, and actions taken in accordance with paragraph XI.C.4.a.(4)(b) (above) shall be made and retained as part of the plan for at least 3 years after the date of the evaluation. The report shall also identify any incidents of noncompliance. Where a report does not identify any incidents of noncompliance, the report shall contain a certification that the facility is in compliance with the plan and this permit. The report shall be signed in accordance with Part VII.G. (Signatory Requirements) of this permit.

5. Numeric Effluent Limitations

In addition to the numeric effluent limitations described by Part V.B. of this permit, the following effluent limitations shall be met by existing and new discharges with:

a. Phosphate Fertilizer Manufacturing Runoff. The provisions of this paragraph are applicable to storm water discharges from the Phosphate Subcategory of the Fertilizer Manufacturing Point Source Category (40 CFR 418.10). The term contaminated storm water runoff shall mean precipitation runoff, that during manufacturing or processing, comes into contact with any raw materials, intermediate product, finished product, by-products or waste product (40 CFR 418.11(c)). The concentration of pollutants in storm water discharges shall not exceed the effluent limitations in Table C–1.

TABLE C–1.—NUMERIC EFFLUENT LIMITATIONS

Effluent characteristics	Effluent limitations (mg/L)	
	Maximum for any 1 day	Average of daily values for 30 consecutive days shall not exceed
Total Phosphorus (as P)	105.0	35.0
Fluoride	75.0	25.0

6. Monitoring and Reporting Requirements

a. Analytical Monitoring Requirements.

During the period beginning [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] and the period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance], permittees with agricultural chemical manufacturing facilities; industrial inorganic chemical facilities; soaps, detergents, cosmetics, and perfume manufacturing facilities; and plastics, synthetics, and resin manufacturing facilities must monitor their storm water discharges associated with industrial activity at least quarterly (4 times per year) during years 2 and 4 except as provided in paragraphs 6.a.(3) (Sampling Waiver), 6.a.(4) (Representative Discharge), and 6.a.(5) (Alternative Certification). Agricultural chemical manufacturing facilities; industrial inorganic chemical facilities; soaps, detergents, cosmetics, and perfume manufacturing facilities; and plastics, synthetics, and resin manufacturing facilities are required to monitor their storm water discharges for the pollutants of concern listed in Tables C–2, C–3, C–4, and C–5 below. Facilities must report in accordance with 6.b. (Reporting). In addition to the parameters listed in Tables C–2, C–3, C–4, and C–5 below, the permittee shall provide the date and duration (in hours) of the storm event(s) sampled; rainfall measurements or estimates (in inches) of the storm event that generated the sampled runoff; the duration between the storm event sampled and the end of the previous measurable (greater than 0.1 inch rainfall) storm event; and an estimate of the total volume (in gallons) of the discharge sampled.

TABLE C–2.—AGRICULTURAL CHEMICALS MONITORING REQUIREMENTS

Pollutants of concern	Cut-off concentration
Nitrate plus Nitrite Nitrogen	0.68 mg/L
Total Recoverable Lead	0.0816 mg/L
Total Recoverable Iron	1.0 mg/L
Total Recoverable Zinc	0.117 mg/L
Phosphorus	2.0 mg/L

TABLE C–3.—INDUSTRIAL INORGANIC CHEMICALS MONITORING REQUIREMENTS

Pollutants of concern	Cut-off concentration
Total Recoverable Aluminum .	0.75 mg/L
Total Recoverable Iron	1.0 mg/L
Nitrate plus Nitrite Nitrogen	0.68 mg/L

TABLE C–4.—SOAPS, DETERGENTS, COSMETICS, AND PERFUMES MONITORING REQUIREMENTS

Pollutants of concern	Cut-off concentration
Nitrate plus Nitrite Nitrogen	0.68 mg/L
Total Recoverable Zinc	0.117 mg/L

TABLE C–5.—PLASTICS, SYNTHETICS, AND RESINS MONITORING REQUIREMENTS

Pollutants of concern	Cut-off concentration
Total Recoverable Zinc	0.117 mg/L

(1) Monitoring Periods. Agricultural chemical manufacturing facilities; industrial inorganic chemical facilities; soaps, detergents, cosmetics, and perfume manufacturing facilities; and plastics, synthetics, and resin manufacturing facilities shall monitor samples collected during the sampling periods of: January through March, April through June, July through September, and October through December for the years specified in paragraph a. (above).

(2) Sample Type. A minimum of one grab sample shall be taken. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The required 72-hour storm event interval is waived where the preceding measurable storm event did not result in a measurable discharge from the facility. The required 72-hour storm event interval may also be waived where the permittee documents that less than a 72-hour interval is representative for local storm events during the season when sampling is being conducted. The grab sample shall be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable. If storm water discharges associated with industrial activity commingle with process or nonprocess water, then where practicable permittees must attempt to sample the storm water discharge before it mixes with the non-storm water discharge.

(3) Sampling Waiver.

(a) Adverse Conditions—When a discharger is unable to collect samples within a specified sampling period due to adverse climatic conditions, the discharger shall collect a substitute sample from a separate qualifying event in the next period and submit the data along with data for the routine sample in that period. Adverse weather conditions that may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricanes, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(b) Low Concentration Waiver—When the average concentration for a pollutant calculated from all monitoring data collected from an outfall during the monitoring period [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] is less than the corresponding value for that pollutant listed in Table C-2 under the column Monitoring Cut-off Concentration, a facility may waive monitoring and reporting requirements in the monitoring period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance]. The facility must submit to the Director, in lieu of the monitoring data, a certification that there has not been a significant change in industrial activity or the pollution prevention measures in area of the facility that drains to the outfall for which sampling was waived.

(c) When a discharger is unable to conduct quarterly chemical storm water sampling at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirements as long as the facility remains inactive and unstaffed. The facility must submit to the Director, in lieu of monitoring data, a certification statement on the DMR stating that the site is inactive and unstaffed so that collecting a sample during a qualifying event is not possible.

(4) Representative Discharge. When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may test the effluent of one of such outfalls and report that the quantitative data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan. The permittee shall include the description of the location of the outfalls, explanation of why outfalls are expected to discharge substantially identical effluents, and estimate of the size of the drainage area and runoff coefficient with the Discharge Monitoring Report.

(5) Alternative Certification. A discharger is not subject to the monitoring requirements of this section provided the discharger makes a certification for a given outfall or on a pollutant-by-pollutant basis in lieu of monitoring reports required under paragraph (*b*) below, under penalty of law, signed in accordance with Part VII.G. (Signatory Requirements), that material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, industrial machinery or operations, or significant materials from past industrial activity that are located in areas of the facility

within the drainage area of the outfall are not presently exposed to storm water and are not expected to be exposed to storm water for the certification period. Such certification must be retained in the storm water pollution prevention plan, and submitted to EPA in accordance with Part VI.C. of this permit. In the case of certifying that a pollutant is not present, the permittee must submit the certification along with the monitoring reports required under paragraph *b*. below. If the permittee cannot certify for an entire period, they must submit the date exposure was eliminated and any monitoring required up until that date. This certification option is not applicable to compliance monitoring requirements associated with effluent limitations.

b Reporting. Permittees with agricultural chemical manufacturing facilities; industrial inorganic chemical facilities; soaps, detergents, cosmetics, and perfume manufacturing facilities; and plastics, synthetics, and resin manufacturing facilities shall submit monitoring results for each outfall associated with industrial activity [or a certification in accordance with Sections (3), (4), or (5) above] obtained during the reporting period beginning [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] on Discharge Monitoring Report Form(s) postmarked no later than the 31st day of the following March [insert the date 2 years after permit issuance]. Monitoring results [or a certification in accordance with Sections (3), (4), or (5) above] obtained during the period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance] shall be submitted on Discharge Monitoring Report Form(s) postmarked no later than the 31st day of the following March. For each outfall, one Discharge Monitoring Report Form must be submitted per storm event sampled. Signed copies of Discharge Monitoring Reports, or said certifications, shall be submitted to the Director of the NPDES program at the address of the appropriate Regional Office listed in Part VI.G. of the fact sheet.

(1) Additional Notification. In addition to filing copies of discharge monitoring reports in accordance with paragraph b (above), agricultural chemical manufacturing facilities; industrial inorganic chemical facilities; soaps, detergents, cosmetics, and perfume manufacturing facilities; and plastics, synthetics, and resin manufacturing facilities with at least one storm water discharge associated with industrial activity through a large or medium municipal separate storm sewer system (systems serving a population of 100,000 or more) must submit signed copies of discharge monitoring reports to the operator of the municipal separate storm sewer system in accordance with the dates provided in paragraph b (above).

c. Compliance Monitoring Requirements. In addition to the monitoring required in paragraph 6a (above), permittees with contaminated storm water runoff from phosphate fertilizer manufacturing facilities must monitor their contaminated storm water discharges for the presence of phosphorus and fluoride at least annually (one time per year). Facilities must report in accordance with Part XI.C.6.c.(2) (Reporting). In addition to the parameters listed above, the permittee shall provide the date and duration (in hours) of the storm event(s) sampled; rainfall measurements or estimates (in inches) of the storm event that generated the sampled runoff; the duration between the storm event sampled and the end of the previous measurable (greater than 0.1 inch rainfall) storm event; and an estimate of the total volume (in gallons) of the discharge sampled;

(1) Sample Type. A minimum of one grab sample shall be taken. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The required 72-hour storm event interval is waived where the preceding measurable storm event did not result in a measurable discharge from the facility. The required 72-hour storm event interval may also be waived where the permittee documents that less than a 72-hour interval is representative for local storm events during the season when sampling is being conducted. The grab sample shall be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable.

(2) Reporting. Permittees with phosphate fertilizer manufacturing facilities shall submit monitoring results obtained during the reporting period beginning [insert date of permit issuance] on Discharge Monitoring Report Form(s) postmarked no later than the 31st day of the following [insert month after permit issuance date]. For each outfall, one signed Discharge Monitoring Report form must be submitted to the Director per storm event sampled. Signed copies of Discharge Monitoring Reports shall be submitted to the Director of the NPDES program at the address of the appropriate Regional Office indicated in Part VI.B. of this permit.

(3) Additional Notification. In addition to filing copies of discharge monitoring reports in accordance with paragraph (2) (above), permittees that discharge through a large or medium municipal separate storm sewer system (systems serving a population of 100,000 or more) must submit signed copies of discharge monitoring reports to the operator of the municipal separate storm sewer system in accordance with the dates provided in paragraph (3) (above).

d. Quarterly Visual Examination of Storm Water Quality. Facilities shall perform and document a visual examination of a storm water discharge associated with industrial activity from each outfall, except discharges exempted below. The examination must be made at least once in each of the following periods: January through March; April through June; July through September; and October through December during daylight hours unless there is insufficient rainfall or snow melt to produce a runoff event.

(1) Examinations shall be made of samples collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 1 hour) of when the runoff or snowmelt begins discharging. The examinations shall document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on the samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. Where practicable, the same individual should carry out the collection and examination of discharges for entire permit term.

(2) Visual examination reports must be maintained onsite in the pollution prevention plan. The report shall include the examination date and time, examination personnel, the nature of the discharge (i.e., runoff or snow melt), visual quality of the storm water discharge (including observations of color, odor, clarity, floating solids,

settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution), and probable sources of any observed storm water contamination.

(*3*) When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may collect a sample of effluent of one of such outfalls and report that the examination data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

(*4*) When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the records of the visual examination. Adverse weather conditions that may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricanes, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(*5*) When a discharger is unable to conduct visual storm water examinations at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirement as long as the facility remains inactive and unstaffed. The facility must maintain a certification with the pollution prevention plan stating that the site is inactive and unstaffed so that performing visual examinations during a qualifying event is not feasible.

D. Storm Water Discharges Associated With Industrial Activity From Asphalt Paving and Roofing Materials and Lubricant Manufacturers

1. Discharges Covered Under This Section. a. This section of the permit describes requirements for all existing point source discharges of storm water associated with industrial activity to waters of the United States from facilities engaged in manufacturing asphalt paving and roofing materials, including those facilities commonly identified by Standard Industrial Classification (SIC) codes 2951 and 2952.

b. This section of the permit describes requirements for all existing point source discharges of storm water associated with industrial activity to waters of the United States from portable asphalt plant facilities (also commonly identified by SIC code 2951).

c. This section of the permit describes requirements for all existing point source discharges of storm water associated with industrial activity to waters of the United States from facilities engaged in manufacturing lubricating oils and greases, including those facilities classified as SIC code 2992.

d. When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

e. Limitations on Coverage. The following storm water discharges associated with industrial activity are not authorized by this section of the permit:

(*1*) Storm water discharges from petroleum refining facilities, including those that manufacture asphalt or asphalt products and that are classified as SIC code 2911,

(*2*) Storm water discharges from oil recycling facilities, and

(*3*) Storm water discharges associated with fats and oils rendering.

2. Special Conditions. a. Prohibition of Non-storm Water Discharges.

(*1*) There are no additional prohibitions beyond those listed in Section III.A.2. of this permit.

3. Storm Water Pollution Prevention Plan Requirements. a. Contents of Plan. The plan shall include, at a minimum, the following items:

(*1*) *Pollution Prevention Team.* Each plan shall identify a specific individual or individuals within the facility organization as members of a storm water Pollution Prevention Team that are responsible for developing the storm water pollution prevention plan and assisting the facility or plant manager in its implementation, maintenance, and revision. The plan shall clearly identify the responsibilities of each team member. The activities and responsibilities of the team shall address all aspects of the facility's storm water pollution prevention plan.

(*2*) *Description of Potential Pollutant Sources.* Each plan shall provide a description of potential sources that may reasonably be expected to add significant amounts of pollutants to storm water discharges or that may result in the discharge of pollutants during dry weather from separate storm sewers draining the facility. Each plan shall identify all activities and significant materials that may potentially be significant pollutant sources. Each plan shall include, at a minimum:

(*a*) *Drainage.*

(*i*) A site map indicating an outline of the portions of the drainage area of each storm water outfall that are within the facility boundaries, each existing structural control measure to reduce pollutants in storm water runoff, surface water bodies, locations where significant materials are exposed to precipitation, locations where major spills or leaks identified under XI.D.3.a.(2)(c) (spills and leaks) of this permit have occurred, and the locations of the following activities where such activities are exposed to precipitation: fueling stations, vehicle and equipment maintenance and/or cleaning areas, loading/unloading areas, locations used for the treatment, storage or disposal of wastes, liquid storage tanks, processing areas and storage areas including areas where raw materials, finished products and drums are stored. The map must indicate the outfall locations and the types of discharges contained in the drainage areas of the outfalls.

(*ii*) For each area of the facility that generates storm water discharges associated with industrial activity with a reasonable potential for containing significant amounts of pollutants, a prediction of the direction of flow, and an identification of the types of pollutants that are likely to be present in storm water discharges associated with industrial activity. Factors to consider include the toxicity of a chemical; quantity of chemicals used, produced or discharged; the likelihood of contact with storm water; and history of significant leaks or spills of toxic or hazardous pollutants. Flows with a significant potential for causing erosion shall be identified.

(b) *Inventory of Exposed Materials*—An inventory of the types of materials handled at the site that potentially may be exposed to precipitation. Such inventory shall include a narrative description of significant materials that have been handled, treated, stored or disposed in a manner to allow exposure to storm water between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; method and location of onsite storage or disposal; materials management practices employed to minimize contact of materials with storm water runoff between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; the location and a description of existing structural and nonstructural control measures to reduce pollutants in storm water runoff; and a description of any treatment the storm water receives.

(d) *Spills and Leaks*—A list of significant spills and significant leaks of toxic or hazardous pollutants that occurred at areas that are exposed to precipitation or that otherwise drain to a storm water conveyance at the facility after the date of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit. Such list shall be updated as appropriate during the term of the permit.

(d) *Sampling Data*—A summary of existing discharge sampling data describing pollutants in storm water discharges from the facility, including a summary of sampling data collected during the term of this permit.

(e) *Risk Identification and Summary of Potential Pollutant Sources*—A narrative description of the potential pollutant sources from the following activities: loading and unloading operations; outdoor storage activities; outdoor manufacturing or processing activities; significant dust or particulate generating processes; and onsite waste disposal practices. The description shall specifically list any significant potential source of pollutants at the site and for each potential source, any pollutant or pollutant parameter (e.g., biochemical oxygen demand, etc.) of concern shall be identified.

(3) *Measures and Controls*. Each facility covered by this permit shall develop a description of storm water management controls appropriate for the facility, and implement such controls. The appropriateness and priorities of controls in a plan shall reflect identified potential sources of pollutants at the facility. The description of storm water management controls shall address the following minimum components, including a schedule for implementing such controls:

(a) *Good Housekeeping*—Good housekeeping requires the maintenance of areas that may contribute pollutants to storm water discharges in a clean, orderly manner. Particular attention should be paid to areas where raw materials are stockpiled, material handling areas, storage areas, liquid storage tanks, material handling areas, and loading/unloading areas.

(b) *Preventive Maintenance*—A preventive maintenance program shall involve timely inspection and maintenance of storm water management devices (e.g., cleaning oil/water separators, catch basins) as well as inspecting and testing facility equipment and systems to uncover conditions that could cause breakdowns or failures resulting in discharges of pollutants to surface waters, and ensuring appropriate maintenance of such equipment and systems.

(c) *Spill Prevention and Response Procedures*—Areas where potential spills that can contribute pollutants to storm water discharges can occur, and their accompanying drainage points shall be identified clearly in the storm water pollution prevention plan. Where appropriate, specifying material handling procedures, storage requirements, and use of equipment such as diversion valves in the plan should be considered. Procedures for cleaning up spills shall be identified in the plan and made available to the appropriate personnel. The necessary equipment to implement a clean up should be available to personnel.

(d) *Inspections*—In addition to or as part of the comprehensive site evaluation required under XI.D.3.a.(4) of this section, qualified facility personnel shall be identified to inspect designated equipment and areas of the facility at appropriate intervals specified in the plan. Material storage and handling areas, liquid storage tanks, hoppers or silos, vehicle and equipment maintenance, cleaning, and fueling areas, material handling vehicles, equipment and processing areas shall be inspected at least once per month as part of the maintenance program. A set of tracking or follow-up procedures shall be used to ensure that appropriate actions are taken in response to the inspections. Records of inspections shall be maintained.

(e) *Employee Training*—Employee training programs shall inform personnel responsible for implementing activities identified in the storm water pollution prevention plan or otherwise responsible for storm water management at all levels of responsibility of the components and goals of the storm water pollution prevention plan. Training should address topics such as spill response, good housekeeping and material management practices. The pollution prevention plan shall identify periodic dates for such training.

(f) *Recordkeeping and Internal Reporting Procedures*—A description of incidents (such as spills, or other discharges), along with other information describing the quality and quantity of storm water discharges shall be included in the plan required under this part. Inspections and maintenance activities shall be documented and records of such activities shall be incorporated into the plan.

(g) Non-storm Water Discharges.

(*i*) The plan shall include a certification that the discharge has been tested or evaluated for the presence of non-storm water discharges. The certification shall include the identification of potential significant sources of non-storm water at the site, a description of the results of any test and/or evaluation for the presence of non-storm water discharges, the evaluation criteria or testing method used, the date of any testing and/or evaluation, and the onsite drainage points that were directly observed during the test. Certifications shall be signed in accordance with Part VII.G. of this permit. Such certification may not be feasible if the facility operating the storm water discharge associated with industrial activity does not have access to an outfall, manhole, or other point of access to the ultimate conduit that receives the discharge. In such cases, the source identification section of the storm water pollution prevention plan shall indicate why the certification required by this part was not feasible, along with the identification of potential significant sources of non-storm water at the site. A discharger that is unable to provide the certification required by this paragraph must notify the Director in accordance with paragraph XI.D.3.a.(3)(g)(iii) (below).

(*ii*) Except for flows from fire fighting activities, sources of non-storm water listed in Part III.A.2 (Prohibition of Non-storm Water Discharges) of this permit that are combined with storm water discharges associated with industrial activity must be identified in the plan.

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The plan shall identify and ensure the implementation of appropriate pollution prevention measures for the non-storm water component(s) of the discharge.

(iii) Failure to Certify—Any facility that is unable to provide the certification required (testing for non-storm water discharges), must notify the Director by [Insert date 270 days after permit issuance] or, for facilities that begin to discharge storm water associated with industrial activity after [Insert date 270 days after permit issuance], 180 days after submitting an NOI to be covered by this permit. If the failure to certify is caused by the inability to perform adequate tests or evaluations, such notification shall describe: the procedure of any test conducted for the presence of non-storm water discharges; the results of such test or other relevant observations; potential sources of non-storm water discharges to the storm sewer; and why adequate tests for such storm sewers were not feasible. Non-storm water discharges to waters of the United States that are not authorized by an NPDES permit are unlawful, and must be terminated.

(h) Sediment and Erosion Control—The plan shall identify areas that, due to topography, activities, or other factors, have a high potential for significant soil erosion, and identify structural, vegetative, and/or stabilization measures to be used to limit erosion.

(i) Management of Runoff—The plan shall contain a narrative consideration of the appropriateness of traditional storm water management practices (practices other than those that control the generation or source(s) of pollutants) used to divert, infiltrate, reuse, or otherwise manage storm water runoff in a manner that reduces pollutants in storm water discharges from the site. The plan shall provide that measures that the permittee determines to be reasonable and appropriate shall be implemented and maintained. The potential of various sources at the facility to contribute pollutants to storm water discharges associated with industrial activity [see paragraph XI.D.3.a.(2) of this section (Description of Potential Pollutant Sources)] shall be considered when determining reasonable and appropriate measures. Appropriate measures may include: vegetated swales, reuse of collected storm water (such as for a process or as an irrigation source), inlet controls (such as oil/water separators), infiltration devices, and detention/retention basins or other equivalent measures.

(4) Comprehensive Site Compliance Evaluation. Qualified personnel shall conduct site compliance evaluations at appropriate intervals specified in the plan, but in no case less than once a year. Evaluations shall be conducted at least once at portable plant locations that are not in operation for a complete year. Such evaluations shall provide:

(a) Areas contributing to a storm water discharge associated with industrial activity including; material storage and handling areas, liquid storage tanks, hoppers or silos, vehicle and equipment maintenance, cleaning, and fueling areas, material handling vehicles, equipment and processing areas, and areas where aggregate is stockpiled outdoors shall be visually inspected for evidence of, or the potential for, pollutants entering the drainage system. Measures to reduce pollutant loadings shall be evaluated to determine whether they are adequate and properly implemented in accordance with the terms of the permit or whether additional control measures are needed. Structural storm water management measures, (e.g., oil/water separators, detention ponds, sedimentation basins or equivalent measures) sediment and erosion control measures, and other structural pollution prevention measures identified in the plan shall be observed to ensure that they are operating correctly. A visual inspection of equipment needed to implement the plan, such as dust collection equipment and spill response equipment, shall be made.

(b) Based on the results of the evaluation, the description of potential pollutant sources identified in the plan in accordance with XI.D.3.a.(2) of this section (description of potential pollutant sources) and pollution prevention measures and controls identified in the plan in accordance with XI.D.3.a.(3) of this section (measures and controls) shall be revised as appropriate within 2 weeks of such evaluation and shall provide for implementation of any changes to the plan in a timely manner, but in no case later than 12 weeks after the evaluation.

(c) A report summarizing the scope of the evaluation, personnel making the evaluation, the date(s) of the evaluation, major observations relating to the implementation of the storm water pollution prevention plan, and actions taken in accordance with paragraph (4)(b) (above) of the permit shall be made and retained as part of the storm water pollution prevention plan for at least 3 years after the date of the evaluation. The report shall identify any incidents of noncompliance. Where a report does not identify any incidents of noncompliance, the report shall contain a certification that the facility is in compliance with the storm water pollution prevention plan and this permit. The report shall be signed in accordance with Part VII.G. (Signatory Requirements) of this permit.

(d) Where compliance evaluation schedules overlap with inspections required under XI.D.3.a.(3)(d), the compliance evaluation may be conducted in place of one such inspection.

4. Numeric Effluent Limitations. In addition to the numeric effluent limitations listed in Part V.B. of this permit,discharges from areas where production of asphalt paving and roofing emulsions occurs may not exceed a TSS concentration of 23.0 mg/L of runoff for any 1 day, nor shall the average of daily values for 30 executive days exceed a TSS concentration of 15.0 mg/L of runoff. Oil and grease concentrations in storm water discharges from these areas may not exceed 15.0 mg/L of runoff for any 1 day, nor should the average daily values for 30 consecutive days exceed an oil and grease concentration of 10.0 mg/L of runoff. The pH of these discharges must be within the range of 6.0 to 9.0.

5. Monitoring and Reporting Requirements. a. Analytical Monitoring Requirements. During the period beginning [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] and the period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance], permittees with asphalt paving and roofing materials manufacturing facilities (including portable plants) must monitor their storm water discharges associated with industrial activity at least quarterly (4 times per year) during years 2 and 4 except as provided in paragraphs 5.a.(3) (Sampling Waiver), 5.a.(4) (Representative Discharge), and 5.a.(5) (Alternative Certification). Asphalt paving and roofing materials manufacturing facilities are required to monitor their storm water discharges for the pollutant of concern listed in Table D–1 below. Facilities must report in accordance with 5.b. (Reporting). In addition to the parameters listed in Table D–1 below, the permittee shall provide the date and duration (in hours) of the storm event(s) sampled; rainfall measurements or estimates (in inches) of the storm event that generated the sampled runoff; the duration between the storm event sampled and the end of the previous measurable (greater than 0.1 inch rainfall) storm event; and an estimate of the total volume (in gallons) of the discharge sampled.

TABLE D–1.—MONITORING REQUIREMENTS

Pollutants of concern	Cut-off concentration
Total Suspended Solids	100 mg/L

(1) Monitoring Periods. Asphalt paving and roofing materials manufacturing facilities shall monitor samples collected during the sampling periods of: January through March, April through June, July through September, and October through December for the years specified in paragraph a. (above).

(2) Sample Type. A minimum of one grab sample shall be taken. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The required 72-hour storm event interval is waived where the preceding measurable storm event did not result in a measurable discharge from the facility. The required 72-hour storm event interval may also be waived where the permittee documents that less than a 72-hour interval is representative for local storm events during the season when sampling is being conducted. The grab sample shall be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable. If storm water discharges associated with industrial activity commingle with process or nonprocess water, then where practicable permittees must attempt to sample the storm water discharge before it mixes with the non-storm water discharge.

(3) Sampling Waiver.

(a) Adverse Conditions—When a discharger is unable to collect samples within a specified sampling period due to adverse climatic conditions, the discharger shall collect a substitute sample from a separate qualifying event in the next period and submit the data along with data for the routine sample in that period. Adverse weather conditions that may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricanes, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(b) Low Concentration Waiver—When the average concentration for a pollutant calculated from all monitoring data collected from an outfall during the monitoring period [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] is less than the corresponding value for that pollutant listed in Table B–1 under the column Monitoring Cut-off Concentration, a facility may waive monitoring and reporting requirements in the monitoring period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance]. The facility must submit to the Director, in lieu of the monitoring data, a certification that there has not been a significant change in industrial activity or the pollution prevention measures in area of the facility that drains to the outfall for which sampling was waived.

(c) When a discharger is unable to conduct quarterly chemical storm water sampling at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirements as long as the facility remains inactive and unstaffed. The facility must submit to the Director, in lieu of monitoring data, a certification statement on the DMR stating that the site is inactive and unstaffed so that collecting a sample during a qualifying event is not possible.

(4) Representative Discharge. When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may test the effluent of one of such outfalls and report that the quantitative data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan. The permittee shall include the description of the location of the outfalls, explanation of why outfalls are expected to discharge substantially identical effluents, and estimate of the size of the drainage area and runoff coefficient with the Discharge Monitoring Report.

(5) Alternative Certification. A discharger is not subject to the monitoring requirements of this section provided the discharger makes a certification for a given outfall or on a pollutant-by-pollutant basis in lieu of monitoring reports required under paragraph (b) below, under penalty of law, signed in accordance with Part VII.G. (Signatory Requirements), that material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, industrial machinery or operations, or significant materials from past industrial activity that are located in areas of the facility within the drainage area of the outfall are not presently exposed to storm water and are not expected to be exposed to storm water for the certification period. Such certification must be retained in the storm water pollution prevention plan, and submitted to EPA in accordance with Part VI.C. of this permit. In the case of certifying that a pollutant is not present, the permittee must submit the certification along with the monitoring reports required under paragraph (b) below. If the permittee cannot certify for an entire period, they must submit the date exposure was eliminated and any monitoring required up until that date. This certification option is not applicable to compliance monitoring requirements in part XI.D.5.c of this permit associated with effluent limitations.

b. Reporting. Permittees with asphalt paving and roofing materials manufacturing facilities shall submit monitoring results for each outfall associated with industrial activity [or a certification in accordance with Sections (3), (4), or (5) above] obtained during the reporting period beginning [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] on Discharge Monitoring Report Form(s) postmarked no later than the 31st day of the following March [insert the date 2 years after permit issuance]. Monitoring results [or a certification in accordance with Sections (3), (4), or (5) above] obtained during the period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance] shall be submitted on Discharge Monitoring Report Form(s) postmarked no later than the 31st day of the following March. For each outfall, one signed Discharge Monitoring Report Form must be submitted per storm event completed. Signed copies of Discharge Monitoring

Reports, or said certifications, shall be submitted to the Director of the NPDES program at the address of the appropriate Regional Office listed in Part VI.G. of the fact sheet.

(1) Additional Notification. In addition to filing copies of discharge monitoring reports in accordance with paragraph b (above), asphalt paving and roofing materials manufacturing facilities with at least one storm water discharge associated with industrial activity through a large or medium municipal separate storm sewer system (systems serving a population of 100,000 or more) must submit signed copies of discharge monitoring reports to the operator of the municipal separate storm sewer system in accordance with the dates provided in paragraph b (above).

c. Quarterly Visual Examination of Storm Water Quality. Facilities shall perform and document a visual examination of a storm water discharge associated with industrial activity from each outfall, except discharges exempted below. The examination must be made at least once in each designated period [described in (1), below] during daylight hours unless there is insufficient rainfall or snow melt to produce a runoff event.

(1) Examinations shall be conducted in each of the following periods for the purposes of evaluating storm water quality associated with storm water runoff or snow melt: January through March; April through June; July through September; and October through December.

(2) Examinations shall be made of samples collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 1 hour) of when the runoff or snowmelt begins discharging. The examinations shall document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on the samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. Where practicable, the same individual should carry out the collection and examination of discharges for the life of the permit.

(3) Visual examination reports must be maintained onsite in the pollution prevention plan. The report shall include the examination date and time, examination personnel, the nature of the discharge (i.e., runoff or snow melt), visual quality of the storm water discharge (including observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution), and probable sources of any observed storm water contamination.

(4) When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may collect a sample of effluent of one of such outfalls and report that the examination data also applies to the substantially identical outfalls provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explaining in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

(5) When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation on site with the results of the visual examination. Adverse weather conditions that may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricanes, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(6) When a discharger is unable to conduct visual storm water examinations at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirement as long as the facility remains inactive and unstaffed. The facility must maintain a certification with the pollution prevention plan stating that the site is inactive and unstaffed so that performing visual examinations during a qualifying event is not feasible.

d. Compliance Monitoring Requirements. Permitters with facilities that produce asphalt paving or roofing emulsions must monitor their storm water discharges associated with these activities for the presence of TSS, oil and grease, and for pH at least annually (one time per year). Facilities must report in accordance with 5.d.(2) (reporting). In addition to the parameters listed above, the permittee shall provide the date and duration (in hours) of the storm event(s) sampled; rainfall measurements or estimates (in inches) of the storm event that generated the sampled runoff; the duration between the storm event sampled and the end of the previous measurable (greater than 0.1 inch rainfall) storm event; and an estimate of the total volume (in gallons) of the discharge sampled.

(1) Sample Type. A minimum of one grab sample shall be taken. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The grab sample shall be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable.

(2) Reporting. Permittees with asphalt paving or roofing emulsion production facilities shall submit monitoring results obtained during the reporting period beginning [insert date of permit issuance] on Discharge Monitoring Report Form(s) postmarked no later than the last day of the following [insert month after permit issuance date]. Signed copies of Discharge Monitoring Reports shall be submitted to the Director of the NPDES program at the address of the appropriate Regional Office indicated in Part VI.B. of this permit. For each outfall one Discharge monitoring form shall be submitted per storm event sampled.

(3) Additional Notification. In addition to filing copies of discharge monitoring reports in accordance with paragraph (2) (above), permittees that discharge through a large or medium municipal separate storm sewer system (systems serving a population of 100,000 or more) must submit signed copies of discharge monitoring reports to the operator of the municipal separate storm sewer system in accordance with the dates provided in paragraph (3) (above).

E. Storm Water Discharges Associated With Industrial Activity From Glass, Clay, Cement, Concrete, and Gypsum Product Manufacturing Facilities

1. Discharges Covered Under This Section. The requirements listed under this section shall apply to storm water discharges from the following activities: manufacturing flat, pressed, or blown glass or glass containers; manufacturing hydraulic cement; manufacturing clay products including tile and brick; manufacturing of pottery and porcelain electrical supplies; manufacturing concrete products; manufacturing gypsum products; nonclay refractories; and grinding or otherwise treating minerals and earths. This section generally includes the following types of manufacturing operations: flat glass, (SIC code 3211); glass containers, (SIC code 3221); pressed and blown glass, not elsewhere classified, (SIC code 3229); hydraulic cement, (SIC code 3241); brick and structural clay tile, (SIC code 3251); ceramic wall and floor tile, (SIC code 3253); clay refractories, (SIC code 3255); structural clay products not elsewhere classified (SIC code 3259); vitreous china table and kitchen articles (SIC code 3262); fine earthenware table and kitchen articles (SIC code 3263); porcelain electrical supplies, (SIC code 3264); pottery products, (SIC code 3269); concrete block and brick, (SIC code 3271); concrete products, except block and brick (SIC code 3272); ready-mix concrete, (SIC code 3273); gypsum products, (SIC code 3275); minerals and earths, ground or otherwise treated, (SIC code 3295); and nonclay refractories, (SIC code 3297).

Facilities engaged in the following activities are not eligible for coverage under this section: lime manufacturing (SIC 3274); cut stone and stone products (SIC 3281); abrasive products (SIC 3291); asbestos products (SIC 3292); mineral wool and mineral wool insulation products (SIC 3296).

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

2. Special Conditions. a. Prohibition of Non-storm Water Discharges. The discharge of pavement washwaters are only authorized where the permittee has minimized the presence of spilled materials in accordance with part XI.E.3.a.(3).(a).(i) of this permit.

3. Storm Water Pollution Prevention Plan Requirements. a. Contents of Plan. The plan shall include, at a minimum, the following items:

(1) Pollution Prevention Team. Each plan shall identify a specific individual or individuals within the facility organization as members of a storm water Pollution Prevention Team that are responsible for developing the storm water pollution prevention plan and assisting the facility or plant manager in its implementation, maintenance, and revision. The plan shall clearly identify the responsibilities of each team member. The activities and responsibilities of the team shall address all aspects of the facility's storm water pollution prevention plan.

(2) Description of Potential Pollutant Sources. Each plan shall provide a description of potential sources that may reasonably be expected to add significant amounts of pollutants to storm water discharges or that may result in the discharge of pollutants during dry weather from separate storm sewers draining the facility. Each plan shall identify all activities and significant materials that may potentially be significant pollutant sources. Each plan shall include, at a minimum:

(a) Drainage.

(i) A site map indicating an outline of the portions of the drainage area of each storm water outfall that are within the facility boundaries, each existing structural control measure to reduce pollutants in storm water runoff, surface water bodies, locations where significant materials are exposed to precipitation, locations where major spills or leaks identified under Part XI.E.3.a.(2)(c) (Spills and Leaks) of this permit have occurred, and the locations of the following activities where such activities are exposed to precipitation: fueling stations, vehicle and equipment maintenance and/or cleaning areas, loading/unloading areas, locations used for the treatment, storage or disposal of wastes, liquid storage tanks, processing areas and storage areas. Facilities shall also identify, on the site map, the location of any: bag house or other dust control device; recycle/sedimentation pond, clarifier or other device used for the treatment of process wastewater and the areas that drain to the treatment device. The map must indicate the outfall locations and the types of discharges contained in the drainage areas of the outfalls.

(ii) For each area of the facility that generates storm water discharges associated with industrial activity with a reasonable potential for containing significant amounts of pollutants, a prediction of the direction of flow, and an identification of the types of pollutants that are likely to be present in storm water discharges associated with industrial activity. Factors to consider include the toxicity of chemical; quantity of chemicals used, produced or discharged; the likelihood of contact with storm water; and history of significant leaks or spills of toxic or hazardous pollutants. Flows with a significant potential for causing erosion shall be identified.

(b) Inventory of Exposed Materials.—An inventory of the types of materials handled at the site that potentially may be exposed to precipitation. Such inventory shall include a narrative description of significant materials that have been handled, treated, stored or disposed in a manner to allow exposure to storm water between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; method and location of onsite storage or disposal; materials management practices employed to minimize contact of materials with storm water runoff between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; the location and a description of existing structural and nonstructural control measures to reduce pollutants in storm water runoff; and a description of any treatment the storm water receives.

(c) Spills and Leaks—A list of significant spills and significant leaks of toxic or hazardous pollutants that occurred at areas that are exposed to precipitation or that otherwise drain to a storm water conveyance at the facility after the date of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit. Such list shall be updated as appropriate during the term of the permit.

(d) Sampling Data—A summary of existing discharge sampling data describing pollutants in storm water discharges from the facility, including a summary of sampling data collected during the term of this permit.

(e) Risk Identification and Summary of Potential Pollutant Sources—A narrative description of the potential

pollutant sources from the following activities: loading and unloading operations; outdoor storage activities; outdoor manufacturing or processing activities; significant dust or particulate generating processes; and onsite waste disposal practices. The description shall specifically list any significant potential source of pollutants at the site and for each potential source, any pollutant or pollutant parameter [e.g., Total Suspended Solids (TSS), etc.] of concern shall be identified.

(3) Measures and Controls. Each facility covered by this permit shall develop a description of storm water management controls appropriate for the facility, and implement such controls. The appropriateness and priorities of controls in a plan shall reflect identified potential sources of pollutants at the facility. The description of storm water management controls shall address the following minimum components, including a schedule for implementing such controls:

(a) Good Housekeeping—Good housekeeping requires the maintenance of areas that may contribute pollutants to storm water discharges in a clean, orderly manner.

(i) Facilities shall prevent or minimize the discharge of spilled cement, aggregate (including sand or gravel), kiln dust, fly ash, settled dust other significant materials in storm water from paved portions of the site that are exposed to storm water. Measures used to minimize the presence of these materials may include regular sweeping, or other equivalent measures. The plan shall indicate the frequency of sweeping or other measures. The frequency shall be determined based upon consideration of the amount of industrial activity occurring in the area and frequency of precipitation, but shall not be less than once per week when cement, aggregate, kiln dust or fly ash are being handled or otherwise processed in the area.

(ii) Facilities shall prevent the exposure of fine granular solids such as cement, fly ash, and kiln dust to storm water. Where practicable, these materials shall be stored in enclosed silos, hoppers or buildings, in covered areas, or under covering.

(b) Preventive Maintenance—A preventive maintenance program shall involve routine inspection and maintenance of storm water management devices (e.g., cleaning oil/water separators, catch basins) as well as inspecting and testing facility equipment and systems to uncover conditions that could cause breakdowns or failures resulting in discharges of pollutants to surface waters, and ensuring appropriate maintenance of such equipment and systems.

(c) Spill Prevention and Response Procedures—Areas where potential spills that can contribute pollutants to storm water discharges can occur, and their accompanying drainage points shall be identified clearly in the storm water pollution prevention plan. Where appropriate, specifying material handling procedures, storage requirements, and use of equipment such as diversion valves in the plan should be considered. Procedures for cleaning up spills shall be identified in the plan and made available to the appropriate personnel. The necessary equipment to implement a clean up should be available to personnel.

(d) Inspections—Qualified facility personnel shall be identified to inspect designated equipment and areas of the facility specified in the plan. The inspection frequency shall be specified in the plan based upon a consideration of the level of industrial activity at the facility, but shall be a minimum of once per month while the facility is in operation. The inspection shall take place while the facility is in operation and shall at a minimum include all of the following areas that are exposed to storm water at the site: material handling areas, above ground storage tanks, hoppers or silos, dust collection/containment systems, truck wash down and equipment cleaning areas. Tracking or follow-up procedures shall be used to ensure that appropriate actions are taken in response to the inspections. Records of inspections shall be maintained.

(e) Employee Training—Employee training programs shall inform personnel responsible for implementing activities identified in the storm water pollution prevention plan or otherwise responsible for storm water management at all levels of responsibility of the components and goals of the storm water pollution prevention plan. Training should address topics such as spill response, good housekeeping, truck wash out procedures, equipment wash down procedures and material management practices. The pollution prevention plan shall identify periodic dates for such training.

(f) Recordkeeping and Internal Reporting Procedures—A description of incidents (such as spills, or other discharges), along with other information describing the quality and quantity of storm water discharges shall be included in the plan required under this part. Inspections and maintenance activities shall be documented and records of such activities shall be incorporated into the plan.

(g) Non-storm Water Discharges.

(i) The plan shall include a certification that the discharge has been tested or evaluated for the presence of non-storm water discharges. The certification shall include the identification of potential significant sources of non-storm water at the site, a description of the results of any test and/or evaluation for the presence of non-storm water discharges, the evaluation criteria or testing method used, the date of any testing and/or evaluation, and the onsite drainage points that were directly observed during the test. Certifications shall be signed in accordance with Part VII.G. of this permit. Such certification may not be feasible if the facility operating the storm water discharge associated with industrial activity does not have access to an outfall, manhole, or other point of access to the ultimate conduit that receives the discharge. In such cases, the source identification section of the storm water pollution prevention plan shall indicate why the certification required by this part was not feasible, along with the identification of potential significant sources of non-storm water at the site. A discharger that is unable to provide the certification required by this paragraph must notify the Director in accordance with paragraph XI.E.3.a.(3)(g)(iii) (below).

Facilities engaged in production of ready-mix concrete, concrete block, brick or other products shall include in the certification a description of measures that insure that process waste water that results from washing of trucks, mixers, transport buckets, forms or other equipment are discharged in accordance with NPDES requirements or are recycled. Facilities with wash water recycle ponds shall include an estimate of the amount of rainfall (in inches) required to cause the recycle pond to overflow in a 24-hour period.

(ii) Except for flows from fire fighting activities, sources of non-storm water listed in Part III.A.2 (Prohibition of Non-storm Water Discharges) of this permit that are combined with storm water discharges associated with industrial activity must be identified in the plan. The plan shall identify and ensure the implementation of appropriate pollution prevention measures for the non-storm water component(s) of the discharge.

(iii) Failure to Certify—Any facility that is unable to provide the certification required (testing for non-storm water discharges), must notify the Director by [Insert date 270 days after permit issuance] or, for facilities that begin to discharge storm water

associated with industrial activity after [Insert date 270 days after permit issuance], 180 days after submitting an NOI to be covered by this permit. If the failure to certify is caused by the inability to perform adequate tests or evaluations, such notification shall describe: the procedure of any test conducted for the presence of non-storm water discharges; the results of such test or other relevant observations; potential sources of non-storm water discharges to the storm sewer; and why adequate tests for such storm sewers were not feasible. Non-storm water discharges to waters of the United States that are not authorized by an NPDES permit are unlawful, and must be terminated.

(i) Sediment and Erosion Control—The plan shall identify areas that, due to topography, activities, or other factors, have a high potential for significant soil erosion, and identify structural, vegetative, and/or stabilization measures to be used to limit erosion.

(i) Management of Runoff—The plan shall contain a narrative consideration of the appropriateness of traditional storm water management practices (practices other than those that control the generation or source(s) of pollutants) used to divert, infiltrate, reuse, or otherwise manage storm water runoff in a manner that reduces pollutants in storm water discharges from the site. The plan shall provide that measures that the permittee determines to be reasonable and appropriate shall be implemented and maintained. The potential of various sources at the facility to contribute pollutants to storm water discharges associated with industrial activity [see paragraph XI.E.3.a.(2) of this section (Description of Potential Pollutant Sources)] shall be considered when determining reasonable and appropriate measures. Appropriate measures may include: vegetative swales and practices, reuse of collected storm water (such as for a process or as an irrigation source), inlet controls (such as oil/water separators), snow management activities, infiltration devices, and wet detention/retention devices or other equivalent measures.

(4) Comprehensive Site Compliance Evaluation. Qualified personnel shall conduct site compliance evaluations at appropriate intervals specified in the plan, but, in no case less than once a year. Such evaluations shall provide:

(a) Areas contributing to a storm water discharge associated with industrial activity including but not limited to: material handling areas, above ground storage tanks, hoppers or silos, dust collection/containment systems, truck wash down and equipment cleaning areas shall be visually inspected for evidence of, or the potential for, pollutants entering the drainage system. Measures to reduce pollutant loadings shall be evaluated to determine whether they are adequate and properly implemented in accordance with the terms of the permit or whether additional control measures are needed. Structural storm water management measures, sediment and erosion control measures, and other structural pollution prevention measures such as recycle ponds, identified in the plan shall be observed to ensure that they are operating correctly. A visual inspection of equipment needed to implement the plan, such as spill response equipment, shall be made.

(b) Based on the results of the evaluation, the description of potential pollutant sources identified in the plan in accordance with paragraph XI.E.3.a.(2) of this section (Description of Potential Pollutant Sources) and pollution prevention measures and controls identified in the plan in accordance with paragraph XI.E.3.a.(3) of this section (Measures and Controls) shall be revised as appropriate within 2 weeks of such evaluation and shall provide for implementation of any changes to the plan in a timely manner, but in no case more than 12 weeks after the evaluation.

(c) A report summarizing the scope of the evaluation, personnel making the evaluation, the date(s) of the evaluation, major observations relating to the implementation of the storm water pollution prevention plan, and actions taken in accordance with paragraph XI.E.3.a.(4)(b) (above) of the permit shall be made and retained as part of the storm water pollution prevention plan for at least 3 years after the date of the evaluation. The report shall identify any incidents of noncompliance. Where a report does not identify any incidents of noncompliance, the report shall contain a certification that the facility is in compliance with the storm water pollution prevention plan and this permit. The report shall be signed in accordance with Part VII.G. (Signatory Requirements) of this permit.

(d) Where compliance evaluation schedules overlap with inspections required under 3.a.(3)(d), the compliance evaluation may be conducted in place of one such inspection.

4. Numeric Effluent Limitations

In addition to the numeric effluent limitations described by Part V.B, the following limitations shall be met by existing and new dischargers.

a. Cement Manufacturing Facility, Material Storage Runoff. Any discharge composed of runoff that derives from the storage of materials including raw materials, intermediate products, finished products, and waste materials that are used in or derived from the manufacture of cement shall not exceed a maximum concentration for any time of 50 mg/L Total Suspended Solids (TSS) nor the 6.0 to 9.0 range limitation for pH. Runoff from the storage piles shall not be diluted with other storm water runoff or flows to meet this limitation. Any untreated overflow from facilities designed, constructed and operated to treat the volume of material storage pile runoff that is associated with a 10-year, 24-hour rainfall event shall not be subject to the TSS or pH limitations. Dischargers subject to these numeric effluent limitations must be in compliance with these limits upon commencement of coverage and for the entire term of this permit.

5. Monitoring and Reporting Requirements

a. Analytical Monitoring Requirements. During the period beginning [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] and the period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance], permittees that manufacture clay products and concrete products and gypsum products must monitor their storm water discharges associated with industrial activity at least quarterly (4 times per year during years 2 and 4) except as provided in paragraphs 5.a.(3) (Sampling Waiver), 5.a.(4) (Representative Discharge), and 5.a.(5) (Alternative Certification).

Clay product manufacturers include: brick and structural clay tile manufacturers (SIC 3251), ceramic wall and floor tile manufacturers (SIC 3253), clay refractories (SIC 3255), manufacturers of structural clay products, not elsewhere classified (SIC 3259), manufacturers of vitreous china table and kitchen articles (SIC 3232), manufacturers of fine earthenware table and kitchen articles (SIC 3263), manufacturers of porcelain electrical supplies (SIC 3264), pottery products (SIC 3269) and non-clay refractories (3297). Facilities with these industrial activities must monitor for the pollutant listed in Table E-1.

Concrete and gypsum product manufacturers include concrete block and brick manufacturers (SIC 3271), concrete products manufacturers (SIC 3272), ready mix concrete manufacturers (SIC 3273), gypsum product manufacturers (SIC 3275) and manufacturers of mineral and earth products (SIC 3295). Facilities with these industrial activities must monitor for the pollutant listed in Table E–2.

Facilities must report in accordance with 5.b. (Reporting). In addition to the parameters listed in Tables E-1 and E-2 below, the permittee shall provide the date and duration (in hours) of the storm event(s) sampled; rainfall measurements or estimates (in inches) of the storm event that generated the sampled runoff; the duration between the storm event sampled and the end of the previous measurable (greater than 0.1 inch rainfall) storm event; and an estimate of the total volume (in gallons) of the discharge sampled.

TABLE E–1.—MONITORING REQUIREMENTS FOR CLAY PRODUCT MANUFACTURERS

Pollutants of concern	Monitoring cut-off concentration
Total Recoverable Aluminum	0.75 mg/L

TABLE E–2.—MONITORING REQUIREMENTS FOR CONCRETE AND GYPSUM PRODUCT MANUFACTURERS

Pollutants of concern	Monitoring cut-off concentration
Total Suspended Solids (TSS) ...	100 mg/L
Total Recoverable Iron	1.0 mg/L

(1) Monitoring Periods. Facilities subject to analytical monitoring requirements described in part XI.E.5.a, shall monitor samples collected during the sampling periods of: January to March, April to June, July to September, and October to December for the years specified in paragraph a. (above).

(2) Sample Type. A minimum of one grab sample shall be taken. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The required 72-hour storm event interval is waived where the preceding measurable storm event did not result in a measurable discharge from the facility. The required 72-hour storm event interval may also be waived where the permittee documents that less than a 72-hour interval is representative for local storm events during the season when sampling is being conducted. The grab sample shall be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable. If storm water discharges associated with industrial activity commingle with process or non-process water, then where practicable permittees must attempt to sample the storm water discharge before it mixes with the non-storm water discharge.

(3) Sampling Waiver.

(a) Adverse Conditions—When a discharger is unable to collect samples within a specified sampling period due to adverse climatic conditions, the discharger shall collect a substitute sample from a separate qualifying event in the next period and submit the data along with data for the routine sample in that period. Adverse weather conditions that may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(b) Low Concentration Waiver—When the average concentration for a pollutant calculated from all monitoring data collected from an outfall during the monitoring period [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] is less than the corresponding value for that pollutant listed in Table E–1 under the column Monitoring Cut-off Concentration, a facility may waive monitoring and reporting requirements in the monitoring period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance]. The facility must submit to the Director, in lieu of the monitoring data, a certification that there has not been a significant change in industrial activity or the pollution prevention measures in area of the facility that drains to the outfall for which sampling was waived.

(c) When a discharger is unable to conduct quarterly chemical storm water sampling at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirements as long as the facility remains inactive and unstaffed. The facility must submit to the Director, in lieu of monitoring data, a certification statement on the DMR stating that the site is inactive and unstaffed so that collecting a sample during a qualifying event is not possible.

(4) Representative Discharge. When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may test the effluent of one of such outfalls and report that the quantitative data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan. The permittee shall include the description of the location of the outfalls, explanation of why outfalls are expected to discharge substantially identical effluents, and estimate of the size of the drainage area and runoff coefficient with the Discharge Monitoring Report.

(5) Alternative Certification. A discharger is not subject to the monitoring requirements of this section provided the discharger makes a certification for a given outfall, on pollutant by pollutant basis in lieu of monitoring reports required by paragraph *(b)* below, under penalty of law, signed in accordance with Part VII.G. (Signatory Requirements), that material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, industrial machinery or operations, or significant materials from past industrial activity that are located in areas of the facility within the drainage area of the outfall are not presently exposed to storm water and are not expected to be exposed to storm water for the certification period. Such certification must be retained in the storm water pollution prevention plan, and submitted to EPA in accordance with Part VI.C. of this permit. In the case of certifying that a pollutant is not present, the permittee must submit the certification along with the monitoring reports required under paragraph *(b)* below. If the permittee cannot certify for an entire period, they must submit the date exposure was eliminated and any monitoring required

up until that date. This certification option is not applicable to compliance monitoring requirements associated with effluent limitations. EPA does not expect facilities to be able to exercise this certification for indicator parameters, such as TSS and BOD.

(b) Reporting. Permittees with monitoring requirements under Part XI.E.5.a. shall submit monitoring results for each outfall associated with industrial activity [or a certification in accordance with Sections (3), (4), or (5) above] obtained during the reporting period beginning [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] on Discharge Monitoring Report Form(s) postmarked no later than the 31st day of the following March [insert the date 2 years after permit issuance]. Monitoring results [or a certification in accordance with Sections (3), (4), or (5) above] obtained during the period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance] shall be submitted on Discharge Monitoring Report Form(s) postmarked no later than the 31st day of the following March. For each outfall, one signed Discharge Monitoring Report Form must be submitted for each event sampled. Signed copies of Discharge Monitoring Reports, or said certifications, shall be submitted to the Director of the NPDES program at the address of the appropriate Regional Office listed in Part VI.G. of the fact sheet to this permit.

(1) Additional Notification. In addition to filing copies of discharge monitoring reports in accordance with paragraph b (above), facilities with monitoring requirements under Part XI.E.5.a. with at least one storm water discharge associated with industrial activity through a large or medium municipal separate storm sewer system (systems serving a population of 100,000 or more) must submit signed copies of discharge monitoring reports to the operator of the municipal separate storm sewer system in accordance with the dates provided in paragraph b (above).

c. Quarterly Visual Examination of Storm Water Quality. Glass, clay, cement, concrete, and gypsum manufacturing facilities shall perform and document a visual examination of a storm water discharge associated with industrial activity from each outfall, except discharges exempted below. The examination(s) must be made at least once in each of the following three-month periods: January through March, April through June, July through September, and October through December. The examination shall be made during daylight hours unless there is insufficient rainfall or snow melt to produce a runoff event.

(1) Examinations shall be made of grab samples collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 1 hour) of when the runoff or snowmelt begins discharging. The examinations shall document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on the samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. Where practicable, the same individual should carry out the collection and examination of discharges for entire permit term.

(2) Visual examination reports must be maintained onsite in the pollution prevention plan. The report shall include the examination date and time, examination personnel, the nature of the discharge (i.e., runoff or snow melt), visual quality of the storm water discharge (including observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution), and probable sources of any observed storm water contamination.

(3) When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may collect a sample of effluent of one of such outfalls and report that the evaluation data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

(4) When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the records of the visual examinations. Adverse weather conditions that may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(5) When a discharger is unable to conduct visual storm water examinations at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirement as long as the facility remains inactive and unstaffed. The facility must maintain a certification with the pollution prevention plan stating that the site is inactive and unstaffed so that performing visual examinations during a qualifying event is not feasible.

d. Compliance Monitoring Requirements. Permittees with cement manufacturing facilities must monitor runoff from material storage for the presence of TSS and pH at least annually (one time per year). Facilities must report in accordance with 5.d.(2) below (reporting). In addition to the parameters listed above, the permittee shall provide the date and duration (in hours) of the storm event(s) sampled; rainfall measurements or estimates (in inches) of the storm event that generated the sampled runoff; the duration between the storm event sampled and the end of the previous measurable (greater than 0.1 inch rainfall) storm event; and an estimate of the total volume (in gallons) of the discharge sampled.

(1) Sample Type. A minimum of one grab sample shall be taken. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The grab sample shall be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable.

(2) Reporting. Permittees with material storage runoff from cement manufacturing facilities shall submit monitoring results obtained during the reporting period beginning [insert date of permit issuance] on Discharge Monitoring Report Form(s) postmarked no later than the 31st day of the following [insert month after permit issuance date]. Signed copies of Discharge Monitoring Reports shall be submitted to the Director of the NPDES program at the address of the appropriate Regional Office indicated in Part VI.B. of this permit. For each outfall, one signed Discharge Monitoring Report form shall be submitted for each storm event sampled.

(3) Additional Notification. In addition to filing copies of discharge monitoring reports in accordance with paragraph (2) (above), permittees with discharges of material storage runoff from cement manufacturing facilities through a large or medium municipal separate storm sewer system (systems serving a population of 100,000 or more) must submit signed copies of discharge monitoring reports to the operator of the municipal separate storm sewer system in accordance with the dates provided in paragraph 5.d.(3) (above).

F. Storm Water Discharges Associated With Industrial Activity From Primary Metals Facilities

1. Discharges Covered Under This Section

The requirements listed under this section of today's permit shall apply to storm water discharges from the primary metal industry, which includes the following types of facilities:

a. Steel works, blast furnaces, and rolling and finishing mills including: steel wiredrawing and steel nails and spikes; cold-rolled steel sheet, strip, and bars; and steel pipes and tubes (SIC code 331).

b. Iron and steel foundries, including: gray and ductile iron, malleable iron, steel investment, and steel foundries not elsewhere classified (SIC code 332).

c. Primary smelting and refining of nonferrous metals, including: primary smelting and refining of copper, and primary production of aluminum (SIC code 333).

d. Secondary smelting and refining of nonferrous metals (SIC code 334).

e. Rolling, drawing, and extruding of nonferrous metals, including: rolling, drawing, and extruding of copper; rolling, drawing, and extruding of nonferrous metals, except copper and aluminum; and drawing and insulating of nonferrous wire (SIC code 335).

f. Nonferrous foundries (castings), including: aluminum die-castings, nonferrous die-castings, except aluminum, aluminum foundries, copper foundries, and nonferrous foundries, except copper and aluminum (SIC code 336).

g. Miscellaneous primary metal products, not elsewhere classified, including: metal heat treating, and primary metal products, not elsewhere classified (SIC code 339).

Activities covered include, but are not limited to, storm water discharges associated with coking operations, sintering plants, blast furnaces, smelting operations, rolling mills, casting operations, heat treating, extruding, drawing, or forging of all types of ferrous and nonferrous metals, scrap, and ore.

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

2. Special Conditions

a. Prohibition of Non-storm Water Discharges. There are no additional requirements beyond those described in Part III.A.2. of this permit.

3. Storm Water Pollution Prevention Plan Requirements

a. Contents of Plan. The plan shall include, at a minimum, the following items:

(1) Pollution Prevention Team. Each plan shall identify a specific individual or individuals within the facility organization as members of a storm water Pollution Prevention Team that are responsible for developing the storm water pollution prevention plan and assisting the facility or plant manager in its implementation, maintenance, and revision. The plan shall clearly identify the responsibilities of each team member. The activities and responsibilities of the team shall address all aspects of the facility's storm water pollution prevention plan.

(2) Description of Potential Pollutant Sources. Each plan shall provide a description of potential sources that may reasonably be expected to add significant amounts of pollutants to storm water discharges or that may result in the discharge of pollutants during dry weather from separate storm sewers draining the facility. Each plan shall identify all activities and significant materials that may potentially be significant pollutant sources. Each plan shall include, at a minimum:

(a) Drainage.

(i) A site map indicating an outline of the portions of the drainage area of each storm water outfall that are within the facility boundaries, each existing structural control measure to reduce pollutants in storm water runoff, surface water bodies, locations where significant materials are exposed to precipitation, locations where major spills or leaks identified under Part XI.F.3.a.(2)(c) (Spills and Leaks) of this permit have occurred, and the locations of the following activities where such activities are exposed to precipitation: fueling stations, vehicle and equipment maintenance and/or cleaning areas, loading/unloading areas, locations used for the treatment, storage or disposal of wastes such as spent solvents or baths, sand, slag or dross, liquid storage tanks or drums, processing areas including pollution control equipment such as baghouses, and storage areas of raw materials such as coal, coke, scrap, sand, fluxes, refractories, or metal in any form. The map shall also indicate areas of the facility where accumulation of significant amounts of particulate matter from operations such as furnace or oven emissions or losses from coal/coke handling operations, etc., is likely, and could result in a discharge of pollutants to waters of the United States. The map must indicate the outfall locations and the types of discharges contained in the drainage areas of the outfalls.

(ii) For each area of the facility that generates storm water discharges associated with industrial activity with a reasonable potential for containing significant amounts of pollutants, a prediction of the direction of flow, and an identification of the types of pollutants that are likely to be present in storm water discharges associated with industrial activity. Factors to consider include the toxicity of a chemical; quantity of chemicals used, produced or discharged; the likelihood of contact with storm water; and history of significant leaks or spills of toxic or hazardous pollutants. Flows with a significant potential for causing erosion shall be identified.

(b) Inventory of Exposed Materials—An inventory of the types of materials handled at the site that potentially may be exposed to precipitation. Such inventory shall include a narrative description of significant materials that have been handled, treated, stored or disposed in a manner to allow exposure to storm water between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; method and location of onsite storage or disposal; materials management practices employed to minimize contact of materials with storm water runoff between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; the location and a description of existing structural and nonstructural control measures to reduce pollutants in storm water runoff; and a description of any treatment the storm water receives. This description should also include areas with the potential for deposition of particulate matter from process air emissions or losses during material handling activities. The description shall be updated whenever there is a significant change in the type or quantity of exposed materials, or material management practices, that may affect the exposure of materials to storm water.

(c) Spills and Leaks—A list of significant spills and significant leaks of toxic or hazardous pollutants that occurred at areas that are exposed to precipitation or that otherwise drain to a storm water conveyance at the facility after the date of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit. Such list shall be updated as appropriate during the term of the permit.

(d) Sampling Data—A summary of existing discharge sampling data describing pollutants in storm water discharges from the facility, including a summary of sampling data collected during the term of this permit.

(e) Risk Identification and Summary of Potential Pollutant Sources—A narrative description of the potential pollutant sources from the following activities: loading and unloading operations; outdoor storage activities; outdoor manufacturing or processing activities; significant dust or particulate generating processes occurring indoors or out, with or without pollution control equipment in place to trap particulates; and onsite waste disposal practices. The description shall specifically list any significant potential source of pollutants at the site and for each potential source, any pollutant or pollutant parameter (e.g., chemical oxygen demand, oil and grease, copper, lead, zinc, etc.) of concern, shall be identified.

(3) Measures and Controls. Each facility covered by this permit shall develop a description of storm water management controls appropriate for the facility, and implement such controls. The appropriateness and priorities of controls in a plan shall reflect identified potential sources of pollutants at the facility. The description of storm water management controls shall address the following minimum components, including a schedule for implementing such controls:

(a) Good Housekeeping—Good housekeeping requires the maintenance of areas that may contribute pollutants to storm water discharges in a clean, orderly manner. The pollution prevention plan should consider implementation of the following measures, or equivalent measures, where applicable.

(i) Establish a cleaning or maintenance program for all impervious areas of the facility where particulate matter, dust, or debris may accumulate, particularly areas of material loading/unloading, material storage and handling, and processing.

(ii) Pave areas of vehicle traffic or material storage where vegetative or other stabilization methods are not practical. Institute sweeping programs in these areas as well.

(iii) For unstabilized areas of the facility where sweeping is not practical, storm water management devices such as sediment traps, vegetative buffer strips, filter fabric fence, sediment filtering boom, gravel outlet protection, or other equivalent measures, that effectively trap or remove sediment should be considered.

(b) Source Controls—The permittee shall consider preventive measures to minimize the potential exposure of all significant materials (as described in Part XI.F.3.a.(3) of this section) to precipitation and storm water runoff. The permittee should consider the implementation of the following measures, or equivalent measures, to reduce the exposure of all materials to storm water:

(i) Relocating all materials, including raw materials, intermediate products, material handling equipment, obsolete equipment, and wastes currently stored outside to inside locations.

(ii) Establishment of a schedule for removal of wastes and obsolete equipment to minimize the volume of these materials stored onsite that may be exposed to storm water.

(iii) Substitution of less hazardous materials, or materials less likely to contaminate storm water, or substitution of recyclable materials for nonrecyclables wherever possible.

(iv) Constructing permanent or semipermanent covers, or other similar forms of protection over stockpiled materials, material handling and processing equipment. Options include roofs, tarps, and covers. This may also include the use of containment bins or covered dumpsters for raw materials, waste materials and nonrecyclable waste materials.

(v) Dikes, berms, curbs, trenches, or other equivalent measures to divert runon from material storage, processing, or waste disposal areas.

(c) Preventive Maintenance—A preventive maintenance program shall involve timely inspection and maintenance of storm water management devices (e.g., cleaning oil/water separators, catch basins) as well as inspecting and testing facility equipment and systems to uncover conditions that could cause breakdowns or failures resulting in discharges of pollutants to surface waters, and ensuring appropriate maintenance of such equipment and systems.

(i) A schedule for inspection and maintenance of all particulate emissions control equipment should be established to ensure proper operation. Inspections should be conducted as described in Section XI.F.3.a.(3)(e) below. Detection of any leaks or defects that could lead to excessive emissions shall be repaired as soon as practicable. Where significant settling or deposition from process emissions are observed during proper operation of existing equipment, the permittee shall consider ways to reduce these emissions including but not limited to: upgrading or replacing existing equipment; collecting runoff from areas of deposition for treatment or recycling; or changes in materials or processes to reduce the generation of particulate matter.

(ii) Structural Best Management Practices (BMPs) will be visually inspected for signs of washout, excessive sedimentation, deterioration, damage, or overflowing, and shall be repaired or maintained as soon as practicable.

(d) Spill Prevention and Response Procedures—Areas where potential spills that can contribute pollutants to storm water discharges may occur, and their accompanying drainage points shall be identified clearly in the storm water pollution prevention plan. Where appropriate, specifying material handling procedures, storage

requirements, and use of equipment such as diversion valves in the plan should be considered. Procedures for cleaning up spills shall be identified in the plan and made available to the appropriate personnel. The necessary equipment to implement a clean up should be available to personnel.

(e) Inspections—Qualified facility personnel shall be identified to inspect designated equipment and areas of the facility at appropriate intervals, but no less frequently than once during each of the following periods: January through March; April through June; July through September; and October through December. A set of tracking or follow-up procedures shall be used to ensure that appropriate actions are taken in response to the inspections. Records of inspections shall be maintained. Inspections shall be conducted on a quarterly basis and address, at a minimum, the following areas where applicable:

(i) Air pollution control equipment such as baghouses, electrostatic precipitators, scrubbers, and cyclones, should be inspected on a routine basis for any signs of disrepair such as leaks, corrosion, or improper operation that could limit their efficiency and lead to excessive emissions. The permittee should consider monitoring air flow at inlets and outlets, or equivalent measures, to check for leaks or blockage in ducts. Visual inspections shall be made for corrosion, leaks, or signs of particulate deposition or visible emissions that could indicate leaks.

(ii) All process or material handling equipment such as conveyors, cranes, and vehicles should be inspected for leaks, drips, etc. or for the potential loss of materials.

(iii) Material storage areas such as piles, bins or hoppers for storing coke, coal, scrap, or slag, as well as chemicals stored in tanks or drums, should be examined for signs of material losses due to wind or storm water runoff.

(f) Employee Training—Employee training programs shall inform personnel responsible for implementing activities identified in the storm water pollution prevention plan or otherwise responsible for storm water management at all levels of responsibility of the components and goals of the storm water pollution prevention plan. Training should address topics such as spill response, good housekeeping and material management practices. The pollution prevention plan shall identify periodic dates for such training.

(g) Recordkeeping and Internal Reporting Procedures—A description of incidents (such as spills, or other discharges), along with other information describing the quality and quantity of storm water discharges shall be included in the plan required under this part. Inspections and maintenance activities shall be documented and records of such activities shall be incorporated into the plan.

(h) Non-storm Water Discharges.

(i) Certification. The plan shall include a certification that the discharge has been tested or evaluated for the presence of non-storm water discharges. The certification shall include the identification of potential significant sources of non-storm water at the site, a description of the results of any test and/or evaluation for the presence of non-storm water discharges, the evaluation criteria or testing method used, the date of any testing and/or evaluation, and the onsite drainage points that were directly observed during the test. Certifications shall be signed in accordance with Part VII.G. of this permit. Such certification may not be feasible if the facility operating the storm water discharge associated with industrial activity does not have access to an outfall, manhole, or other point of access to the ultimate conduit that receives the discharge. In such cases, the source identification section of the storm water pollution prevention plan shall indicate why the certification required by this part was not feasible, along with the identification of potential significant sources of non-storm water at the site. A discharger that is unable to provide the certification required by this paragraph must notify the Director in accordance with paragraph XI.F.3.a.(3)(h)(iii) (below).

(ii) Exceptions. Except for flows from fire fighting activities, sources of non-storm water listed in Part III.A.2. (Prohibition of Non-storm Water Discharges) of this permit that are combined with storm water discharges associated with industrial activity must be identified in the plan. The plan shall identify and ensure the implementation of appropriate pollution prevention measures for the non-storm water component(s) of the discharge.

(iii) Failure to Certify—Any facility that is unable to provide the certification required (testing for non-storm water discharges), must notify the Director by [Insert date 270 days after permit issuance] or, for facilities that begin to discharge storm water associated with industrial activity after [Insert 270 days after permit issuance], 180 days after submitting an NOI to be covered by this permit. If the failure to certify is caused by the inability to perform adequate tests or evaluations, such notification shall describe: the procedure of any test conducted for the presence of non-storm water discharges; the results of such test or other relevant observations; potential sources of non-storm water discharges to the storm sewer; and why adequate tests for such storm sewers were not feasible. Non-storm water discharges to waters of the United States that are not authorized by an NPDES permit are unlawful, and must be terminated.

(i) Sediment and Erosion Control—The plan shall identify areas that, due to topography, activities, or other factors, have a high potential for significant soil erosion, and identify structural, vegetative, and/or stabilization measures to be used to limit erosion. The plan shall also contain a narrative consideration of the appropriateness of traditional storm water management practices (practices other than those that control the generation or source(s) of pollutants) used to divert, infiltrate, reuse, or otherwise manage storm water runoff in a manner that reduces pollutants in storm water discharges from the site. The plan shall provide that measures that the permittee determines to be reasonable and appropriate shall be implemented and maintained. The potential of various sources at the facility to contribute pollutants to storm water discharges associated with industrial activity (see paragraph XI.F.3.a.(2) of this section (Description of Potential Pollutant Sources) shall be considered when determining reasonable and appropriate measures. Appropriate measures may include: vegetative swales and practices, reuse of collected storm water (such as for a process or as an irrigation source), inlet controls (such as oil/water separators), snow management activities, infiltration devices, and wet detention/retention devices or other equivalent measures.

(i) Management of Runoff—Facilities shall consider implementation of the following storm water management practices or other equivalent measures to address pollutants of concern:

(i) Vegetative buffer strips, filter fabric fence, sediment filtering boom, or other equivalent measures, that effectively trap or remove sediment prior to discharge through an inlet or catch basin.

(ii) Media filtration such as catch basin filters and sand filters.

(iii) Oil/water separators or the equivalent.

(iv) Structural BMPs such as settling basins, sediment traps, retention or detention ponds, recycling ponds or other equivalent measures.

(4) Comprehensive Site Compliance Evaluation. Qualified personnel shall conduct site compliance evaluations at

appropriate intervals specified in the plan but in no case less than once a year. Such evaluations shall provide:

(a) Areas contributing to a storm water discharge associated with industrial activity such as material storage and handling, loading and unloading, process activities, and plant yards shall be visually inspected for evidence of, or the potential for, pollutants entering the drainage system. Measures to reduce pollutant loadings shall be evaluated to determine whether they are adequate and properly implemented in accordance with the terms of the permit or whether additional control measures are needed. Structural storm water management measures, sediment and erosion control measures, other structural pollution prevention measures identified in the plan, as well as process related pollution control equipment shall be observed or tested to ensure that they are operating correctly. A visual inspection of equipment needed to implement the plan, such as spill response equipment, shall be made.

(b) Based on the results of the evaluation, the description of potential pollutant sources identified in the plan in accordance with paragraph XI.F.3.a.(2) of this section (Description of Potential Pollutant Sources) and pollution prevention measures and controls identified in the plan in accordance with paragraph XI.F.3.a.(3) of this section (Measures and Controls) shall be revised as appropriate within 2 weeks of such evaluation and shall provide for implementation of any changes to the plan in a timely manner, but in no case more than 12 weeks after the evaluation.

(c) A report summarizing the scope of the evaluation, personnel making the evaluation, the date(s) of the evaluation, major observations relating to the implementation of the storm water pollution prevention plan, and actions taken in accordance with paragraph XI.F.3.a.(4)(b) (above) of the permit shall be made and retained as part of the storm water pollution prevention plan for at least 3 years from the date of the evaluation. The report shall identify any incidents of noncompliance. Where a report does not identify any incidents of noncompliance, the report shall contain a certification that the facility is in compliance with the storm water pollution prevention plan and this permit. The report shall be signed in accordance with Part VII.G. (Signatory Requirements) of this permit.

(d) Where compliance evaluation schedules overlap with inspections required under 3.a.(3)(e), the compliance evaluation may be conducted in place of one such inspection.

4. Numeric Effluent Limitations

There are no additional effluent limitations beyond those described in Part V.B. of this permit.

5. Monitoring and Reporting Requirements

a. Analytical Monitoring Requirements. During the period beginning [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] and the period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance], permittees with primary metals facilities identified by SIC codes 331, 332, 335, and 336 must monitor their storm water discharges associated with industrial activity at least quarterly (4 times per year during the second and fourth year of coverage) except as provided in paragraphs 5.a.(3) (Sampling Waiver), 5.a.(4) (Representative Discharge), and 5.a.(5) (Alternative Certification). Primary metals facilities are required to monitor their storm water discharges for the pollutants of concern listed in Tables F–1, F–2, F–3, and F–4 below. Facilities must report in accordance with 5.b. (Reporting). In addition to the parameters listed in Tables F–1 through F–4 below, the permittee shall provide the date and duration (in hours) of the storm event(s) sampled; rainfall measurements or estimates (in inches) of the storm event that generated the sampled runoff; the duration between the storm event sampled and the end of the previous measurable (greater than 0.1 inch rainfall) storm event; and an estimate of the total volume (in gallons) of the discharge sampled.

TABLE F–1.—STEEL WORKS, BLAST FURNACES, AND ROLLING AND FINISHING MILLS (SIC 331) MONITORING REQUIREMENTS

Pollutants of concern	Monitoring cut-off concentration
Total Recoverable Aluminum	0.75 mg/L
Total Recoverable Zinc	0.117 mg/L

TABLE F–2.—IRON AND STEEL FOUNDRIES (SIC 332) MONITORING REQUIREMENTS

Pollutants of concern	Monitoring cut-off concentration
Total Recoverable Aluminum	0.75 mg/L
Total Suspended Solids	100 mg/L
Total Recoverable Copper	0.0636 mg/L
Total Recoverable Iron	1 mg/L
Total Recoverable Zinc	0.117 mg/L

TABLE F–3.—ROLLING, DRAWING, AND EXTRUDING OF NON-FERROUS METALS (SIC 335) MONITORING REQUIREMENTS

Pollutants of concern	Monitoring cut-off concentration
Total Recoverable Copper	0.0636 mg/L
Total Recoverable Zinc	0.117 mg/L

TABLE F–4.—NON-FERROUS FOUNDRIES (SIC 336) MONITORING REQUIREMENTS

Pollutants of concern	Monitoring cut-off concentration
Total Recoverable Copper	0.0636 mg/L
Total Recoverable Zinc	0.117 mg/L

(1) Monitoring Periods. Primary metals facilities shall monitor samples collected during the sampling periods of: January through March, April through June, July through September, and October through December for the years specified in paragraph a. (above).

(2) Sample Type. A minimum of one grab sample shall be taken. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The required 72-hour storm event interval is waived where the preceding measurable storm event did not result in a measurable discharge from the facility. The required 72-hour storm event internal may also be waived where the permittee documents that less than a 72-hour interval is representative for local storm events during the season when sampling is being conducted. The grab sample shall be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why

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a grab sample during the first 30 minutes was impracticable. If storm water discharges associated with industrial activity commingle with process or nonprocess water, then where practicable permittees must attempt to sample the storm water discharge before it mixes with the non-storm water discharge.

(3) Sampling Waiver.

(a) Adverse Conditions—When a discharger is unable to collect samples within a specified sampling period due to adverse climatic conditions, the discharger shall collect a substitute sample from a separate qualifying event in the next period and submit the data along with data for the routine sample in that period. Adverse weather conditions that may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(b) Low Concentration Waiver—When the average concentration for a pollutant calculated from all monitoring data collected from an outfall during the monitoring period [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] is less than the corresponding value for that pollutant listed in Table F-1 under the column Monitoring Cut-off Concentration, a facility may waive monitoring and reporting requirements in the monitoring period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance]. The facility must submit to the Director, in lieu of the monitoring data, a certification that there has not been a significant change in industrial activity or the pollution prevention measures in area of the facility that drains to the outfall for which sampling was waived.

(c) When a discharger is unable to conduct quarterly chemical storm water sampling at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirements as long as the facility remains inactive and unstaffed. The facility must submit to the Director, in lieu of monitoring data, a certification statement on the DMR stating that the site is inactive and unstaffed so that collecting a sample during a qualifying event is not possible.

(4) Representative Discharge. When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may test the effluent of one of such outfalls and report that the quantitative data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan. The permittee shall include the description of the location of the outfalls, explanation of why outfalls are expected to discharge substantially identical effluents, and estimate of the size of the drainage area and runoff coefficient with the Discharge Monitoring Report.

(5) Alternative Certification. A discharger is not subject to the monitoring requirements of this section provided the discharger makes a certification for a given outfall or on a pollutant-by-pollutant basis in lieu of monitoring reports required under paragraph *(b)* below, under penalty of law, signed in accordance with Part VII.G. (Signatory Requirements), that material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, industrial machinery or operations, or significant materials from past industrial activity that are located in areas of the facility within the drainage area of the outfall are not presently exposed to storm water and are not expected to be exposed to storm water for the certification period. Such certification must be retained in the storm water pollution prevention plan, and submitted to EPA in accordance with Part VI.C. of this permit. In the case of certifying that a pollutant is not present, the permittee must submit the certification along with the monitoring reports required under paragraph *(b)* below. If the permittee cannot certify for an entire period, they must submit the date exposure was eliminated and any monitoring required up until that date. The certification option is not applicable to compliance monitoring requirements associated with effluent limitations.

b. Reporting. Permittees with primary metals facilities shall submit monitoring results for each outfall associated with industrial activity [or a certification in accordance with Sections (3), (4), or (5) above] obtained during the reporting period beginning [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] on Discharge Monitoring Report Form(s) postmarked no later than the 31st day of the following March [insert the date 2 years after permit issuance]. Monitoring results [or a certification in accordance with Sections (3), (4), or (5) above] obtained during the period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance] shall be submitted on Discharge Monitoring Report Form(s) postmarked no later than the 31st day of the following March. For each outfall, one Discharge Monitoring Report Form must be submitted per storm event sampled. Signed copies of Discharge Monitoring Reports, or said certifications, shall be submitted to the Director of the NPDES program at the address of the appropriate Regional Office listed in Part VI.G. of the fact sheet.

(1) Additional Notification. In addition to filing copies of discharge monitoring reports in accordance with paragraph b (above), primary metals facilities with at least one storm water discharge associated with industrial activity through a large or medium municipal separate storm sewer system (systems serving a population of 100,000 or more) must submit signed copies of discharge monitoring reports to the operator of the municipal separate storm sewer system in accordance with the dates provided in paragraph b (above).

c. Quarterly Visual Examination of Storm Water Quality. Facilities shall perform and document a visual examination of a storm water discharge associated with industrial activity from each outfall, except discharges exempted below. The examination must be made at least once in each designated period [described in *(1)* below] during daylight hours unless there is insufficient rainfall or snow melt to produce a runoff event.

(1) Examinations shall be conducted in each of the following periods for the purposes of visually inspecting storm water quality associated with storm water runoff or snow melt: January through March; April through June; July through September; and October through December.

(2) Examinations shall be made of samples collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 1 hour) of when the runoff or snow melt begins discharging. The examinations shall

document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on the samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. Where practicable, the same individual should carry out the collection and examination of discharges for entire permit term.

(3) Visual examination reports must be maintained onsite in the pollution prevention plan. The report shall include the examination date and time, examination personnel, the nature of the discharge (i.e., runoff or snow melt), visual quality of the storm water discharge (including observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution), and probable sources of any observed storm water contamination.

(4) When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may collect a sample of effluent of one of such outfalls and report that the examination data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan, a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

(5) When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the records of the visual examination. Adverse weather conditions that may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (e.g., drought, extended frozen conditions, etc.).

(6) When a discharger is unable to conduct visual storm water examinations at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirement as long as the facility remains inactive and unstaffed. The facility must maintain a certification with the pollution prevention plan stating that the site is inactive and unstaffed so that performing visual examinations during a qualifying event is not feasible.

G. Storm Water Discharges Associated With Industrial Activity From Metal Mining (Ore Mining and Dressing) Facilities

1. Discharges Covered Under This Section

The requirements listed under this section shall apply to storm water discharges from active and inactive metal mining and ore dressing facilities (Standard Industrial Classification (SIC) Major Group 10) if the storm water has come into contact with, or is contaminated by, any overburden, raw material, intermediate product, finished product, byproduct, or waste product located on the site of the operation. SIC Major Group 10 includes establishments primarily engaged in mining, developing mines, or exploring for metallic minerals (ores) and also includes all ore dressing and beneficiating operations, whether performed at mills operated in conjunction with the mines served or at mills, such as custom mills, operated separately. For the purposes of this part of the permit, the term "metal mining" includes all ore mining and/or dressing and beneficiating operations, whether performed at mills operated in conjunction with the mines served or at mills, such as custom mills, operated separately. All storm water discharges from inactive metal mining facilities and the storm water discharges from the following areas of active, and temporarily inactive, metal mining facilities are the only discharges covered by this section of the permit: topsoil piles; offsite haul/access roads if off active area; onsite haul roads if not constructed of waste rock or if spent ore and mine water is not used for dust control; runoff from tailings dams/dikes when not constructed of waste rock/tailings and no process fluids are present; concentration building, if no contact with material piles; mill site, if no contact with material piles; chemical storage area; docking facility, if no excessive contact with waste product; explosive storage; reclaimed areas released from reclamation bonds prior to December 17, 1990; and partially/inadequately reclaimed areas or areas not released from reclamation bonds.

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

a. Limitations on Coverage. The following storm water discharges associated with industrial activity are not authorized by this permit:

(1) Discharges from active metal mining facilities that are subject to the effluent limitation guidelines for the Ore Mining and Dressing Point Source Point Source Category (40 CFR Part 440). Coverage under this permit does not include adit drainage or contaminated springs or seeps at active facilities, temporarily inactive facilities, or inactive facilities. Also see Limitations on Coverage, Part I.B.3.

(2) Storm water discharges associated with an industrial activity that the Director (EPA) has determined to be, or may reasonably be expected to be, contributing to a violation of a water quality standard.

(3) Storm water discharges associated with industrial activity from inactive mining operations occurring on Federal lands where an operator cannot be identified.

2. Special Definitions

The following definitions are only for this section of today's permit and are not intended to supersede the definitions of active and inactive mining facilities established by 40 CFR 122.26(b)(14)(iii):

"Active Metal Mining Facility" is a place where work or other related activity to the extraction, removal, or recovery of metal ore is being

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conducted. With respect to surface mines, an "active metal mining facility" does not include any area of land on or in which grading has been completed to return the earth to a desired contour and reclamation work has begun.

"Inactive Metal Mining Facility" means a site or portion of a site where metal mining and/or milling activities occurred in the past but is not an active metal mining facility, as defined in this permit and that portion of the facility does not have an active mining permit issued by the applicable (federal or state) governmental agency.

"Temporarily Inactive Metal Mining Facility" means a site or portion of a site where metal mining and/or milling activities occurred in the past, but currently are not being actively undertaken, and the facility has an active mining permit issued by the applicable (federal or state) government agency that authorizes mining at the site.

3. Storm Water Pollution Prevention Plan Requirements

a. Contents of Plan for Active and Temporarily Inactive Metal Mining Facilities. The plan shall include, at a minimum, the following items:

(1) Pollution Prevention Team. Identification of a specific individual or individuals within the facility organization as members of a storm water Pollution Prevention Team that are responsible for developing the storm water pollution prevention plan and assisting the facility or plant manager in its implementation, maintenance, and revision. The plan shall clearly identify the responsibilities of each team member. The activities and responsibilities of the team shall address all aspects of the facility's storm water pollution prevention plan.

(2) Description of Mining Activities. A description of the mining and associated activities taking place at the site that affect or may affect storm water runoff intended to be covered by this permit. The description shall report the total acreage within the mine site, an estimate of the number of acres of disturbed land and an estimate of the total amount of land proposed to be disturbed throughout the life of the mine. A general description of the location of the mining site relative to major transportation routes and communities shall also be provided.

(3) Description of Potential Pollutant Sources. A description of potential sources that may reasonably be expected to add significant amounts of pollutants (including sediment) to storm water discharges or that may result in the discharge of pollutants during dry weather. Each description shall identify all activities and significant materials that may potentially be significant storm water pollutant sources from the active mining activity (see Part XI.G.1.), including, at a minimum:

(a) Drainage.

(i) A site topographic map that indicates, at a minimum: mining/milling site boundaries and access and haul roads; the location of each storm water outfall and an outline of the portions of the drainage area that are within the facility boundaries; equipment storage, fueling and maintenance areas; materials handling areas; storage areas for chemicals and explosives; areas used for storage of overburden, materials, soils or wastes; location of mine drainage (where water leaves mine) or any other process water; tailings piles/ponds, both proposed and existing; heap leach pads; points of discharge from the property for mine drainage or any other process water; springs, streams, wetlands and other surface waters; and boundary of tributary areas that are subject to effluent limitations guidelines. In addition, the map must indicate the types of discharges contained in the drainage areas of the outfalls.

(ii) Prediction of the direction of flow, and identification of the types of pollutants (e.g., heavy metals, sediment) that are likely to be present in storm water discharges associated with industrial activity, for each area of the mine/mill site that generates storm water discharges associated with industrial activity with a reasonable potential for containing significant amounts of pollutants. Factors to consider include the mineralogy of the ore and waste rock (e.g., acid forming), toxicity and quantity of chemical(s) used, produced or discharged; the likelihood of contact with storm water; vegetation on site if any, and history of significant leaks or spills of toxic or hazardous pollutants. Flows with a significant potential for causing erosion shall be identified.

(b) Inventory of Exposed Materials—An inventory of the types of materials handled at the site that potentially may be exposed to precipitation for each storm water outfall that may be covered under this permit (see Part XI.G.1.). Such inventory shall include a narrative description of: significant materials that have been handled, treated, stored or disposed in a manner to allow exposure to storm water between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; method and location of onsite storage or disposal; materials management practices employed to minimize contact of materials with storm water runoff between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; the location and a description of existing structural and nonstructural control measures to reduce pollutants in storm water runoff; and a description of any treatment the storm water receives. The inventory of exposed materials shall include, but shall not be limited to the significant materials stored exposed to storm water, and material management practices employed that were listed for the facility in the approved group application.

A summary of any existing ore or waste rock/overburden characterization data, including results of testing for acid rock generation potential. If the ore or waste rock/overburden characterization data is updated due to a change in the ore type being mined, the storm water pollution prevention plan shall be updated with the new data.

(c) Spills and Leaks—A list of significant spills and significant leaks of toxic or hazardous pollutants that occurred at areas that are exposed to precipitation or that otherwise drain to a storm water conveyance at the facility after the date of 3 years prior to the date of submission of a Notice of Intent (NOI) to be covered under this permit. Such list shall be updated as appropriate during the term of the permit.

(d) Sampling Data—A summary of existing discharge sampling data describing pollutants in storm water discharges from the facility, including a summary of sampling data collected during the term of this permit.

(e) Risk Identification and Summary of Potential Pollutant Sources—A narrative description of the potential pollutant sources from the following activities associated with metal mining: loading and unloading operations; outdoor storage activities; outdoor manufacturing or processing activities; significant dust or particulate generating processes; and onsite waste disposal practices. The description shall specifically list any significant potential source of pollutants at the site and for each potential source, any pollutant or pollutant parameter (e.g., heavy metals, etc.) of concern shall be identified.

(4) Measures and Controls. A description of storm water management controls appropriate for the facility, and procedures for implementing such controls. The appropriateness and priorities of controls in a plan shall reflect identified potential sources of pollutants at the facility. The description of storm water management

controls shall address the following minimum components, including a schedule for implementing such controls:

(a) Good Housekeeping—Good housekeeping such as maintenance in a clean, orderly manner of areas that may contribute pollutants to storm water discharges. (For suggested measures for vehicle maintenance operations, see good housekeeping measures specified in Part XI.P. for transportation facilities.)

(b) Preventive Maintenance—A narrative describing the program for timely inspection and maintenance of storm water management devices (e.g., cleaning oil/water separators, catch basins) as well as inspection and testing of facility equipment and systems to uncover conditions that could cause breakdowns or failures resulting in discharges of pollutants to surface waters, and ensuring appropriate maintenance of such equipment and systems. Particular attention shall be given to erosion control and sediment control systems and devices.

(c) Spill Prevention and Response Procedures—Areas where potential spills that can contribute pollutants to storm water discharges, and their accompanying drainage points. The description area shall include, where appropriate, specific material handling procedures, storage requirements, and use of equipment such as diversion valves in the plan should be considered; procedures for cleaning up spills and the method for making these plans and the necessary equipment to implement a clean up available to the appropriate personnel.

(d) Inspections—Provisions for qualified personnel to inspect designated equipment and mine areas at least on a monthly basis for active sites. The monthly inspections can be done at any time during the month and do not have to be done immediately following a precipitation event. For temporarily inactive sites, the inspections should be quarterly; however, inspections are not required when adverse weather conditions (e.g., snow) make the site inaccessible. All material handling areas shall be inspected for evidence of, or the potential for, pollutants entering the drainage system. Erosion control systems and sediment control devices shall also be inspected to determine if they are working properly. A set of tracking or follow-up procedures shall be used to ensure that appropriate actions are taken in response to the inspections. Records of inspections shall be maintained. The use of a checklist developed by the facility is encouraged.

(e) Employee Training—Outlines of employee training programs that inform personnel responsible for implementing activities identified in the storm water pollution prevention plan or otherwise responsible for storm water management at all levels of responsibility of the components and goals of the storm water pollution prevention plan. Training should address topics such as spill response, good housekeeping, and material management practices. The pollution prevention plan shall specify how often training shall take place, but in all cases training must be held at least annually (once per calendar year).

(f) Recordkeeping and Internal Reporting Procedures—Descriptions of incidents (such as spills, major storm events, or other discharges), as well as information describing the quality and quantity of storm water discharges. Inspections, maintenance activities, and training sessions shall also be documented and records of such activities shall be incorporated into the plan.

(g) Non-storm Water Discharges.

(i) A certification that any discharge has been tested or evaluated for the presence of non-storm water discharges, such as seeps or adit discharges or discharges subject to effluent limitation guidelines (e.g., 40 CFR Part 440), such as mine drainage or process water of any kind. The certification shall include the identification of potential significant sources of non-storm water or water subject to effluent limitation guidelines at the site, a description of the results of any test and/or evaluation for the presence of non-storm water discharges, the evaluation criteria or testing method used, the date of any testing and/or evaluation, and the onsite drainage points that were directly observed during the test. Certifications shall be signed in accordance with Part VII.G. of this permit. Such certification may not be feasible if the facility operating the storm water discharge associated with industrial activity does not have access to an outfall, manhole, or other point of access to the ultimate conduit that receives the discharge. In such cases, the source identification section of the storm water pollution prevention plan shall indicate why the certification required by this part was not feasible, along with the identification of potential significant sources of non-storm water at the site. A discharger that is unable to provide the certification required by this paragraph must notify the Director in accordance with paragraph XI.G.3.a.(4)(g)(iii) (below).

Alternatively, the plan may include a certification that any non-storm water discharge that mixes with storm water is subject to a separate NPDES permit that applies applicable effluent limitations prior to the mixing of non-storm water and storm water. In such cases, the certification shall identify the non-storm water discharge(s), the applicable NPDES permit(s), the effluent limitations placed on the non-storm water discharge by the NPDES permit(s), and the point(s) at which the limitations are applied.

(ii) Except for flows from fire fighting activities, sources of non-storm water listed in Part III.A.2 (Prohibition of Non-storm Water Discharges) of this permit that are combined with storm water discharges associated with industrial activity must be identified in the plan. The plan shall identify and ensure the implementation of appropriate pollution prevention measures for the non-storm water component(s) of the discharge.

(iii) Failure to Certify—Any facility that is unable to provide the certification required (testing for non-storm water discharges), must notify the Director by [Insert date 270 days after permit issuance] or, for facilities that begin to discharge storm water associated with industrial activity after [Insert date 270 days after permit issuance], 180 days after submitting an NOI to be covered by this permit. If the failure to certify is caused by the inability to perform adequate tests or evaluations, such notification shall describe: the procedure of any test conducted for the presence of non-storm water discharges; the results of such test or other relevant observations; potential sources of non-storm water discharges to the storm sewer; and why adequate tests for such storm sewers were not feasible. Non-storm water discharges to waters of the United States that are not authorized by an NPDES permit are unlawful, and must be terminated.

(h) Sediment and Erosion Control—Identification of areas that, due to topography, activities, or other factors, have a high potential for significant erosion of soil and/or other materials, and measures to be used to limit erosion and/or remove sediment from storm water runoff. The measures to consider include diversion of flow away from areas susceptible to erosion (such as interceptor dikes and swales; diversion dikes curbs and berms; pipe slope drains; subsurface drains; and drainage/storm water conveyance systems [channels or gutters; open top box culverts, and waterbars; rolling dips and road sloping; roadway surface water deflector; and culverts]), stabilization methods to prevent or minimize erosion (such as temporary or permanent seeding; vegetative buffer strips; protection of trees; topsoiling; soil

conditioning; contouring; mulching; geotextiles [matting; netting; or blankets]; riprap; gabions; and retaining walls), and structural methods for controlling sediment (such as check dams; rock outlet protection; level spreaders; gradient terraces; straw bale barriers; silt fences; gravel or stone filter berms; brush barriers; sediment traps; grass swales; pipe slope drains; earth dikes; other controls such as entrance stabilization, waterway crossings or wind breaks; or other equivalent measures).

(i) Management of Runoff—A narrative consideration of the appropriateness of traditional storm water management practices (practices other than those that control the generation or source(s) of pollutants) used to divert, infiltrate, reuse, or otherwise manage storm water runoff in a manner that reduces pollutants in storm water discharges from the site and provisions for implementation and maintenance of measures that the permittee determines to be reasonable and appropriate. The potential of various sources at the facility to contribute pollutants to storm water discharges associated with industrial activity [see paragraph XI.G.3.a.(3) of this section (Description of Potential Pollutant Sources)] shall be considered when determining reasonable and appropriate measures. Appropriate measures may include: vegetative swales and practices, reuse of collected storm water (such as for a process or as an irrigation source), inlet controls (such as oil/water separators), snow management activities, infiltration devices, and wet detention/retention devices, or impoundments.

(i) Capping—Where capping of a contaminant source is necessary, the source being capped and materials and procedures used to cap the contaminant source must be identified. In some cases, the elimination of a pollution source through capping contaminant sources may be the most effective control measure for discharges from inactive ore mining and dressing facilities.

(k) Treatment—A description of how storm water will be treated prior to discharging to waters of the United States if treatment of a storm water discharge is necessary. Storm water treatments include the following: chemical/physical treatment; oil/water separators; and artificial wetlands.

(5) Comprehensive Site Compliance Evaluation. Procedures for qualified personnel to conduct site compliance evaluations at appropriate intervals specified in the plan, but in no case less than once a year. Such evaluations shall include:

(a) Visual inspections of areas contributing to a storm water discharge associated with industrial activity for evidence of, or the potential for, pollutants entering the drainage system. Measures to reduce pollutant loadings shall be evaluated to determine whether they are adequate and properly implemented in accordance with the terms of the permit or whether additional control measures are needed. Structural storm water management measures, sediment and erosion control measures, and other structural pollution prevention measures identified in the plan shall be observed to ensure that they are operating correctly. A visual inspection of equipment needed to implement the plan, such as spill response equipment, shall be made.

(b) Based on the results of the evaluation, the description of potential pollutant sources identified in the plan in accordance with paragraph XI.G.3.a.(3) of this section (Description of Potential Pollutant Sources) and pollution prevention measures and controls identified in the plan in accordance with paragraph XI.G.3.a.(4) of this section (Measures and Controls) shall be revised as appropriate within 30 days of such inspection and shall provide for implementation of any changes to the plan in a timely manner, but in no case more than 12 weeks after the evaluation unless additional time is authorized by the permit issuing authority.

(c) Preparation of a report summarizing the scope of the evaluation, personnel making the evaluation, the date(s) of the evaluation, major observations relating to the implementation of the storm water pollution prevention plan, and actions taken in accordance with paragraph XI.G.3.a.(5)(b) (above) of the permit shall be made and retained as part of the storm water pollution prevention plan for at least 3 years after the date of the evaluation. The report shall identify any incidents of noncompliance. Where a report does not identify any incidents of noncompliance, the report shall contain a certification that the facility is in compliance with the storm water pollution prevention plan and this permit. The report shall be signed in accordance with Part VII.G. (Signatory Requirements) of this permit.

(d) Where compliance evaluation schedules overlap with inspections required under XI.G.3.a.(4)(d), the compliance evaluation may be conducted in place of one such inspection.

b. Contents of Plan for Inactive Metal Mining Facilities. The plan shall include, at a minimum, the following items:

(1) Pollution Prevention Team. Identification of a specific individual or individuals that are responsible for the development, implementation, maintenance, and revision of the storm water pollution prevention plan. The plan shall clearly identify the responsibilities of each team member. The activities and responsibilities of the team shall address all aspects of the storm water pollution prevention plan at the inactive facility.

(2) Description of Mining Activities. A description of the mining and associated activities that took place at the site. The description shall report the approximate dates of operation, the total acreage within the mine and/or processing site, an estimate of the number of acres of disturbed area, and the current activities (e.g., reclamation) that are taking place at the facility. A general description of the location of the mining site relative to major transportation routes and communities shall also be provided.

(3) Description of Potential Pollutant Sources. A description of potential sources that may reasonably be expected to add significant amounts of pollutants (including sediment) to storm water discharges or that may result in the discharge of pollutants during dry weather from separate storm sewers draining the facility. Each plan shall identify all activities and significant materials that may potentially be significant storm water pollutant sources form the inactive mining site. Each description shall include, at a minimum:

(a) Site Map—A generalized site map or maps that depict any of the following that may be applicable: mining/milling site boundaries and access and haul roads; the location of each storm water outfall and an outline of the portions of the drainage area that are within the facility boundaries; areas used for storage of overburden, materials, soils, tailings, or wastes; areas used for outdoor manufacturing, storage, or disposal of materials; any remaining equipment storage, fueling, and maintenance ares; tailings piles/ponds; mine drainage or any other process water discharge points; an estimate of the direction(s) of flow; existing structural controls to reduce pollutants in storm water runoff; and springs, streams, wetlands, and other surface waters. The map must also indicate the types of discharges contained in the drainage areas of the outfalls.

(b) Inventory of Exposed Materials—An inventory and narrative description

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for each outfall of any significant materials that may still be at the site. This description of sources should agree with sources identified on the map.

(c) Sampling Data—A summary of existing discharge sampling data describing pollutants in storm water discharges from the facility, including a summary of sampling data collected during the term of this permit.

(d) Risk Identification and Summary of Potential Pollutant Sources—For each potential pollutant source at the site the pollutants of concern (e.g., heavy metals) shall be identified and an assessment made of the potential of these pollutant sources to contribute pollutants to storm water discharges.

(4) Measures and Controls. A description of storm water management controls appropriate for the facility, and procedures for implementing such controls. The appropriateness and priorities of controls in a plan shall reflect identified potential sources of pollutants at the facility. The description of storm water management controls shall address the following minimum components, including a schedule for implementing such controls:

(a) Storm Water Diversion—Description of how and where storm water will be diverted away from potential pollutant sources to prevent storm water contamination. Storm water diversions may include the following: interceptor dikes and swales; diversion dikes curbs and berms; pipe slope drains; subsurface drains; drainage/storm water conveyance systems (channels or gutters; open top box culverts, and waterbars; rolling dips and road sloping; roadway surface water deflector; and culverts) or equivalent measures.

(b) Sediment and Erosion Control—Identification of areas that, due to topography, activities, or other factors, have a high potential for significant erosion of soil and/or other materials, and measures to be used to limit erosion and/or remove sediment from storm water runoff. The measures to consider include diversion of flow away from areas susceptible to erosion, stabilization methods to prevent or minimize erosion (such as temporary or permanent seeding; vegetative buffer strips; protection of trees; topsoiling; soil conditioning; contouring; mulching; geotextiles (matting; netting; or blankets); riprap; gabions; and retaining walls), structural methods for controlling sediment (such as check dams; rock outlet protection; level spreaders; gradient terraces; straw bale barriers; silt fences; gravel or stone filter berms; brush barriers; sediment traps; grass swales; pipe slope drains; earth dikes; and other controls such as entrance stabilization, waterway crossings or wind breaks; or other equivalent measures).

(c) Management of Runoff—A narrative consideration of the appropriateness of traditional storm water management practices (practices other than those that control the generation or source(s) of pollutants) used to divert, infiltrate, reuse, or otherwise manage storm water runoff in a manner that reduces pollutants in storm water discharges from the site and provisions for implementation and maintenance of measures that the permittee determines to be reasonable and appropriate. The potential of various sources at the facility to contribute pollutants to storm water discharges associated with industrial activity [see paragraph XI.G.3.b.(3) of this section (Description of Potential Pollutant Sources)] shall be considered when determining reasonable and appropriate measures. Appropriate measures may include: vegetative swales and practices, reuse of collected storm water (such as for a process or as an irrigation source), inlet controls, snow management activities, infiltration devices, and wet detention/retention devices, or impoundments.

(d) Capping—Where capping of a contaminant source is necessary, the source being capped and materials and procedures used to cap the contaminant source must be identified. In some cases, the elimination of a pollution source through capping contaminant sources may be the most effective control measure for discharges from inactive ore mining and dressing facilities.

(e) Treatment—A description of how storm water will be treated prior to discharging to waters of the United States if treatment of a storm water discharge is necessary. Storm water treatments include the following: chemical/physical treatment; oil/water separators; artificial wetlands or other equivalent measures.

(f) Recordkeeping and Internal Reporting Procedures—A description of incidents (such as spills, or other discharges), as well as information describing the quality and quantity of storm water discharges shall be included in the plan required under this part. Inspections and maintenance activities shall be documented and records of such activities shall be incorporated into the plan.

(5) Comprehensive Site Compliance Evaluation. Procedures for qualified personnel to conduct site compliance evaluations at appropriate intervals specified in the plan, but, except as provided in paragraph XI.G.3.b.(5)(d) (below), in no case less than once a year. Such evaluations shall include:

(a) Visual inspection of areas contributing to a storm water discharge associated with industrial activity for evidence of, or the potential for, pollutants entering the drainage system. Measures to reduce pollutant loadings shall be evaluated to determine whether they are adequate and properly implemented in accordance with the terms of the permit or whether additional control measures are needed. Structural storm water management measures, sediment and erosion control measures, and other structural pollution prevention measures identified in the plan shall be observed to ensure that they are operating correctly. A visual inspection of equipment needed to implement the plan, such as spill response equipment, shall be made.

(b) Based on the results of the evaluation, the description of potential pollutant sources identified in the plan in accordance with paragraph XI.G.3.a.(3) of this section (Description of Potential Pollutant Sources) and pollution prevention measures and controls identified in the plan in accordance with paragraph XI.G.3.a.(4) of this section (Measures and Controls) shall be revised as appropriate within 30 days of such inspection and shall provide for implementation of any changes to the plan in a timely manner, but in no case more than 12 weeks after the evaluation unless additional time is authorized by the permit issuing authority.

(c) Preparation of a report summarizing the scope of the evaluation, personnel making the evaluation, the date(s) of the evaluation, major observations relating to the implementation of the storm water pollution prevention plan, and actions taken in accordance with paragraph XI.G.3.b.(5)(b) (above) of the permit shall be made and retained as part of the storm water pollution prevention plan for at least 3 years after the date of the evaluation. The report shall identify any incidents of noncompliance. Where a report does not identify any incidents of noncompliance, the report shall contain a certification that the facility is in compliance with the storm water pollution prevention plan and this permit. The report shall be signed in accordance with Part VII.G. (Signatory Requirements) of this permit.

(d) Where annual site compliance evaluations are shown in the plan to be impractical for inactive mining sites due to the remote location and inaccessibility of the site, site

evaluations required under this part shall be conducted at appropriate intervals specified in the plan, but, in no case less than once in 3 years.

4. Numeric Effluent Limitations

There are no additional numeric effluent limitations beyond those described in Part V.B of this permit.

5. Monitoring and Reporting Requirements

a. Analytical Monitoring Requirements. During the period beginning [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] and the period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance], copper ore mining and dressing facilities must monitor their storm water discharges associated with industrial activity at least quarterly (4 times per year) during years 2 and 4 except as provided in paragraphs 5.a.(3) (Sampling Waiver), 5.a.(4) (Representative Discharge), and 5.a.(5) (Alternative Certification). Active copper ore mining and dressing facilities are required to monitor their storm water discharges for the pollutants of concern listed in Table G-1 below. Facilities must report in accordance with 5.b. (Reporting). In addition to the parameters listed in Table G-1 below, the permittee shall provide the date and duration (in hours) of the storm event(s) sampled; rainfall measurements or estimates (in inches) of the storm event that generated the sampled runoff; the duration between the storm event sampled and the end of the previous measurable (greater than 0.1 inch rainfall) storm event; and an estimate of the total volume (in gallons) of the discharge sampled.

TABLE G–1.—MONITORING REQUIREMENTS FOR ACTIVE FACILITIES

Pollutants of concern	Monitoring cut-off concentration
Chemical Oxygen Demand (COD).	120 mg/L
Total Suspended Solids (TSS)	100 mg/L
Nitrate plus Nitrite Nitrogen	0.68 mg/L

(1) Monitoring Periods. Active copper ore mining and dressing facilities shall monitor samples collected during the sampling periods of: January through March, April through June, July through September, and October through December for the years specified in paragraph a. (above).

(2) Sample Type. A minimum of one grab sample shall be taken. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The required 72-hour storm event interval is waived where the preceding measurable storm event did not result in a measurable discharge from the facility. The required 72-hour storm event interval may also be waived where the permittee documents that less than a 72-hour interval is representative for local storm events during the season when sampling is being conducted. The grab sample shall be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable. If storm water discharges associated with industrial activity commingle with process or non-process water, then where practicable permittees must attempt to sample the storm water discharge before it mixes with the non-storm water discharge.

(3) Sampling Waiver.

(a) Adverse Conditions—When a discharger is unable to collect samples within a specified sampling period due to adverse climatic conditions, the discharger shall collect a substitute sample from a separate qualifying event in the next period and submit the data along with data for the routine sample in that period. Adverse weather conditions that may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(b) Low Concentration Waiver—When the average concentration for a pollutant calculated from all monitoring data collected from an outfall during the monitoring period [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] is less than the corresponding value for that pollutant listed in Table G-1 under the column Monitoring Cut-off Concentration, a facility may waive monitoring and reporting requirements in the monitoring period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance]. The facility must submit to the Director, in lieu of the monitoring data, a certification that there has not been a significant change in industrial activity or the pollution prevention measures in area of the facility that drains to the outfall for which sampling was waived.

(4) Representative Discharge. When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may test the effluent of one of such outfalls and report that the quantitative data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan. The permittee shall include the description of the location of the outfalls, explanation of why outfalls are expected to discharge substantially identical effluents, and estimate of the size of the drainage area and runoff coefficient with the Discharge Monitoring Report.

(5) Alternative Certification. A discharger is not subject to the monitoring requirements of this section provided the discharger makes a certification for a given outfall, or on a pollutant-by-pollutant basis in lieu of the monitoring reports required under paragraph *b* below, under penalty of law, signed in accordance with Part VII.G. (Signatory Requirements), that material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, industrial machinery or operations, or significant materials from past industrial activity that are located in areas of the facility within the drainage area of the outfall are not presently exposed to storm water and are not expected to be exposed to storm water for the certification period. Such certification must be retained in the storm water pollution prevention plan, and submitted to EPA in accordance with Part VI.C. of this permit. In the case of certifying that a pollutant is not present, the permittee must submit the certification along with the monitoring reports required under

paragraph *b.* below. If the permittee cannot certify for an entire period, they must submit the date exposure was eliminated and any monitoring required up until that date. This certification option is not applicable to compliance monitoring requirements associated with effluent limitations.

b. Reporting. Permittees with active copper ore mining and dressing facilities shall submit monitoring results for each outfall associated with industrial activity [or a certification in accordance with Sections (3), (4), or (5) above] obtained during the reporting period beginning [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] on Discharge Monitoring Report Form(s) postmarked no later than the 31st day of the following March [insert the date 2 years after permit issuance]. Monitoring results [or a certification in accordance with Sections (3), (4), or (5) above] obtained during the period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance] shall be submitted on Discharge Monitoring Report Form(s) postmarked no later than the 31st day of the following March. For each outfall, one signed Discharge Monitoring Report form must be submitted to the Director per storm event sampled. Signed copies of Discharge Monitoring Reports, or said certifications, shall be submitted to the Director of the NPDES program at the address of the appropriate Regional Office listed in Part VI.G. of the fact sheet to this permit.

(1) Additional Notification. In addition to filing copies of discharge monitoring reports in accordance with paragraph b (above), active ore mining and dressing facilities with at least one storm water discharge associated with industrial activity through a large or medium municipal separate storm sewer system (systems serving a population of 100,000 or more) must submit signed copies of discharge monitoring reports to the operator of the municipal separate storm sewer system in accordance with the dates provided in paragraph b (above).

c. Visual Examination of Storm Water Quality. Mining facilities covered under this sector shall perform and document a visual examination of storm water discharges associated with industrial activity from each outfall, except discharges exempted below. The examination must be made during daylight hours unless there is insufficient rainfall or snow melt to produce a runoff event. Mining facilities must examine storm water quality at least once in each of the following periods: January through March; April through June; July through September; and October through December.

(1) Examinations shall be made of grab samples collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 1 hour) of when the runoff or snowmelt begins discharging. The examinations shall document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on the samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. Where practicable, the same individual should carry out the collection and examination of discharges for entire permit term.

(2) Visual examination reports must be maintained onsite in the pollution prevention plan. The report shall include the examination date and time, examination personnel, the nature of the discharge (i.e., runoff or snow melt), visual quality of the storm water discharge (including observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution), and probable sources of any observed storm water contamination.

(3) When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may collect a sample of effluent of one of such outfalls and report that the examination data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

(4) When a discharger is unable to conduct one of the required visual examinations during the required period as a result of adverse climatic conditions or inaccessibility, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the records of the visual examination. Adverse weather conditions that may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(5) When a discharger is unable to conduct visual storm water examinations at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirement as long as the facility remains inactive and unstaffed. The facility must maintain a certification with the pollution prevention plan stating that the site is inactive and unstaffed so that performing visual examinations during a qualifying event is not feasible.

H. Storm Water Discharges Associated With Industrial Activity From Coal Mines and Coal Mining-Related Facilities

1. Discharges Covered Under This Section

The requirements listed under this section shall apply to storm water discharges from coal mining-related areas (SIC Major Group 12) if they are not subject to effluent limitations guidelines under 40 CFR Part 434.

a. Coverage. Storm water discharges from the following portions of coal mines may be eligible for this permit: haul roads (nonpublic roads on which coal or coal refuse is conveyed), access roads (nonpublic roads providing light vehicular traffic within the facility property and to public roadways), railroad spurs, sidings, and internal haulage lines (rail lines used for hauling coal within the facility property and to offsite commercial railroad lines or loading areas), conveyor belts, chutes, and aerial tramway haulage areas (areas under and around coal or refuse conveyor areas, including transfer stations), equipment storage and maintenance yards, coal handling buildings and structures, and inactive coal mines and related areas (abandoned and other inactive mines, refuse disposal sites and other mining-related areas on private lands).

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

b. Limitations. Storm water discharges from inactive mining activities occurring on Federal lands where an operator cannot be identified are not eligible for coverage under this permit.

2. Special Conditions

a. Prohibition of Non-storm Water Discharges. In addition to the broad prohibition of non-storm water discharges of Part III.A.2. of the permit, point source discharges of pollutant seeps or underground drainage from inactive coal mines and refuse disposal areas that do not occur as storm water discharges in response to precipitation events are also excluded from coverage under this permit. In addition, floordrains from maintenance buildings and other similar drains in mining and preparation plant areas are prohibited.

3. Storm Water Pollution Prevention Plan Requirements

Most of the active coal mining-related areas, described in paragraph XI.H.1. above, are subject to sediment and erosion control regulations of the U.S. Office of Surface Mining (OSM) that enforces the Surface Mining Control and Reclamation Act (SMCRA). OSM has granted authority to most coal-producing states to implement SMCRA through State SMCRA regulations. All SMCRA requirements regarding control of erosion, siltation and other pollutants resulting from storm water runoff, including road dust resulting from erosion, shall be primary requirements of the pollution prevention plan and shall be included in the contents of the plan directly, or by reference. Where determined to be appropriate for protection of water quality, additional sedimentation and erosion controls may be warranted.

a. Contents of Plan. The plan shall include at a minimum, the following items:

(1) Pollution Prevention Team. Each plan shall identify a specific individual or individuals within the facility organization as members of a storm water Pollution Prevention Team that are responsible for developing the storm water pollution prevention plan and assisting the facility manager in its implementation, maintenance, and revision. The plan shall clearly identify the responsibilities of each team member. The activities and responsibilities of the team shall address all aspects of the facility's storm water pollution prevention plan.

(2) Description of Potential Pollutant Sources. Each plan shall provide a description of potential sources that may reasonably be expected to add significant amounts of pollutants to storm water discharges or that may result in the discharge of pollutants during dry weather from separate storm sewers draining the facility. Each plan shall identify all activities and significant materials that may potentially be significant pollutant sources. Each plan shall include, at a minimum:

Drainage.

(i) Asite map, such as a drainage map required for SMCRA permit applications, that indicate drainage areas and storm water outfalls. These shall include but not be limited to the following:

(a) Drainage direction and discharge points from all applicable mining-related areas described in Section XI.H.1.a. (discharges covered under this section) above, including culvert and sump discharges from roads and rail beds and also from equipment and maintenance areas subject to storm runoff of fuel, lubricants and other potentially harmful liquids.

(b) Location of each existing erosion and sedimentation control structure or other control measures for reducing pollutants in storm water runoff.

(c) Receiving streams or other surface water bodies.

(d) Locations exposed to precipitation that contain acidic spoil, refuse or unreclaimed disturbed areas.

(e) Locations where major spills or leaks of toxic or hazardous pollutants have occurred.

(f) Locations where liquid storage tanks containing potential pollutants, such as caustics, hydraulic fluids and lubricants, are exposed to precipitation.

(g) Locations where fueling stations, vehicle and equipment maintenance areas are exposed to precipitation.

(h) Locations at outfalls and the types of discharges contained in the drainage areas of the outfalls.

(ii) For each area of the facility that generates storm water discharges associated with the mining-related activity with a reasonable potential for containing significant amounts of pollutants, a prediction of the direction of flow, and an identification of the types of pollutants that are likely to be present in storm water discharges associated with the activity. Factors to consider include the toxicity of the pollutant; quantity of chemicals used, produced or discharged; the likelihood of contact with storm water; and history of significant leaks or spills of toxic or hazardous pollutants. Flows with a significant potential for causing erosion shall be identified.

(b) Inventory of Exposed Materials—An inventory of the types of materials handled at the site that potentially may be exposed to precipitation. Such inventory shall include a narrative description of significant materials that have been handled, treated, stored or disposed in a manner to allow exposure to storm water between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; method and location of onsite storage or disposal; materials management practices employed to minimize contact of materials with storm water runoff between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; the location and a description of existing structural and nonstructural control measures to reduce pollutants in storm water runoff; and a description of any treatment the storm water receives.

(c) Spills and Leaks—A list of significant spills and leaks of toxic or hazardous pollutants that occurred at areas that are exposed to precipitation or that otherwise drain to a storm water conveyance at the facility after the date of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit. Such list shall be updated as appropriate during the term of the permit.

(d) Sampling Data—A summary of any existing discharge sampling data describing pollutants in storm water discharges from the portions of the facility covered by this permit, including a summary of any sampling data collected during the term of this permit.

(e) Risk Identification and Summary of Potential Pollutant Sources—A narrative description of the potential pollutant sources from the following activities: truck traffic on haul roads and resulting generation of sediment subject to runoff and dust generation; fuel or

other liquid storage; pressure lines containing slurry, hydraulic fluid or other potential harmful liquids; and loading or temporary storage of acidic refuse or spoil. Specific potential pollutants shall be identified, where known.

(3) Measures and Controls. Each facility covered by this permit shall develop a description of storm water management controls appropriate for the facility and implement such controls. The appropriateness and priorities of controls in a plan shall reflect identified potential sources of pollutants at the facility. The description of storm water management controls shall address the following minimum components, including a schedule for implementing such controls.

(a) Good Housekeeping—Good housekeeping requires the maintenance of areas that may contribute pollutants to storm water discharges in a clean, orderly manner. These would be practices that would minimize the generation of pollutants at the source or before it would be necessary to employ sediment ponds or other control measures at the discharge outlets. Where applicable, such measures or other equivalent measures would include the following: sweepers and covered storage to minimize dust generation and storm runoff; conservation of vegetation where possible to minimize erosion; watering of haul roads to minimize dust generation; collection, removal, and proper disposal of waste oils and other fluids resulting from vehicle and equipment maintenance; or other equivalent measures.

(b) Preventive Maintenance—A preventive maintenance program shall involve timely inspection and maintenance of storm water management devices as well as inspecting and testing facility equipment and systems to uncover conditions that could cause breakdowns or failures resulting in discharges of pollutants to surface waters, and ensuring appropriate maintenance of such equipment and systems. Where applicable, such measures would include the following: removal and proper disposal of settled solids in catch basins to allow sufficient retention capacity; periodic replacement of siltation control measures subject to deterioration such as straw bales; inspections of storage tanks and pressure lines for fuels, lubricants, hydraulic fluid or slurry to prevent leaks due to deterioration or faulty connections; or other equivalent measures.

(c) Spill Prevention and Response Procedures—Areas where potential spills that can contribute pollutants to storm water discharges can occur, and their accompanying drainage points shall be identified clearly in the storm water pollution prevention plan. Where appropriate, specifying material handling procedures, storage requirements, and use of equipment such as diversion valves in the plan should be considered. Procedures for cleaning up spills shall be identified in the plan and made available to the appropriate personnel. The necessary equipment to implement a clean up should be available to personnel.

(d) Inspections—In addition to or as part of the comprehensive site evaluation required under paragraph XI.H.3.a.(4) of this section, qualified facility personnel shall be identified to inspect designated areas of the facility at appropriate intervals specified in the plan. The following shall be included in the plan:

(i) Active Mining-Related Areas and Those Inactive Areas Under SMCRA Bond Authority—The plan shall require quarterly inspections by the facility personnel for areas of the facility covered by pollution prevention plan requirements. This inspection interval corresponds with the quarterly inspections for the entire facility required to be provided by SMCRA authority inspectors for all mining-related areas under SMCRA authority, including sediment and erosion control measures. Inspections by the facility representative may be done at the same time as the mandatory inspections performed by SMCRA inspectors. Records of inspections of the SMCRA *authority facility representative* shall be maintained.

(ii) Inactive Mining-Related Areas Not Under SMCRA Bond.—The plan shall require annual inspections by the facility representative except in situations referred to in paragraph XI.H.3.a.(4)(d) below.

(iii) Inspection Records—The plan shall require that inspection records of the facility representative and those of the SMCRA authority inspector shall be maintained. A set of tracking or follow-up procedures shall be used to ensure that appropriate actions are taken in response to the inspections.

(e) Employee Training—Employee training programs shall inform personnel responsible for implementing activities identified in the storm water pollution prevention plan or otherwise responsible for storm water management at all levels of responsibility of the components and goals of the storm water pollution prevention plan. Training should address topics such as spill response, good housekeeping and material management practices. The pollution prevention plan shall identify periodic dates for such training.

(f) Recordkeeping and Internal Reporting Procedures—A description of incidents (such as spills, or other discharges) along with other information describing the quality and quantity of storm water discharges shall be included in the plan required under this part. Inspections and maintenance activities shall be documented and records of such activities shall be incorporated into the plan.

(g) Non-storm Water Discharges

(i) The plan shall include a certification that the discharge has been tested or evaluated for the presence of non-storm water discharges such as drainage from underground portions of inactive mines or floor drains from maintenance or coal handling buildings. The certification shall include the identification of potential significant sources of non-storm water discharges at the site, a description of the results of any test and/or evaluation, a description of the evaluation criteria or testing method used, the date of any testing and/or evaluation, and the onsite drainage points that were directly observed during the test. Certifications shall be signed in accordance with Part VII.G. of this permit.

(ii) Except for flows from fire fighting activities, authorized sources of non-storm water listed in Part III.A.2. (Prohibition of Non-storm Water Discharges) of this permit that are combined with storm water discharges associated with industrial activity must be identified in the plan. The plan shall identify and ensure the implementation of appropriate pollution prevention measures for the non-storm water component(s) of the discharge.

(iii) Any facility that is unable to provide the certification required (testing or other evaluation for non-storm water discharges) must notify the Director by [270 days after permit issuance] or, for facilities that begin to discharge storm water associated with industrial activity after [insert date 270 days after permit issuance], 180 days after submitting an NOI to be covered by this permit. If the failure to certify is caused by the inability to perform adequate tests or evaluations, such notification shall describe: the procedure of any test conducted for the presence of non-storm water discharges; the results of such test or other relevant observations; potential sources of non-storm water to the storm discharge lines; and why adequate tests for such storm

discharge lines were not feasible. Non-storm water discharges to waters of the United States that are not authorized by an NPDES permit are unlawful, and must be terminated.

(h) Sediment and Erosion Control—The plan shall identify areas that, due to topography, activities, or other factors, have a high potential for significant soil erosion, and identify structural, vegetative, and/or stabilization measures to be used to limit erosion and reduce sediment concentrations in storm water discharges. As indicated in paragraph XI.H.3.a.(3) above, SMCRA requirements regarding sediment and erosion control measures are primary requirements of the pollution prevention plan for mining-related areas subject to SMCRA authority. The following sediment and erosion control measures or other equivalent measures, should be included in the plan where reasonable and appropriate for all areas subject to storm water runoff:

(i) Stabilization Measures—Interim and permanent stabilization measures to minimize erosion and lessen amount of structural sediment control measures needed, including: mature vegetation preservation; temporary seeding; permanent seeding and planting; temporary mulching, matting, and netting; sod stabilization; vegetative buffer strips; temporary chemical mulch, soil binders, and soil palliatives; nonacidic roadsurfacing material; and protective trees.

(ii) Structural Measures—Structural measures to lessen erosion and reduce sediment discharges, including: silt fences; earth dikes; straw dikes; gradient terraces; drainage swales; sediment traps; pipe slope drains; porous rock check dams; sedimentation ponds; riprap channel protection; capping of contaminated sources; and physical/chemical treatment of storm water.

(i) Management of Flow—The plan shall contain a narrative consideration of the appropriateness of traditional storm water management practices (other than those as sediment and erosion control measures listed above) used to manage storm water runoff in a manner that reduces pollutants in storm water runoff from the site. The plan shall provide that the measures, which the permittee determines to be reasonable and appropriate, shall be implemented and maintained. Appropriate measures may include: discharge diversions; drainage/storm water conveyances; runoff dispersion; sediment control and collection; vegetation/soil stabilization; capping of contaminated sources; treatment; or other equivalent measures.

(4) Comprehensive Site Compliance Evaluation. Qualified personnel shall conduct site compliance evaluations at intervals specified in the plan, but in no case less than once a year. Such evaluations shall provide:

(a) Areas contributing to a storm water discharge associated with coal mining-related areas shall be visually inspected for evidence of, or the potential for, pollutants entering the drainage system. These areas include haul and access roads; railroad spurs, sidings, and internal haulage lines; conveyor belts, chutes and aerial tramways; equipment storage and maintenance yards; coal handling buildings and structures; and inactive mines and related areas. Measures to reduce pollutant loadings shall be evaluated to determine whether they are adequate and properly implemented in accordance with the terms of the permit or whether additional control measures are needed. Structural storm water management measures, sediment and erosion control measures, and other structural pollution prevention measures, as indicated in paragraphs XI.H.3.a.(3)(h) and XI.H.3.a.(3)(i) above and where identified in the plan, shall be observed to ensure that they are operating correctly. A visual evaluation of any equipment needed to implement the plan, such as spill response equipment, shall be made.

(b) Based on the results of the evaluation, the description of potential pollutant sources identified in the plan, in accordance with paragraph XI.H.3.a.(2) of this section, and pollution prevention measures and controls identified in the plan, in accordance with paragraph XI.H.3.a.(3) of this section, shall be revised as appropriate within 2 weeks of such evaluation and shall provide for implementation of any changes to the plan in a timely manner. For inactive mines, such revisions may be extended to a maximum of 12 weeks after the evaluation.

(c) A report summarizing the scope of the evaluation, personnel making the evaluation, the date(s) of the evaluation, major observations relating to the implementation of the storm water pollution prevention plan, and actions taken in accordance with paragraph XI.H.3.a.(4)(b) above shall be made and retained as part of the storm water pollution prevention plan for at least 3 years after the date of the evaluation. The report shall identify any incidents of noncompliance. Where a report does not identify any incidents of noncompliance, the report shall contain a certification that the facility is in compliance with the storm water pollution prevention plan and this permit. The report shall be signed in accordance with Part VII.G. (Signatory Requirements) of this permit.

(d) Where compliance evaluation schedules overlap with inspections required under 3.a.(3)(d), the compliance evaluation may be conducted in place of one such inspection. Where annual site compliance evaluations are shown in the plan to be impractical for inactive mining sites due to the remote location and inaccessibility of the site, site inspections required under this part shall be conducted at appropriate intervals specified in the plan, but, in no case less than once in 3 years.

4. Numeric Effluent Limitations

There are no additional numeric effluent limitations beyond those described in Part V.B. of this permit.

5. Monitoring and Reporting Requirements

a. Analytical Monitoring Requirements. During the period beginning [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] and the period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance], permittees with coal mining activities must monitor their storm water discharges associated with industrial activity at least quarterly (4 times per year) during years 2 and 4 except as provided in paragraphs 5.a.(3) (Sampling Waiver), 5.a.(4) (Representative Discharge), and 5.a.(5) (Alternative Certification). Coal mining facilities are required to monitor their storm water discharges for the pollutants of concern listed in Table H-1 below. Facilities must report in accordance with 5.b. (Reporting). In addition to the parameters listed in Table H-1 below, the permittee shall provide the date and duration (in hours) of the storm event(s) sampled; rainfall measurements or estimates (in inches) of the storm event that generated the sampled runoff; the duration between the storm event sampled and the end of the previous measurable (greater than 0.1 inch rainfall) storm event; and an estimate of the total volume (in gallons) of the discharge sampled.

TABLE H-1.—MONITORING REQUIREMENTS FOR COAL MINING FACILITIES

Pollutants of concern	Cut-off concentration (mg/L)
Total Recoverable Aluminum	0.75
Total Recoverable Iron	1.0
Total Suspended Solids	100

(1) Monitoring Periods. Coal mining facilities shall monitor samples collected during the sampling periods of: January through March, April through June, July through September, and October through December for the years specified in paragraph a. (above).

(2) Sample Type. A minimum of one grab sample shall be taken. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The required 72-hour storm event interval is waived where the preceding measurable storm event did not result in a measurable discharge from the facility. The required 72-hour storm event interval may also be waived where the permittee documents that less than a 72-hour interval is representative for local storm events during the season when sampling is being conducted. The grab sample shall be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable. If storm water discharges associated with industrial activity commingle with process or nonprocess water, then where practicable permittees must attempt to sample the storm water discharge before it mixes with the non-storm water discharge.

(3) Sampling Waiver

(a) Adverse Conditions—When a discharger is unable to collect samples within a specified sampling period due to adverse climatic conditions, the discharger shall collect a substitute sample from a separate qualifying event in the next monitoring period and submit the data along with the data for the routine sample in that period. Adverse weather conditions that may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricanes, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(b) Low Concentration Waiver—When the average concentration for a pollutant calculated from all monitoring data collected from an outfall during the monitoring period [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] is less than the corresponding value for that pollutant listed in Table H-1 under the column Monitoring Cut-off Concentration, a facility may waive monitoring and reporting requirements in the monitoring period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance]. The facility must submit to the Director, in lieu of the monitoring data, a certification that there has not been a significant change in industrial activity or the pollution prevention measures in area of the facility that drains to the outfall for which sampling was waived.

(c) When a discharger is unable to conduct quarterly chemical storm water sampling at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirements as long as the facility remains inactive and unstaffed. The facility must submit to the Director, in lieu of monitoring data, a certification statement on the DMR stating that the site is inactive and unstaffed so that collecting a sample during a qualifying event is not possible.

(4) Representative Discharge. When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may test the effluent of one of such outfalls and report that the quantitative data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan. The permittee shall include the description of the location of the outfalls, explanation of why outfalls are expected to discharge substantially identical effluents, and estimate of the size of the drainage area and runoff coefficient with the Discharge Monitoring Report.

(5) Alternative Certification. A discharger is not subject to the monitoring requirements of this section provided the discharger makes a certification for a given outfall or on a pollutant-by-pollutant basis in lieu of monitoring reports required under paragraph *b.* below, under penalty of law, signed in accordance with Part VII.G. (Signatory Requirements), that material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, industrial machinery or operations, or significant materials from past industrial activity that are located in areas of the facility within the drainage area of the outfall are not presently exposed to storm water and are not expected to be exposed to storm water for the certification period. Such certification must be retained in the storm water pollution prevention plan, and submitted to EPA in accordance with Part VI.C. of this permit. In the case of certifying that a pollutant is not present, the permittee must submit the certification along with the monitoring reports required under paragraph *b.* below. If the permittee cannot certify for an entire period, they must submit the date exposure was eliminated and any monitoring required up until that date. This certification option is not applicable to compliance monitoring requirements associated with effluent limitations.

b. Reporting. Permittees shall submit monitoring results for each outfall associated with industrial activity [or a certification in accordance with Sections (3), (4), or (5) above] obtained during the reporting period beginning [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] on Discharge Monitoring Report Form(s) postmarked no later than the 31st day of the following March [insert the date 2 years after permit issuance]. Monitoring results [or a certification in accordance with Sections (3), (4), or (5) above] obtained during the period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance] shall be submitted on Discharge Monitoring Report Form(s) postmarked no later than the 31st day of the following March. For each outfall, one signed Discharge Monitoring Report form must be submitted to the Director per storm event sampled. Signed copies of

Discharge Monitoring Reports, or said certifications, shall be submitted to the Director of the NPDES program at the address of the appropriate Regional Office listed in Part VI.B.1. of the permit.

(1) Additional Notification. In addition to filing copies of discharge monitoring reports in accordance with paragraph *b.* (above), coal-mining related facilities with at least one storm water discharge associated with industrial activity through a large or medium municipal separate storm sewer system (systems serving a population of 100,000 or more) must submit signed copies of discharge monitoring reports to the operator of the municipal separate storm sewer system in accordance with the dates provided in paragraph *b.* (above).

c. Visual Examination of Storm Water Quality. Coal mining-related facilities shall perform and document a visual examination of a representative storm water discharge at the following frequencies: quarterly for active areas under SMCRA bond located in areas with average annual precipitation over 20 inches; semi-annually for inactive areas under SMCRA bond, and active areas under SMCRA bond located in areas with average annual precipitation of 20 inches or less; visual examinations are not required at inactive areas not under SMCRA bond.

(1) Examinations shall be conducted in each of the following periods for the purposes of visually inspecting storm water runoff or snow melt: Quarterly—January through March; April through June; July through September; and October through December. Semi-annually—January through June and July through December.

(2) Examinations shall be made of samples collected within the first 60 minutes (or as soon thereafter as practical, but not to exceed two hours) of when the runoff or snow melt begins discharging. The examinations shall document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on the samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. Where practicable, the same individual will carry out the collection and examination of discharges for the life of the permit.

(3) Visual examination reports must be maintained onsite in the pollution prevention plan. The report shall include the examination date and time, examination personnel, the nature of the discharge (i.e., runoff or snow melt), visual quality of the storm water discharge (including observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution), and probable sources of any observed storm water contamination.

(4) When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may collect a sample of effluent of one of such outfalls and report that the examination data also applies to the substantially identical outfalls provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explaining in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

(5) When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the records of the visual examination. Adverse weather conditions which may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricanes, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(6) When a discharger is unable to conduct visual storm water examinations at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirement as long as the facility remains inactive and unstaffed. The facility must maintain a certification with the pollution prevention plan stating that the site is inactive and unstaffed so that performing visual examinations during a qualifying event is not feasible.

I. Storm Water Discharges Associated With Industrial Activity From Oil and Gas Extraction Facilities

1. Discharges Covered Under This Section

a. Coverage. This permit covers all existing point source discharges of storm water associated with industrial activity to waters of the United States from oil and gas facilities listed under Standard Industrial Classification (SIC) Major Group 13 which are required to be permitted under 40 CFR 122.26. These include "* * * oil and gas exploration, production, processing, or treatment operations, or transmission facilities that discharge storm water contaminated by contract with or that has come into contact with any overburden raw material, intermediate products, finished products, by-products or waste products located on the site of such operations." Contaminated storm water discharges from petroleum refining or drilling operations that are subject to nationally established BAT or BPT guidelines found at 40 CFR 419 and 435 respectively are not included. Industries in SIC Major Group 13 include the extraction and production of crude oil, natural gas, oil sands and shale; the production of hydrocarbon liquids and natural gas from coal; and associated oil field service, supply and repair industries.

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

b. Limitations. Storm water discharges associated with industrial activity from inactive oil and gas operations occurring on Federal lands where an operator cannot be identified are not covered by this permit.

2. Special Conditions

There are no additional requirements beyond those listed in Part III. of this permit.

3. Storm Water Pollution Prevention Plan Requirements

a. Contents of Plan. The plan shall include, at a minimum, the following items:

(1) Pollution Prevention Team. Each plan shall identify a specific individual or individuals within the facility organization as members of a storm water Pollution Prevention Team that are responsible for developing the storm water pollution prevention plan and assisting the facility or plant manager in its implementation, maintenance, and revision. The plan shall clearly identify the responsibilities of each team member. The activities and responsibilities of the team shall address all aspects of the facility's storm water pollution prevention plan.

(2) Description of Potential Pollutant Sources. Each plan shall provide a description of potential sources which may reasonably be expected to add significant amounts of pollutants to storm water discharges or which may result in the discharge of pollutants during dry weather from separate storm sewers draining the facility. Each plan shall identify all activities and significant materials which may potentially be significant pollutant sources. Each plan shall include, at a minimum:

(a) Drainage

(i) A site map indicating an outline of the portions of the drainage area of each storm water outfall that are within the facility boundaries, each existing structural control measure to reduce pollutants in storm water runoff, surface water bodies, locations where significant materials are exposed to precipitation, locations where major spills or leaks identified under Part IX.I.3.a.(1)(c) (Spills and Leaks) of this permit have occurred, location of any areas where RQ releases have occurred; and the locations of the following activities where such activities are exposed to precipitation: fueling stations, vehicle and equipment maintenance and/or cleaning areas, loading/unloading areas, locations used for the treatment, storage or disposal of wastes, liquid storage tanks, processing areas and storage areas, chemical mixing areas, construction and drilling areas. The site map will indicate all areas subject to the effluent guidelines requirement of "No Discharge" in accordance with 40 CFR 435.32 and the existing structural controls to achieve compliance with the "No Discharge" requirement. The map must indicate the outfall locations and the types of discharges contained in the drainage areas of the outfalls.

(ii) For each area of the facility that generates storm water discharges associated with industrial activity with a reasonable potential for containing significant amounts of pollutants, a prediction of the direction of flow, and an identification of the types of pollutants which are likely to be present in storm water discharges associated with industrial activity. Factors to consider include the toxicity of chemical; quantity of chemicals used, produced or discharged; the likelihood of contact with storm water; and history of significant leaks or spills of toxic or hazardous pollutants. The permittee should consider the cause of RQ releases, the materials used to contain and remediate releases, and any other aspect of releases or clean-up which could potentially contribute pollutants to a storm water discharge. Flows with a significant potential for causing erosion shall be identified.

(b) Inventory of Exposed Materials—An inventory of the types of materials handled at the site that potentially may be exposed to precipitation. Such inventory shall include a narrative description of significant materials that have been handled, treated, stored or disposed in a manner to allow exposure to storm water between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; method and location of onsite storage or disposal; materials management practices employed to minimize contact of materials with storm water runoff between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; the location and a description of existing structural and nonstructural control measures to reduce pollutants in storm water runoff; and a description of any treatment the storm water receives.

(c) Spills and Leaks—A list of significant spills and significant leaks of toxic or hazardous pollutants that occurred at areas that are exposed to precipitation or that otherwise drain to a storm water conveyance at the facility after the date of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit. Such list shall be updated as appropriate during the term of the permit.

(d) Sampling Data—A summary of existing discharge sampling data describing pollutants in storm water discharges from the facility, including a summary of sampling data collected during the term of this permit.

(e) Risk Identification and Summary of Potential Pollutant Sources—A narrative description of the potential pollutant sources from the following activities: loading and unloading operations; outdoor storage activities; chemical, cement, mud or gel mixing activities; outdoor manufacturing or processing activities; drilling or mining activities; significant dust or particulate generating processes; and onsite waste disposal practices, equipment cleaning and rehabilitation activities. List any significant potential source of pollutants at the site and for each potential source, any pollutant or pollutant parameter (e.g., biochemical oxygen demand, etc.) of concern shall be identified.

In its description of potential pollutant sources, a facility must include information about the RQ release which triggered the permit application requirements. Such information must include: the nature of the release (e.g., spill of oil from a drum storage area); the amount of oil or hazardous substance released; amount of substance recovered; date of the release; cause of the release (e.g., poor handling techniques as well as lack of containment in area); area affected by release, including land and waters; procedure to cleanup release; actions or procedures implemented to prevent or better respond to a release; and remaining potential contamination of storm water from release. The analysis shall take into account human health risks, the control of drinking water intakes, and the designated uses of the receiving stream.

(3) Measures and Controls. Each facility covered by this permit shall develop and implement storm water management controls appropriate for the facility. The controls in a plan shall reflect identified potential sources of pollutants at the facility. The description of storm water management controls shall address the following minimum components, including a schedule for implementing such measures:

(a) Good Housekeeping—Good housekeeping requires the maintenance of areas which may contribute pollutants to storm water discharges in a clean, orderly manner.

(b) Preventive Maintenance—A preventive maintenance program shall involve timely inspection and maintenance of storm water management devices (e.g., cleaning oil/water separators, catch basins) as well as inspecting and testing facility

equipment and systems to uncover conditions that could cause breakdowns or failures resulting in discharges of pollutants to surface waters, and ensuring appropriate maintenance of such equipment and systems. The preventative maintenance program shall also include the inspection of all on site and off site mixing tanks and equipment, and all vehicles which carry supplies and chemicals to oil field activities.

(c) Spill Prevention and Response Procedures—Areas where potential spills which can contribute pollutants to storm water discharges can occur, and their accompanying drainage points shall be identified clearly in the storm water pollution prevention plan. Materials shall be stored indoors where possible, and drainage systems designed to discharge downstream from drinking water intakes. Where appropriate, specifying material handling procedures, storage requirements, and use of equipment such as diversion valves in the plan should be considered. Procedures for cleaning up spills shall be identified in the plan and made available to the appropriate personnel. The necessary equipment to implement a clean up should be available to personnel.

(d) Inspections—In addition to or as part of the comprehensive site evaluation required under paragraph XI.I.3.a.(4) of this section, qualified facility or plant personnel shall be identified to inspect designated equipment and areas of the facility at appropriate intervals specified in the plan. All equipment and areas addressed in the pollution prevention plan shall be inspected at a minimum of 6-month intervals. Equipment and vehicles which store, mix or transport hazardous materials will be inspected routinely, but not less than quarterly. A set of tracking or follow-up procedures shall be used to ensure that appropriate actions are taken in response to the inspections. Records of inspections shall be maintained.

(e) Employee Training—Employee training programs shall inform personnel responsible for implementing activities identified in the storm water pollution prevention plan or otherwise responsible for storm water management at all levels of responsibility of the components and goals of the storm water pollution prevention plan. Training should address topics such as spill response, good housekeeping and material management practices. The pollution prevention plan shall identify periodic dates for such training.

(f) Recordkeeping and Internal Reporting Procedures—A description of incidents (such as spills, or other discharges), along with other information describing the quality and quantity of storm water discharges shall be included in the plan required under this part. Inspections and maintenance activities shall be documented and records of such activities shall be incorporated into the plan. All records shall be kept for a period of not less than 3 years.

(g) Non-storm Water Discharges

(i) The plan shall include a certification that the discharge has been tested or evaluated for the presence of non-storm water discharges. The certification shall include the identification of potential significant sources of non-storm water at the site, a description of the results of any test and/or evaluation for the presence of non-storm water discharges, the evaluation criteria or testing method used, the date of any testing and/or evaluation, and the onsite drainage points that were directly observed during the test. Certifications shall be signed in accordance with Part VII.G. of this permit. Such certification may not be feasible if the facility operating the storm water discharge associated with industrial activity does not have access to an outfall, manhole, or other point of access to the ultimate conduit which receives the discharge. In such cases, the source identification section of the storm water pollution prevention plan shall indicate why the certification required by this part was not feasible, along with the identification of potential significant sources of non-storm water at the site. A discharger that is unable to provide the certification required by this paragraph must notify the Director in accordance with paragraph XI.I.a.(3)(g)(iii) (below).

(ii) Except for flows from fire fighting activities, sources of non-storm water listed in Part III.A.2. (Prohibition of Non-storm Water Discharges) of this permit that are combined with storm water discharges associated with industrial activity must be identified in the plan. The plan shall identify and ensure the implementation of appropriate pollution prevention measures for the non-storm water component(s) of the discharge.

(iii) Failure to Certify—Any facility that is unable to provide the certification required (testing for non-storm water discharges), must notify the Director by [Insert date 270 days after permit issuance] or, for facilities which begin to discharge storm water associated with industrial activity after [Insert date 270 days after permit issuance], 180 days after submitting an NOI to be covered by this permit. If the failure to certify is caused by the inability to perform adequate tests or evaluations, such notification shall describe: the procedure of any test conducted for the presence of non-storm water discharges; the results of such test or other relevant observations; potential sources of non-storm water discharges to the storm sewer; and why adequate tests for such storm sewers were not feasible. Non-storm water discharges to waters of the United States which are not authorized by an NPDES permit are unlawful, and must be terminated.

(h) Sediment and Erosion Control—The plan shall identify areas which, due to topography, activities, or other factors, have a high potential for significant soil erosion, and identify structural, vegetative, and/or stabilization measures to be used to limit erosion. Unless covered by the General Permit for Construction Activity (57 FR 41209), the additional erosion control requirement for well drillings oil, sand, and shale mining areas are as follows:

(i) Site Description—Each plan shall provide a description of the following: (1) A description of the nature of the exploration activity; (2) estimates of the total area of the site and the area of the site that is expected to be disturbed due to the exploration activity; (3) an estimate of the runoff coefficient of the site; (4) a site map indicating drainage patterns and approximate slopes, the location of major control structures identified in the plan, and surface waters; and (5) the name of the receiving water(s) and the ultimate receiving water(s) of the runoff.

(ii) Controls—The pollution prevention plan shall include a description of controls appropriate for the activity and implement such controls. The description of controls shall address the following minimum components:

(a) A description of vegetative practices designed to preserve existing vegetation where attainable and revegetate open areas as soon as practicable after grade drilling. Such practices may include: temporary seeding, permanent seeding, mulching, sod stabilization, vegetative buffer strips, protection of trees, or other equivalent measures. The operator shall initiate appropriate vegetative practices on all disturbed areas within 14 calendar days of the last activity at that area.

(b) A description of structural practices that, to the degree attainable, divert flows from exposed soils, store flows or otherwise limit runoff from exposed areas of the site. Such practices

may include straw bale dikes, silt fences, earth dikes, brush barriers, drainage swales, check dams, subsurface drain, pipe slope drain, level spreaders storm drain inlet protection, rock outlet protection, sediment traps, temporary sediment basins, or other equivalent measures.

(iii) Offsite vehicle tracking of sediments shall be minimized.

(iv) Procedures in a plan shall provide that all erosion controls on the site are inspected at least once every 7 calendar days. Weekly inspections are necessary to ensure erosion controls continue to effectively reduce the amount of sediment carried offsite. A silt fence or silt trap is no longer effective when filled with silt.

(i) Management of Runoff—The plan shall contain a narrative consideration of the appropriateness of traditional storm water management practices (practices other than those which control the generation or source(s) of pollutants) used to divert, infiltrate, reuse, or otherwise manage storm water runoff in a manner that reduces pollutants in storm water discharges from the site. The plan shall provide the measures that the permittee determines to be reasonable and appropriate which shall be implemented and maintained. The potential of various sources at the facility to contribute pollutants to storm water discharges associated with industrial activity shall be considered when determining reasonable and appropriate measures. Appropriate measures may include: vegetative swales and practices, reuse of collected storm water (such as for a process or as an irrigation source), inlet controls (such as oil/water separators), snow management activities, infiltration devices, wet detention/retention devices, or other equivalent measures.

(j) Reportable Quantity (RQ) Release—The permittee must describe the measures taken to clean up RQ releases or related spills of materials, as well as measures proposed to avoid future releases of RQs. Such measures may include, among others: Improved handling or storage techniques; containment around handling areas of liquid materials; and use of improved spill cleanup materials and techniques.

(k) Vehicle and Equipment Storage Areas—The storage of vehicles and equipment awaiting or having completed maintenance must be confined to designated areas (delineated on the site map). The plan must describe measures that prevent or minimize contamination of the storm water runoff from these areas. The facility may consider the use of drip pans under vehicles and equipment, indoor storage of the vehicles and equipment, installation of berming and diking of this area, or other equivalent measures.

(l) Vehicle and Equipment Cleaning and Maintenance Areas—The plan must describe measures that prevent or minimize contamination of the storm water runoff from all areas used for vehicle and equipment cleaning. The facility may consider performing all cleaning operations indoors, covering the cleaning operation, ensuring that all washwaters drain to a sanitary sewer, and/or collecting the storm water runoff from the cleaning area and providing treatment or recycling. The discharge of vehicle and equipment wash waters, including tank cleaning operations, are not authorized by this permit and must be authorized under a separate NPDES permit or discharged to a sanitary sewer in accordance with applicable industrial pretreatment requirements.

The plan must describe measures that prevent or minimize contamination of the storm water runoff from all areas used for vehicle and equipment maintenance and rehabilitation. The facility may consider performing all maintenance activities indoors, using drip pans, maintaining an organized inventory of materials used in the shop, draining all parts of fluids prior to disposal, prohibiting the practice of hosing down the shop floor where the practice would result in the exposure of pollutants to storm water, using dry cleanup methods, collecting the storm water runoff from the maintenance area and providing treatment or recycling, or other equivalent measures.

(m) Materials and Chemical Storage Areas—Storage units of all chemicals and materials (e.g., fuels, oils, used filters, spent solvents, paint wastes, radiator fluids, transmission fluids, hydraulic fluids, detergents drilling mud components, acids, organic additives) must be maintained in good condition so as to prevent contamination of storm water. Hazardous materials must be plainly labeled. The plan must describe measures that prevent or minimize contamination of the storm water runoff from such storage areas. The facility may consider indoor storage of the materials and/or installation of berming and diking at the area.

(n) Chemical Mixing Areas—The plan must describe measures that prevent or minimize contamination of the storm water runoff from chemical mixing areas. The facility may consider covering the mixing area, using spill and overflow protection, minimizing runon of storm water to the mixing area, using dry cleanup methods, and/or collecting the storm water runoff and providing treatment or recycling. The facility may consider installation of berming and diking of the area.

Comprehensive Site Compliance Evaluation. Qualified personnel shall conduct site compliance evaluations at appropriate intervals specified in the plan, but in no case less than once a year. Such evaluations shall provide:

(a) Areas contributing to a storm water discharge associated with industrial activity (e.g., materials and chemical storage areas, vehicle and equipment cleaning and maintenance areas, vehicle and equipment storage areas, chemical mixing areas, and areas of materials handling at the drill site areas) shall be visually inspected for evidence of, or the potential for, pollutants entering the drainage system. Measures to reduce pollutant loadings shall be evaluated to determine whether they are adequate and properly implemented in accordance with the terms of the permit or whether additional control measures are needed. Structural storm water management measures, sediment and erosion control measures, and other structural pollution prevention measures identified in the plan shall be observed to ensure that they are operating correctly. A visual inspection of equipment needed to implement the plan, such as spill response equipment, shall be made.

(b) Based on the results of the evaluation, the description of potential pollutant sources identified in the plan in accordance with paragraph XI.I.3.a.(2) of this section (Description of Potential Pollutant Sources) and pollution prevention measures and controls identified in the plan in accordance with paragraph XI.I.3.a.(3) of this section (Measures and Controls) shall be revised as appropriate within 2 weeks of such evaluation and shall provide for implementation of any changes to the plan in a timely manner, but in no case more than 12 weeks after the evaluation.

(c) A report summarizing the scope of the evaluation, personnel making the evaluation, the date(s) of the evaluation, and major observations relating to the implementation of the storm water pollution prevention plan the permit shall be made and retained as part of the storm water pollution prevention plan for at least 3 years after the date of the evaluation. The report shall identify any incidents of noncompliance. Where a report does not identify any incidents of noncompliance, the report shall contain a certification that the facility is in compliance with the storm water pollution prevention plan and this permit. The report shall be signed in

accordance with Part VII.G. (Signatory Requirements) of this permit.

(d) Where compliance evaluation schedules overlap with inspections required under 3.a.(3)(d), the compliance evaluation may be conducted in place of one such inspection.

4. Numeric Effluent Limitations

There are no additional requirements beyond those listed in Part V.B. of this permit.

5. Monitoring and Reporting Requirements

a. Monitoring Requirements

(1) Quarterly Visual Examination of Storm Water Quality. Facilities shall perform and document a visual examination of a storm water discharge associated with industrial activity from each outfall, except discharges exempted below. The examination(s) must be made at least once in each designated period [described in (a), below] during daylight hours unless there is insufficient rainfall or snow melt to produce a runoff event.

(a) Examinations shall be conducted in each of the following periods for the purposes of visually inspecting storm water quality associated with storm water runoff or snow melt: January through March; April through June; July through September; and October through December.

(b) Examinations shall be made of samples collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed one hour) of when the runoff or snowmelt begins discharging. The examinations shall document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on the samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. Where practicable, the same individual will carry out the collection and examination of discharges for the life of the permit.

(c) Visual examination reports must be maintained onsite in the pollution prevention plan. The report shall include the examination date and time, examination personnel, the nature of the discharge (i.e., runoff or snow melt), visual quality of the storm water discharge (including observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution), and probable sources of any observed storm water contamination.

(d) When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may collect a sample of effluent of one of such outfalls and report that the examination data also applies to the substantially identical outfalls provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explaining in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

(e) When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the records of the visual examination. Adverse weather conditions which may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(f) When a discharger is unable to conduct visual storm water examinations at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirement as long as the facility remains inactive and unstaffed. The facility must maintain a certification with the pollution prevention plan stating that the site is inactive and unstaffed so that performing visual examinations during a qualifying event is not feasible.

J. Storm Water Discharges Associated With Industrial Activity From Mineral Mining and Processing Facilities

1. Discharges Covered Under This Section

This permit covers all existing point source discharges of storm water associated with industrial activity to waters of the United States from active and inactive mineral mining and processing facilities (generally identified by Standard Industrial Classification (SIC) Major Group 14), except for storm water discharges identified under paragraph XI.J.1.a.

This permit may authorize storm water discharges associated with industrial activity that are mixed with storm water discharges associated with industrial activity from construction activities, provided that the storm water discharge from the construction activity is in compliance with the terms, including applicable Notice of Intent (NOI) or application requirements, of a different NPDES general permit or individual permit authorizing such discharges.

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

a. Limitations on Coverage. The following storm water discharges associated with industrial activity are not authorized by this permit:

(1) Storm water discharges associated with industrial activity which are subject to an existing effluent limitation guideline (40 CFR Part 436), except mine dewatering discharges composed entirely of storm water or ground water seepage from construction sand and gravel, industrial sand, and crushed stone mining facilities located in Region VI (the States of Louisiana, New Mexico, Oklahoma, and Texas) and Arizona.

(2) Storm water discharges associated with industrial activity from inactive mineral mining activities occurring on Federal lands where an operator cannot

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be identified are not eligible for coverage under this permit.

2. Special Conditions

a. Prohibition of Non-storm Water Discharges. This section of today's permit does not cover any discharge subject to process wastewater effluent limitation guidelines, including storm water that combines with process wastewater. Part III.A.2 of today's permit does allow certain non-storm water discharges to be covered by this permit.

3. Storm Water Pollution Prevention Plan Requirements

a. Contents of Plan. The plan shall include at a minimum, the following items:

(1) Pollution Prevention Team. Each plan shall identify a specific individual or individuals within the facility organization as members of a storm water Pollution Prevention Team that are responsible for developing the storm water pollution prevention plan and assisting the facility or plant manager in its implementation, maintenance, and revision. The plan shall clearly identify the responsibilities of each team member. The activities and responsibilities of the team shall address all aspects of the facility's storm water pollution prevention plan.

(2) Description of Potential Pollutant Sources. Each storm water pollution prevention plan must describe industrial activities, significant materials, and physical features of the facility that may contribute to storm water runoff or, during periods of dry weather, result in dry weather flows and mine pumpout. Plans must describe the following elements:

(a) Drainage—The plan must contain a map of the site that shows the pattern of storm water drainage, structural or nonstructural features that control pollutants in storm water runoff and process wastewater discharges, surface water bodies (including wetlands), places where significant materials are exposed to rainfall and runoff, and locations of major spills and leaks that occurred in the 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit. The map also must show areas where the following activities take place: fueling, vehicle and equipment maintenance and/or cleaning, loading and unloading, material storage (including tanks or other vessels used for liquid or waste storage), material processing, and waste disposal, haul roads, access roads, and rail spurs. In addition, the map must indicate the outfall locations and the types of discharges contained in the drainage areas of the outfalls.

(b) Inventory of Exposed Materials—Facility operators are required to carefully conduct an inspection of the site and related records to identify significant materials that are or may be exposed to storm water. The inventory must address materials that within 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit have been handled, stored, processed, treated, or disposed of in a manner to allow exposure to storm water. Findings of the inventory must be documented in detail in the pollution prevention plan. At a minimum, the plan must describe the method and location of onsite storage or disposal; practices used to minimize contact of materials with rainfall and runoff; existing structural and nonstructural controls that reduce pollutants in storm water runoff; existing structural controls that limit process wastewater discharges; and any treatment the runoff receives before it is discharged to surface waters or a separate storm sewer system. The description must be updated whenever there is a significant change in the types or amounts of materials, or material management practices, that may affect the exposure of materials to storm water.

(c) Significant Spills and Leaks—The plan must include a list of any significant spills and leaks of toxic or hazardous pollutants that occurred in the 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit. Significant spills include, but are not limited to, releases of oil or hazardous substances in excess of quantities that are reportable under Section 311 of CWA (see 40 CFR 110.10 and 117.21) or Section 102 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (see 40 CFR 302.4). Significant spills may also include releases of oil or hazardous substances that are not in excess of reporting requirements and releases of materials that are not classified as oil or a hazardous substance.

(d) Sampling Data—Any existing data on the quality or quantity of storm water discharges from the facility must be described in the plan. The description should include a discussion of the methods used to collect and analyze the data. Sample collection points should be identified in the plan and shown on the site map.

(e) Risk Identification and Summary of Potential Pollutant Sources—The description of potential pollution sources culminates in a narrative assessment of the risk potential that sources of pollution pose to storm water quality. This assessment should clearly point to activities, materials, and physical features of the facility that have a reasonable potential to contribute significant amounts of pollutants to storm water. Any such industrial activities, significant materials, or features must be addressed by the measures and controls subsequently described in the plan. In conducting the assessment, the facility operator must consider the following activities: loading and unloading operations; outdoor storage activities; outdoor processing activities; significant dust or particulate generating processes; and onsite waste disposal practices. The assessment must list any significant pollution sources at the site and identify the pollutant parameter or parameters (i.e., total suspended solids, total dissolved solids, etc.) associated with each source.

(3) Measures and Controls. Following completion of the source identification and assessment phase, the permittee must evaluate, select, and describe the pollution prevention measures, best management practices (BMPs), and other controls that will be implemented at the facility. The permittee must assess the applicability of the following BMPs for their site: discharge diversions, drainage/storm water conveyance systems, runoff dispersions, sediment control and collection mechanisms, vegetation/soil stabilization, and capping of contaminated sources. In addition, BMPs include processes, procedures, schedules of activities, prohibitions on practices, and other management practices that prevent or reduce the discharge of pollutants in storm water runoff.

The pollution prevention plan must discuss the reasons each selected control or practice is appropriate for the facility and how each will address the potential sources of storm water pollution. The plan also must include a schedule specifying the time or times during which each control or practice will be implemented. In addition, the plan should discuss ways in which the controls and practices relate to one another and, when taken as a whole, produce an integrated and consistent approach for preventing or controlling potential storm water contamination problems.

(a) Good Housekeeping—Good housekeeping requires the maintenance of areas which may contribute pollutants to storm waters discharges in a clean, orderly manner.

(b) Preventive Maintenance—The maintenance program requires periodic

removal of debris from discharge diversions and conveyance systems. These activities should be conducted in the spring, after snowmelt, and during the fall season. Permittees using ponds to control their effluents frequently use impoundments or sedimentation ponds as their BAT/BCT. Maintenance schedules for these ponds must be provided in the pollution prevention plan.

(c) Spill Prevention and Response Procedures—Areas where potential spills which can contribute pollutants to storm water discharges can occur, and their accompanying drainage points shall be identified clearly in the storm water pollution prevention plan. Where appropriate, specifying material handling procedures, storage requirements, and use of equipment such as diversion valves in the plan should be considered. Procedures for cleaning up spills shall be identified in the plan and made available to the appropriate personnel. The necessary equipment to implement a clean up should be available to personnel.

(d) Inspections—Operators of active facilities are required to conduct quarterly visual inspections of all BMPs. Temporarily and permanently inactive operations are required to perform annual inspections. The inspections shall include: (1) An assessment of the integrity of storm water discharge diversions, conveyance systems, sediment control and collection systems, and containment structures; (2) visual inspections of vegetative BMPs, serrated slopes, and benched slopes to determine if soil erosion has occurred; and (3) visual inspections of material handling and storage areas and other potential sources of pollution for evidence of actual or potential pollutant discharges of contaminated storm water.

The inspection must be made at least once in each designated period during daylight hours unless there is insufficient rainfall or snow-melt to produce a runoff event. Inspections shall be conducted in each of the following periods for the purposes of inspecting storm water quality associated with storm water runoff and snow melt: January through March (storm water runoff or snow melt); April through June (storm water runoff); July through September (storm water runoff); October through December (storm water runoff or snow melt).

(e) Employee Training—Employee training programs shall inform personnel responsible for implementing activities identified in the storm water pollution prevention plan or otherwise responsible for storm water management at all levels of responsibility of the components and goals of the storm water pollution prevention plan. Training should address topics such as spill response, good housekeeping and material management practices. The pollution prevention plan shall identify periodic dates for such training.

(f) Recordkeeping and Internal Reporting Procedures—A description of incidents such as spills or other discharges along with other information describing the quality and quantity of storm water discharges shall be included in the plan required under this part. The permittee must describe procedures for developing and retaining records on the status and effectiveness of plan implementation. The plan must address spills, monitoring, and BMP inspection and maintenance activities. Ineffective BMPs must be recorded and the date of their corrective action noted.

(g) Non-storm Water Discharges

(i) The plan shall include a certification that the discharge has been tested or evaluated for the presence of non-storm water discharges. The certification shall include the identification of potential significant sources of non-storm water at the site, a description of the results of any test and/or evaluation for the presence of non-storm water discharges, the evaluation criteria or testing method used, the date of any testing and/or evaluation, and the onsite drainage points that were directly observed during the test. Certifications shall be signed in accordance with Part VII.G. of this permit. Such certification may not be feasible if the facility operating the storm water discharge associated with industrial activity does not have access to an outfall, manhole, or other point of access to the ultimate conduit which receives the discharge. In such cases, the source identification section of the storm water pollution prevention plan shall indicate why the certification required by this part was not feasible, along with the identification of potential significant sources of non-storm water at the site. A discharger that is unable to provide the certification required by this paragraph must notify the Director in accordance with Part XI.J.3.a.(g)(iii) (Failure to Certify) of this permit.

(ii) Except for flows from fire fighting activities, sources of non-storm water listed in Part III.A.2 (Prohibition of Non-storm Water Discharges) of this permit that are combined with storm water discharges associated with industrial activity must be identified in the plan. The plan shall identify and ensure the implementation of appropriate pollution prevention measures for the non-storm water component(s) of the discharge.

(iii) Failure to Certify.—Any facility that is unable to provide the certification required (testing for non-storm water discharges), must notify the Director by [Insert date 270 days after permit issuance] or, for facilities which begin to discharge storm water associated with industrial activity after [Insert date 270 days after permit issuance], 180 days after submitting an NOI to be covered by this permit. If the failure to certify is caused by the inability to perform adequate tests or evaluations, such notification shall describe the procedure of any test conducted for the presence of non-storm water discharges to the storm sewer and why adequate tests for such storm sewers were not feasible. Non-storm water discharges to waters of the United States which are not authorized by an NPDES permit are unlawful and must be terminated.

(h) Sediment and Erosion Control—The plan shall identify areas which, due to topography, activities, or other factors, have a high potential for significant soil erosion, and identify structural, vegetative, and/or stabilization measures to be used to limit erosion.

Permittees must indicate the location and design for proposed BMPs to be implemented prior to land disturbance activities. For sites already disturbed but without BMPs, the permittee must indicate the location and design of BMPs that will be implemented. The permittee is required to indicate plans for grading, contouring, stabilization, and establishment of vegetative cover for all disturbed areas, including road banks. Reclamation activities must continue until final closure notice has been issued.

(i) Management of Runoff—The plan shall contain a narrative consideration of the appropriateness of traditional storm water management practices (practices other than those which control the generation or source(s) of pollutants) used to divert, infiltrate, reuse, or otherwise manage storm water runoff in a manner that reduces pollutants in storm water discharges from the site. The plan shall provide that measures that the permittee determines to be reasonable and appropriate shall be implemented and maintained. The potential of various sources at the facility to contribute pollutants to storm water discharges associated with industrial activity [see Part XI.J.3.a.(2) (Description of Potential Pollutant Sources) of this permit] shall be considered when determining reasonable and appropriate measures. Appropriate measures may include: vegetative swales and practices, reuse of

collected storm water (such as for a process or as an irrigation source), inlet controls (such as oil/water separators), snow management activities, infiltration devices, wet detention/retention devices, or equivalent measures. In addition, the permittee must describe the storm water pollutant source area or activity (i.e., loading and unloading operations, raw material storage piles, etc.) to be controlled by each storm water management practice.

(4) *Comprehensive Site Compliance Evaluation.* Qualified personnel shall conduct site compliance evaluations at appropriate intervals specified in the plan, but, in no case less than once a year. When annual compliance evaluations are shown in the plan to be impractical for inactive mining sites, due to remote location and inaccessibility, site evaluations must be conducted at least once every 3 years. Such evaluations shall provide:

(*a*) Areas contributing to a storm water discharge associated with industrial activity shall be visually inspected for evidence of, or the potential for, pollutants entering the drainage system. Measures to reduce pollutant loadings shall be evaluated to determine whether they are adequate and properly implemented in accordance with the terms of the permit or whether additional control measures are needed. Structural storm water management measures, sediment and erosion control measures, and other structural pollution prevention measures identified in the plan shall be observed to ensure that they are operating correctly. A visual inspection of equipment needed to implement the plan, such as spill response equipment, shall be made.

(*b*) Based on the results of the evaluation, the description of potential pollutant sources identified in the plan in accordance with Part XI.J.3.a.(2) (Description of Potential Pollutant Sources) of this permit and pollution prevention measures and controls identified in the plan in accordance with paragraph XI.J.3.a.(3) (Measures and Controls) of this permit shall be revised as appropriate within 2 weeks of such evaluation and shall provide for implementation of any changes to the plan in a timely manner, but in no case more than 12 weeks after the evaluation.

(*c*) A report summarizing the scope of the evaluation, personnel making the evaluation, the date(s) of the evaluation, major observations relating to the implementation of the storm water pollution prevention plan, and actions taken in accordance with paragraph XI.J.3.a.(4)(b) (above) of the permit shall be made and retained as part of the storm water pollution prevention plan for at least 3 years from the date of the evaluation. The report shall identify any incidents of noncompliance. Where a report does not identify any incidents of noncompliance, the report shall contain a certification that the facility is in compliance with the storm water pollution prevention plan and this permit. The report shall be signed in accordance with Part VII.G. (Signatory Requirements) of this permit.

(*d*) The storm water pollution prevention plan must describe the scope and content of comprehensive site evaluation that qualified personnel will conduct to 1) confirm the accuracy of the description of potential pollution sources contained in the plan, 2) determine the effectiveness of the plan, and 3) assess compliance with the terms and conditions of the permit. Where compliance evaluation schedules overlap with inspections required under 3.a.(3)(d), the compliance evaluation may be conducted in place of one such inspection.

4. Numeric Effluent Limitations

Except as discussed in *a* below, there are no additional numeric effluent limitations beyond those described in Part V.B of this permit.

a. Region VI—Construction Sand and Gravel; Industrial Sand, and Crushed Stone Mining, Mine Dewatering. Any discharge composed entirely of storm water or ground water seepage that derives from mine dewatering activities at construction sand and gravel, industrial sand, or crushed stone mining facilities located in Region VI (the States of Louisiana, New Mexico, Oklahoma, and Texas) and in Arizona shall not exceed a maximum concentration for any day of 45 mg/L or an average of daily values for 30 consecutive days of 25 mg/L Total Suspended Solids (TSS) nor the 6.0 to 9.0 range limitation for pH. The discharge from the dewatering activity shall not be diluted with other storm water runoff or flows to meet this limitation. Dischargers subject to these numeric effluent limitations must be in compliance with these limits upon commencement of coverage and for the entire term of this permit.

5. Monitoring and Reporting Requirements

a. Analytical Monitoring Requirements. During the period beginning [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] and the period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance], permittees with dimension and crushed stone, and nonmetallic minerals (except fuels), and sand and gravel mining activities must monitor their storm water discharges associated with industrial activity at least quarterly (4 times per year) during years 2 and 4 except as provided in paragraphs 5.a.(3) (Sampling Waiver), 5.a.(4) (Representative Discharge), and 5.a.(5) (Alternative Certification). Such facilities are required to monitor their storm water discharges for the pollutants of concern listed in Table J–1 below. Facilities must report in accordance with 5.b. (Reporting). In addition to the parameters listed in Table J–1 below, the permittee shall provide the date and duration (in hours) of the storm event(s) sampled; rainfall measurements or estimates (in inches) of the storm event that generated the sampled runoff; the duration between the storm event sampled and the end of the previous measurable (greater than 0.1 inch rainfall) storm event; and an estimate of the total volume (in gallons) of the discharge sampled.

TABLE J–1.—MONITORING REQUIREMENTS

Pollutants of concern	Cut-off concentration
Sand and Gravel Mining	
Nitrate plus Nitrite Nitrogen ..	0.68 mg/L.
Total Suspended Solids (TSS).	100 mg/L.
Dimension and Crushed Stone and Nonmetallic Minerals (except fuels):	
Total Suspended Solids (TSS).	100 mg/L.

(*1*) *Monitoring Periods.* Facilities subject to analytical monitoring requirements shall monitor samples collected during the sampling periods of: January through March, April through June, July through September, and October through December for the years specified in paragraph a. (above).

(*2*) *Sample Type.* A minimum of one grab sample shall be taken. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The required 72-hour storm event interval is waived where the preceding measurable storm event did not result in a measurable discharge from the facility. The required 72-hour storm event interval may also be waived where the permittee documents that less than a 72-hour interval is representative for local storm events during the season when sampling is being conducted. The grab sample shall be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable. If storm water discharges associated with industrial activity commingle with process or nonprocess water, then where practicable permittees must attempt to sample the storm water discharge before it mixes with the non-storm water discharge.

(3) *Sampling Waiver*

(a) *Adverse Conditions*—When a discharger is unable to collect samples within a specified sampling period due to adverse climatic conditions, the discharger shall collect a substitute sample from a separate qualifying event in the next period and submit the data along with the data for the routine sample in that period. Adverse weather conditions that may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricanes, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(b) *Low Concentration Waiver*—When the average concentration for a pollutant calculated from all monitoring data collected from an outfall during the monitoring period [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] is less than the corresponding value for that pollutant listed in Table J–1 under the column Monitoring Cut-off Concentration, a facility may waive monitoring and reporting requirements in the monitoring period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance]. The facility must submit to the Director, in lieu of the monitoring data, a certification that there has not been a significant change in industrial activity or the pollution prevention measures in area of the facility that drains to the outfall for which sampling was waived.

(c) When a discharger is unable to conduct quarterly chemical storm water sampling at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirements as long as the facility remains inactive and unstaffed. The facility must submit to the Director, in lieu of monitoring data, a certification statement on the DMR stating that the site is inactive and unstaffed so that collecting a sample during a qualifying event is not possible.

(4) *Representative Discharge.* When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may test the effluent of one of such outfalls and report that the quantitative data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan. The permittee shall include the description of the location of the outfalls, explanation of why outfalls are expected to discharge substantially identical effluents, and estimate of the size of the drainage area and runoff coefficient with the Discharge Monitoring Report.

(5) *Alternative Certification.* A discharger is not subject to the monitoring requirements of this section provided the discharger makes a certification for a given outfall or on a pollutant-by-pollutant basis in lieu of monitoring reports required under paragraph *b* below, under penalty of law, signed in accordance with Part VII.G. (Signatory Requirements), that material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, industrial machinery or operations, or significant materials from past industrial activity that are located in areas of the facility within the drainage area of the outfall are not presently exposed to storm water and are not expected to be exposed to storm water for the certification period. Such certification must be retained in the storm water pollution prevention plan, and submitted to EPA in accordance with Part VI.C. of this permit. In the case of certifying that a pollutant is not present, the permittee must submit the certification along with the monitoring reports required under paragraph (*b*) below. If the permittee cannot certify for an entire period, they must submit the date exposure was eliminated and any monitoring required up until that date. This certification option is not applicable to compliance monitoring requirements associated with effluent guidelines.

b. *Reporting.* Permittees with dimension and crushed stone, sand and gravel or nonmetallic mineral (except fuels) mining facilities shall submit monitoring results for each outfall associated with industrial activity [or a certification in accordance with Sections (3), (4), or (5) above] obtained during the reporting period beginning [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] on Discharge Monitoring Report Form(s) postmarked no later than the 31st day of the following March [insert the date 2 years after permit issuance]. Monitoring results [or a certification in accordance with Sections (3), (4), or (5) above] obtained during the period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance] shall be submitted on Discharge Monitoring Report Form(s) postmarked no later than the 31st day of the following March. For each outfall, one signed Discharge Monitoring Report Form must be submitted to the Director per storm event sampled. Signed copies of Discharge Monitoring Reports, or said certifications, shall be submitted to the Director of the NPDES program at the address of the appropriate Regional Office listed in Part VI.G. of the fact sheet.

(1) *Additional Notification.* In addition to filing copies of discharge monitoring reports in accordance with paragraph b (above), sand and gravel mining facilities with at least one storm water discharge associated with industrial activity through a large or medium municipal separate storm sewer system (systems serving a population of 100,000 or more) must submit signed copies of discharge monitoring reports to the operator of the municipal separate storm sewer system in accordance with the dates provided in paragraph b (above).

c. *Quarterly Visual Examination of Storm Water Quality.* Mineral mining and processing facilities covered under this sector shall perform and document a visual examination of a storm water discharge associated with industrial activity from each outfall, except discharges exempted below. The examinations must be made at least once in each designated period [described in (1), below] during daylight hours unless there is insufficient rainfall or snow melt to produce a runoff event.

(1) Examinations shall be conducted in each of the following periods for the purposes of visually inspecting storm water quality associated with storm water runoff or snow melt: January through March; April through June; June through September; and October through December.

(2) Examinations shall be made of samples collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed one hour) of when the runoff or snowmelt begins discharging. The examinations shall document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on the samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. Where practicable, the same individual will carry out the collection and examination of discharges for the life of the permit.

When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the records of the visual examinations. Adverse weather conditions which may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(3) Visual examination reports must be maintained onsite in the pollution prevention plan. The report shall include the examination date and time, examination personnel, the nature of the discharge (i.e., runoff or snow melt), visual quality of the storm water discharge (including observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution), and probable sources of any observed storm water contamination.

(4) When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may collect a sample of effluent of one of such outfalls and report that the examination data also applies to the substantially identical outfalls provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explaining in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area (e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

(5) When a discharger is unable to conduct visual storm water examinations at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirement as long as the facility remains inactive and unstaffed. The facility must maintain a certification with the pollution prevention plan stating that the site is inactive and unstaffed so that performing visual examinations during a qualifying event is not feasible.

d. *Compliance Monitoring Requirements.* Permittees with construction sand and gravel, industrial sand, and crushed stone mining facilities in Region VI that have mine dewatering discharges composed entirely of storm water or ground water seepage which are covered by this permit must monitor the discharge from the dewatering activity for the presence of TSS and pH at least quarterly (four times per year). Facilities must report in accordance with 5.d.(2) below (reporting). In addition to the parameters listed above, the permittee shall provide the date and duration (in hours) of the storm event(s) sampled; rainfall measurements or estimates (in inches) of the storm event that generated the sampled runoff; the duration between the storm event sampled and the end of the previous measurable (greater than 0.1 inch rainfall) storm event; and an estimate of the total volume (in gallons) of the discharge sampled.

(1) Sample Type. A minimum of one grab sample shall be taken. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The grab sample shall be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable.

(2) Reporting. Permittees with mine dewatering discharges from construction sand and gravel, industrial sand, or crushed stone mining facilities located in Region VI and Arizona shall submit monitoring results obtained during the reporting period beginning [insert date of permit issuance] on Discharge Monitoring Report Form(s) postmarked no later than the 31st day of the following [insert month after permit issuance date]. Signed copies of Discharge Monitoring Reports shall be submitted to the Director of the NPDES program at the address of the appropriate Regional Office indicated in Part VI.B. of this permit. For each outfall, one signed Discharge Monitoring Report form shall be submitted for each storm event sampled.

(3) Additional Notification. In addition to filing copies of discharge monitoring reports in accordance with paragraph (2) (above), permittees with discharges of material storage runoff from cement manufacturing facilities through a large or medium municipal separate storm sewer system (systems serving a population of 100,000 or more) must submit signed copies of discharge monitoring reports to the operator of the municipal separate storm sewer system in accordance with the dates provided in paragraph 5.d.(3) (above).

K. Storm Water Discharges Associated With Industrial Activity From Hazardous Waste Treatment, Storage, or Disposal Facilities

1. Discharges Covered Under This Section

The requirements listed under this section shall apply to storm water discharges associated with industrial activity from facilities that treat, store, or dispose of hazardous wastes, including those that are operating under interim status or a permit under subtitle C of RCRA.

Coverage under this sector for facilities located in Region VI is limited to Hazardous Waste Treatment Storage or Disposal Facilities (TSDFs) that are self-generating or totally residential wastes and to those facilities that only store hazardous waste and do not treat or dispose. These permits are issued by EPA Region VI for Louisiana (LAR05*###), New Mexico

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(NMR05*###), Oklahoma (OKR05*###), Texas (TXR05*###), and Federal Indian Reservations in these States (LAR05*##F, NMR05*##F, OKR05*##F, or TXR05*##F). Disposal facilities that have been properly closed and capped, and have no significant materials exposed to storm water, are considered inactive and do not require permits [(40 CFR 122.26(b)(14)]. Prohibited from coverage under this sector are those commercial hazardous wastes disposal and treatment facilities located in Region VI that dispose and treat on a commercial basis any produced hazardous waste (not their own) as a service to generators.

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

2. Special Conditions

a. Prohibition of Non-storm Water Discharges. There are no additional requirements under this section other than those stated in Part III.A.2 of this permit.

3. Storm Water Pollution Prevention Plan Requirements

a. Contents of Plan. The plan shall include, at a minimum, the following items:

(1) Pollution Prevention Team. Each plan shall identify a specific individual or individuals within the facility organization as members of a storm water Pollution Prevention Team that are responsible for developing the storm water pollution prevention plan and assisting the facility or plant manager in its implementation, maintenance, and revision. The plan shall clearly identify the responsibilities of each team member. The activities and responsibilities of the team shall address all aspects of the facility's storm water pollution prevention plan.

(2) Description of Potential Pollutant Sources. Each plan shall provide a description of potential sources which may reasonably be expected to add significant amounts of pollutants to storm water discharges or which may result in the discharge of pollutants during dry weather from separate storm sewers draining the facility. Each plan shall identify all activities and significant materials which may potentially be significant pollutant sources. Each plan shall include, at a minimum:

(a) Drainage.

(i) A site map indicating an outline of the portions of the drainage area of each storm water outfall that are within the facility boundaries, each existing structural control measure to reduce pollutants in storm water runoff, surface water bodies, locations where significant materials are exposed to precipitation, locations where major spills or leaks identified under Part IV.D.3.c. (Spills and Leaks) of this permit have occurred, and the locations of the following activities where such activities are exposed to precipitation: fueling stations, vehicle and equipment maintenance and/or cleaning areas, loading/unloading areas, locations used for the treatment, storage or disposal of wastes, liquid storage tanks, processing areas and storage areas. The map must indicate the outfall locations and the types of discharges contained in the drainage areas of the outfalls.

(ii) For each area of the facility that generates storm water discharges associated with industrial activity with a reasonable potential for containing significant amounts of pollutants, a prediction of the direction of flow, and an identification of the types of pollutants which are likely to be present in storm water discharges associated with industrial activity. Factors to consider include the toxicity of chemicals; quantity of chemicals used, produced or discharged; the likelihood of contact with storm water; and history of significant leaks or spills of toxic or hazardous pollutants. Flows with a significant potential for causing erosion shall be identified.

(b) Inventory of Exposed Materials—An inventory of the types of materials handled at the site that potentially may be exposed to precipitation. Such inventory shall include a narrative description of significant materials that have been handled, treated, stored or disposed in a manner to allow exposure to storm water between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; method and location of onsite storage or disposal; materials management practices employed to minimize contact of materials with storm water runoff between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; the location and a description of existing structural and nonstructural control measures to reduce pollutants in storm water runoff; and a description of any treatment the storm water receives.

(c) Spills and Leaks—A list of significant spills and significant leaks of toxic or hazardous pollutants that occurred at areas that are exposed to precipitation or that otherwise drain to a storm water conveyance at the facility after the date of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit. Such list shall be updated as appropriate during the term of the permit.

(d) Sampling Data—A summary of existing discharge sampling data describing pollutants in storm water discharges from the facility, including a summary of sampling data collected during the term of this permit.

(e) Risk Identification and Summary of Potential Pollutant Sources—A narrative description of the potential pollutant sources from the following activities: loading and unloading operations; outdoor storage activities; outdoor processing activities; significant dust or particulate generating processes; and onsite waste disposal practices. The description shall specifically list any significant potential source of pollutants at the site and for each potential source, any pollutant or pollutant parameter (e.g., chemical oxygen demand, etc.) of concern shall be identified.

(e) Measures and Controls. Each facility covered by this permit shall develop a description of storm water management controls appropriate for the facility, and implement such controls. The appropriateness and priorities of controls in a plan shall reflect identified potential sources of pollutants at the facility. The description of storm water management controls shall address the following minimum components, including a schedule for implementing such controls:

(a) Good Housekeeping—Good housekeeping requires the maintenance of areas which may contribute pollutants to storm water discharges in a clean, orderly manner.

(b) Preventive Maintenance—A preventive maintenance program shall involve timely inspection and maintenance of storm water management devices (e.g., berms, catch basins) as well as inspecting and testing facility equipment and systems to uncover conditions that could cause

breakdowns or failures resulting in discharges of pollutants to surface waters, and ensuring appropriate maintenance of such equipment and systems.

Spill Prevention and Response Procedures—Areas where potential spills which can contribute pollutants to storm water discharges can occur, and their accompanying drainage points shall be identified clearly in the storm water pollution prevention plan. Where appropriate, specifying material handling procedures, storage requirements, and use of equipment such as diversion valves in the plan should be considered. Procedures for cleaning up spills shall be identified in the plan and made available to the appropriate personnel. The necessary equipment to implement a clean up should be available to personnel.

(d) Inspections—In addition to or as part of the comprehensive site evaluation required under paragraph XI.K.3.a.(4) of this section, qualified facility personnel shall be identified to inspect designated equipment and areas of the facility at appropriate intervals specified in the plan. A set of tracking or follow-up procedures shall be used to ensure that appropriate actions are taken in response to the inspections. Records of inspections shall be maintained.

(e) Employee Training—Employee training programs shall inform personnel responsible for implementing activities identified in the storm water pollution prevention plan or otherwise responsible for storm water management at all levels of responsibility of the components and goals of the storm water pollution prevention plan. Training should address topics such as spill response, good housekeeping and material management practices. The pollution prevention plan shall identify periodic dates for such training.

(f) Recordkeeping and Internal Reporting Procedures—A description of incidents (such as spills, or other discharges), along with other information describing the quality and quantity of storm water discharges shall be included in the plan required under this part. Inspections and maintenance activities shall be documented and records of such activities shall be incorporated into the plan.

(g) Non-storm Water Discharges

(i) The plan shall include a certification that the discharge has been tested or evaluated for the presence of non-storm water discharges. The certification shall include the identification of potential significant sources of non-storm water at the site, a description of the results of any test and/or evaluation for the presence of non-storm water discharges, the evaluation criteria or testing method used, the date of any testing and/or evaluation, and the onsite drainage points that were directly observed during the test. Certifications shall be signed in accordance with Part VII.G. of this permit. Such certification may not be feasible if the facility operating the storm water discharge associated with industrial activity does not have access to an outfall, manhole, or other point of access to the ultimate conduit which receives the discharge. In such cases, the source identification section of the storm water pollution prevention plan shall indicate why the certification required by this part was not feasible, along with the identification of potential significant sources of non-storm water at the site. A discharger that is unable to provide the certification required by this paragraph must notify the Director in accordance with paragraph (iii) (below).

(ii) Except for flows from fire fighting activities, sources of non-storm water listed in Part III.A.2 (Prohibition of Non-storm Water Discharges) of this permit that are combined with storm water discharges associated with industrial activity must be identified in the plan. The plan shall identify and ensure the implementation of appropriate pollution prevention measures for the non-storm water component(s) of the discharge.

(iii) Failure to Certify—Any facility that is unable to provide the certification required (testing for non-storm water discharges), must notify the Director by [Insert date 270 days after permit issuance] or, for facilities which begin to discharge storm water associated with industrial activity after [Insert date 270 days after permit issuance], 180 days after submitting an NOI to be covered by this permit. If the failure to certify is caused by the inability to perform adequate tests or evaluations, such notification shall describe: the procedure of any test conducted for the presence of non-storm water discharges; the results of such test or other relevant observations; potential sources of non-storm water discharges to the storm sewer; and why adequate tests for such storm sewers were not feasible. Non-storm water discharges to waters of the United States which are not authorized by an NPDES permit are unlawful, and must be terminated.

(h) Sediment and Erosion Control—The plan shall identify areas which, due to topography, activities, or other factors, have a high potential for significant soil erosion, and identify structural, vegetative, and/or stabilization measures to be used to limit erosion.

(i) Management of Runoff—The plan shall contain a narrative consideration of the appropriateness of traditional storm water management practices (practices other than those which control the generation or source(s) of pollutants) used to divert, infiltrate, reuse, or otherwise manage storm water runoff in a manner that reduces pollutants in storm water discharges from the site. The plan shall provide that measures that the permittee determines to be reasonable and appropriate shall be implemented and maintained. The potential of various sources at the facility to contribute pollutants to storm water discharges associated with industrial activity [see paragraph XI.K.3.a.(2) of this section (Description of Potential Pollutant Sources)] shall be considered when determining reasonable and appropriate measures. Appropriate measures may include: vegetative swales and practices, reuse of collected storm water (such as for a process or as an irrigation source), inlet controls (such as oil/water separators), snow management activities, infiltration devices, wet detention/retention devices, or other equivalent measures.

(4) Comprehensive Site Compliance Evaluation. Qualified personnel shall conduct site compliance evaluations at appropriate intervals specified in the plan but in no case less than once a year. Such evaluations shall provide:

(a) Areas contributing to a storm water discharge associated with industrial activity shall be visually inspected for evidence of, or the potential for, pollutants entering the drainage system. Measures to reduce pollutant loadings shall be evaluated to determine whether they are adequate and properly implemented in accordance with the terms of the permit or whether additional control measures are needed. Structural storm water management measures, sediment and erosion control measures, and other structural pollution prevention measures identified in the plan shall be observed to ensure that they are operating correctly. A visual inspection of equipment needed to implement the plan, such as spill response equipment, shall be made.

(b) Based on the results of the evaluation, the description of potential pollutant sources identified in the plan in accordance with paragraph XI.K.3.a.(2) of this section (Description of Potential Pollutant Sources) and pollution prevention measures and controls identified in the plan in accordance with paragraph XI.K.3.a.(3) of this section (Measures and Controls) shall be revised as appropriate within 2

weeks of such evaluation and shall provide for implementation of any changes to the plan in a timely manner, but in no case more than 12 weeks after the evaluation.

(c) A report summarizing the scope of the evaluation, personnel making the evaluation, the date(s) of the evaluation, major observations relating to the implementation of the storm water pollution prevention plan, and actions taken in accordance with paragraph (4)(b) (above) of the permit shall be made and retained as part of the storm water pollution prevention plan for at least 3 years from the date of the evaluation. The report shall identify any incidents of noncompliance. Where a report does not identify any incidents of noncompliance, the report shall contain a certification that the facility is in compliance with the storm water pollution prevention plan and this permit. The report shall be signed in accordance with Part VII.G. (Signatory Requirements) of this permit.

(d) Where compliance evaluation schedules overlap with inspections required under 3.a.(3)(d), the compliance evaluation may be conducted in place of one such inspection.

4. Numeric Effluent Limitations

There are no additional numeric effluent limitations beyond those in Part V.B of this permit.

5. Monitoring and Reporting Requirements

a. Analytical Monitoring Requirements. During the period beginning [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] and the period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance], permittees with hazardous waste treatment, storage, or disposal facilities (TSDFs) must monitor their storm water discharges associated with industrial activity at least quarterly (4 times per year) during years 2 and 4 except as provided in paragraphs 5.a.(3) (Sampling Waiver), 5.a.(4) (Representative Discharge), and 5.a.(5) (Alternative Certification). TSDFs are required to monitor their storm water discharges for the pollutants of concern listed in Table K–1 below. Facilities must report in accordance with 5.b. (Reporting). In addition to the parameters listed in Table K–1 below, the permittee shall provide the date and duration (in hours) of the storm event(s) sampled; rainfall measurements or estimates (in inches) of the storm event that generated the sampled runoff; the duration between the storm event sampled and the end of the previous measurable (greater than 0.1 inch rainfall) storm event; and an estimate of the total volume (in gallons) of the discharge sampled.

TABLE K–1.—INDUSTRY MONITORING REQUIREMENTS

Pollutants of concern	Cut-off concentration
Ammonia	19.0 mg/L.
Total Recoverable Magnesium*.	0.0636 mg/L.
Chemical Oxygen Demand (COD).	120.0 mg/L.
Total Recoverable Arsenic.	0.16854 mg/L.
Total Recoverable Cadmium.	0.0159 mg/L.
Total Cyanide**	0.0636 mg/L.
Total Recoverable Lead	0.0816 mg/L.
Total Recoverable Mercury.	0.0024 mg/L.
Total Recoverable Selenium.	0.2385 mg/L.
Total Recoverable Silver	0.0318 mg/L.

*The MDL for magnesium is 0.02 mg/L method 200.6.

**The MDL for cyanide is 0.02 mg/L method 335.1, 335.2, or 335.3.

(1) Monitoring Periods. TSDFs shall monitor samples collected during the sampling periods of: January through March, April through June, July through September, and October through December for the years specified in paragraph a. (above).

(2) Sample Type. A minimum of one grab sample shall be taken. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The required 72-hour storm event interval is waived where the preceding measurable storm event did not result in a measurable discharge from the facility. The required 72-hour storm event interval may also be waived where the permittee documents that less than a 72-hour interval is representative for local storm events during the season when sampling is being conducted. The grab sample shall be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable. If storm water discharges associated with industrial activity commingle with process or nonprocess water, then where practicable permittees must attempt to sample the storm water discharge before it mixes with the non-storm water discharge.

(3) Sampling Waiver.

(a) Adverse Conditions—When a discharger is unable to collect samples within a specified sampling period due to adverse climatic conditions, the discharger shall collect a substitute sample from a separate qualifying event in the next period and submit the data along with data for the routine sample in that period. Adverse weather conditions that may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(b) Low Concentration Waiver—When the average concentration for a pollutant calculated from all monitoring data collected from an outfall during the monitoring period [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] is less than the corresponding value for that pollutant listed in Table K–1 under the column Monitoring Cut-off Concentration, a facility may waive monitoring and reporting requirements in the monitoring period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance]. The facility must submit to the Director, in lieu of the monitoring data, a certification that there has not been a significant change in industrial activity or the pollution prevention measures in area of the facility which drains to the outfall for which sampling was waived.

(c) When a discharger is unable to conduct quarterly chemical storm water sampling at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirements as long as the facility remains inactive and unstaffed. The facility must submit to the Director, in lieu of monitoring data, a certification statement on the DMR stating that the site is inactive and unstaffed so that collecting a sample during a qualifying event is not possible.

(4) Representative Discharge. When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may test the

effluent of one of such outfalls and report that the quantitative data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan. The permittee shall include the description of the location of the outfalls, explanation of why outfalls are expected to discharge substantially identical effluents, and estimate of the size of the drainage area and runoff coefficient with the Discharge Monitoring Report.

(5) Alternative Certification. A discharger is not subject to the monitoring requirements of this section provided the discharger makes a certification for a given outfall, or on a pollutant-by-pollutant basis in lieu of monitoring reports required under paragraph b below, under penalty of law, signed in accordance with Part VII.G. (Signatory Requirements), that material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, industrial machinery or operations, or significant materials from past industrial activity that are located in areas of the facility within the drainage area of the outfall are not presently exposed to storm water and are not expected to be exposed to storm water for the certification period. Such certification must be retained in the storm water pollution prevention plan, and submitted to EPA in accordance with Part VI.B. of this permit. In the case of certifying that a pollutant is not present, the permittee must submit the certification along with the monitoring reports required under paragraph (*b*) below. If the permittee cannot certify for an entire period, they must submit the date exposure was eliminated and any monitoring required up until that date. This certification option is not applicable to compliance monitoring requirements associated with effluent limitations.

b. Reporting. Permittees with TSDFs shall submit monitoring results for each outfall associated with industrial activity [or a certification in accordance with Sections (3), (4), or (5) above] obtained during the reporting period beginning [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] on Discharge Monitoring Report Form(s) postmarked no later than the 31st day of the following March [insert the date 2 years after permit issuance]. Monitoring results [or a certification in accordance with Sections (3), (4), or (5) above] obtained during the period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance] shall be submitted on Discharge Monitoring Report Form(s) postmarked no later than the 31st day of the following March. For each outfall, one signed Discharge Monitoring Report form must be submitted to the Director per storm event sampled. Signed copies of Discharge Monitoring Reports, or said certifications, shall be submitted to the Director of the NPDES program at the address of the appropriate Regional Office listed in Part VI.G. of the fact sheet.

(1) Additional Notification. In addition to filing copies of discharge monitoring reports in accordance with paragraph b (above), TSDFs with at least one storm water discharge associated with industrial activity through a large or medium municipal separate storm sewer system (systems serving a population of 100,000 or more) must submit signed copies of discharge monitoring reports to the operator of the municipal separate storm sewer system in accordance with the dates provided in paragraph b (above).

c. Quarterly Visual Examination of Storm Water Quality. Facilities shall perform and document a visual examination of a representative storm water discharge associated with industrial activity from each outfall, except discharges exempted below. The examination must be made at least once in each of the following periods: January through March, April through June, July through September, and October through December during daylight hours unless there is insufficient rainfall or snow melt to produce a runoff event.

(*1*) Examinations shall be made of samples collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 1 hour) of when the runoff or snowmelt begins discharging. The examinations shall document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on the samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. Where practicable, the same individual should carry out the collection and examination of discharges for entire permit term.

(*2*) Visual examination reports must be maintained onsite in the pollution prevention plan. The report shall include the examination date and time, examination personnel, the nature of the discharge (i.e., runoff or snow melt), visual quality of the storm water discharge (including observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution), and probable sources of any observed storm water contamination.

(*3*) When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may collect a sample of effluent of one of such outfalls and report that the observation data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

(*4*) When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the records of the visual examinations. Adverse weather conditions which may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(*5*) When a discharger is unable to conduct visual storm water examinations at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirement as long as the facility remains inactive and unstaffed. The facility must maintain a certification with the pollution prevention plan stating that the site is inactive and unstaffed so that performing visual examinations during a qualifying event is not feasible.

L. Storm Water Discharges Associated With Industrial Activity From Landfills and Land Application Sites

1. Discharges Covered Under This Section

a. Coverage. The requirements listed under this section shall apply to storm water discharges associated with industrial activity from waste disposal at landfills and land application sites that receive or have received industrial wastes. Landfill and land application operators that have storm water discharges from other types of industrial activities such as vehicle maintenance, truck washing, and/or recycling may be subject to additional requirements specified elsewhere in this permit.

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

b. Limitations. Storm water discharges associated with industrial activities from inactive landfills and land application sites occurring on Federal lands where an operator cannot be identified are ineligible for coverage under this permit.

2. Special Conditions

a. Prohibition of Non-storm Water Discharges. In addition to the broad non-storm water prohibition in Part III.A of today's permit, the discharge of leachate and vehicle and equipment washwaters to waters of the United States or a municipal separate storm sewer system is not authorized by this permit. Operators with such discharges must obtain coverage under a separate NPDES permit (other than this permit). Discharges from open dumps as defined under RCRA are also not authorized under this permit (e.g., leachate, runoff).

3. Storm Water Pollution Prevention Plan Requirements

a. Contents of Plan. The plan shall include, at a minimum, the following items:

(1) Pollution Prevention Team. Each plan shall identify a specific individual or individuals within the facility organization as members of a storm water Pollution Prevention Team that are responsible for developing the storm water pollution prevention plan and assisting the facility or plant manager in its implementation, maintenance, and revision. The plan shall clearly identify the responsibilities of each team member. The activities and responsibilities of the team shall address all aspects of the facility's storm water pollution prevention plan.

(2) Description of Potential Pollutant Sources. Each plan shall provide a description of potential sources which may reasonably be expected to add significant amounts of pollutant to storm water discharges or which may result in the discharge of pollutants during dry weather from separate storm sewers draining the facility. Each plan shall identify all activities and significant materials which may potentially be significant pollutant sources. Each plan shall include, at a minimum:

(a) Drainage.

(i) A site map indicating an outline of the portions of the drainage area of each storm water outfall that are within the facility boundaries, each existing structural control measure to reduce pollutants in storm water runoff, surface water bodies, locations of active and closed landfill cells or trenches, locations of active and closed land application areas, locations of any known leachate springs or other areas where uncontrolled leachate may commingle with runoff, locations of any leachate collection and handling systems, locations where major spills or leaks identified under Part XI.L.3.a.(2)(c) (Spills and Leaks) of this permit have occurred, and locations of the following activities where such activities are exposed to precipitation: fueling station, vehicle and equipment maintenance and/or cleaning areas, and waste and other significant material loading/unloading and storage areas. The map must indicate the outfall locations and the types of discharges contained in the drainage areas of the outfalls.

(ii) For each area of the facility that generates storm water discharges associated with industrial activity with a reasonable potential for containing significant amounts of pollutants, a prediction of the direction of flow, and an identification of the types of pollutants which are likely to be present in storm water discharges associated with industrial activity. Factors to consider include the toxicity of chemicals; quantities of chemicals used, produced or discharged; the likelihood of contact with storm water; and the history of significant leaks or spills of toxic or hazardous pollutants. Flows with a significant potential for causing erosion shall be identified.

(b) Inventory of Exposed Materials—An inventory of the types of materials handled at the site that potentially may be exposed to precipitation. Such inventory shall include a narrative description of significant materials that have been handled, treated, or disposed of in a manner to allow exposure to storm water between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; method and location of onsite storage or disposal; materials management practices employed to minimize contact of materials with storm water runoff between the time of 3 years prior to the date of submission of a Notice of Intent (NOI) to be covered under this permit and the present; the location and a description of existing structural and nonstructural control measures to reduce pollutants in storm water runoff; and a description of any treatment the storm water receives. The inventory of exposed materials shall include, but shall not be limited to the significant material management practices employed.

(c) Spills and Leaks—A list of significant spills and significant leaks of toxic or hazardous pollutants that occurred at areas that are exposed to precipitation or that otherwise drain to a storm water conveyance at the facility after the date of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit. Such list shall be updated as appropriate during the term of the permit.

(d) Sampling Data—A summary of existing discharge sampling data describing pollutants in storm water of sampling data collected during the term of this permit. Permittees shall also provide all available sampling data for leachate generated at the site.

(e) Risk Identification and Summary of Potential Pollutant Sources—Include a narrative description of potential

pollutant sources associated with any of the following, providing they occur at the facility: fertilizer, herbicide and pesticide application; earth/soil moving; waste hauling and loading/unloading; outdoor storage of significant materials including daily, interim and final cover material stockpiles as well as temporary waste storage areas; exposure of active and inactive landfill and land application areas; uncontrolled leachate flows; failure or leaks from leachate collection and treatment systems; haul roads; and vehicle tracking of sediments. The description shall specifically list any significant potential sources of pollutants at the site and for each potential source, any pollutant or pollutant parameter (e.g., biochemical oxygen demand, etc.) of concern shall be identified.

(3) Measures and Controls. Each facility covered by this permit shall develop a description of storm water management controls appropriate for the facility, and implement such controls. The appropriateness and priorities of controls in a plan shall reflect identified potential sources of pollutants at the facility. The description of storm water management controls shall address the following minimum components, including a schedule for implementing such controls:

(a) Good Housekeeping—Good housekeeping requires the maintenance of areas which may contribute pollutants to storm water discharges in a clean, orderly manner. Permittees shall consider providing protected materials storage areas for pesticides, herbicides, fertilizers, and other significant materials.

(b) Preventive Maintenance—A preventive maintenance program shall involve timely inspection and maintenance of storm water management devices (e.g., cleaning oil/water separators, catch basins) as well as inspecting and testing facility equipment and systems to uncover conditions that could cause breakdowns or failures resulting in discharges of pollutants to surface waters, and ensuring appropriate maintenance of such equipment and systems.

Where applicable, permittees addressed by this section shall also: (1) maintain containers used for outdoor chemical and significant materials storage to prevent leaking or rupture; (2) maintain all elements of leachate collection and treatment systems to prevent commingling of leachate with storm water; and (3) maintain the integrity and effectiveness of any intermediate or final cover, including making repairs to the cover as necessary to minimize the effects of settlement, sinking, and erosion.

(c) Spill Prevention and Response Procedures—Areas where potential spills which can contribute pollutants to storm water discharges can occur, and their accompanying drainage points shall be identified clearly in the storm water pollution prevention plan. Where appropriate, specifying material handling procedures, storage requirements, and use of equipment such as diversion valves in the plan should be considered. Procedures for cleaning up spills shall be identified in the plan and made available to the appropriate personnel. The necessary equipment to implement a clean up should be available to personnel.

(d) Inspections—Qualified facility personnel shall be identified to inspect designated equipment and areas of the facility at appropriate intervals specified in the plan.

(i) For operating landfills and land application sites, inspections shall be conducted at least once every 7 days. Qualified personnel shall inspect areas of landfills that have not yet been finally stabilized, active land application areas, areas used for storage of materials/wastes that are exposed to precipitation, stabilization and structural control measures, leachate collection and treatment systems, and locations where equipment and waste trucks enter and exit the site. Where landfill areas have been finally stabilized and where land application has been completed, or during seasonal arid periods in arid areas (areas with an average annual rainfall of 0 to 10 inches) and semiarid areas (areas with an average annual rainfall of 10 to 20 inches), inspections will be conducted at least once every month. Erosion and sediment control measures shall be observed to ensure they are operating correctly.

(ii) For inactive landfills and land application sites, inspections shall be conducted at least quarterly, and qualified personnel shall inspect: landfill stabilization and structural erosion control measures and leachate collection and treatment systems, and all closed land application areas.

A set of tracking or follow-up procedures shall be used to ensure that appropriate actions are taken in response to the inspections. The pollution prevention plan shall be revised to address any problems found during inspections. Records of inspections shall be maintained.

(e) Employee Training—Employee training programs shall inform personnel responsible for implementing activities identified in the storm water pollution prevention plan or otherwise responsible for storm water management at all levels of responsibility of the components and goals of the storm water pollution prevention plan. Training should address topics such as conducting inspections, spill response, good housekeeping, conducting inspections and material management practices. The pollution prevention plan shall identify periodic dates for such training.

(f) Recordkeeping and Internal Reporting Procedures—A description of incidents (such as spills, or other discharges), along with other information describing the quality and quantity of storm water discharges shall be included in the plan required under this part. Inspections and maintenance activities shall be documented and records of such activities shall be incorporated into the plan. Landfill operators shall provide for a tracking system for the types of wastes disposed of in each cell or trench of a landfill. Land application site operators shall track the types and quantities of wastes applied in specific areas.

(g) Non-storm Water Discharges.

(i) The plan shall include a certification that the discharge has been tested or evaluated for the presence of non-storm water discharges including leachate and vehicle wash waters. The certification shall include the identification of potential significant sources of non-storm water at the site, a description of the results of any test and/or evaluation for the presence of non-storm water discharges, the evaluation criteria or testing method used, the date of any testing and/or evaluation, and the onsite drainage points that were directly observed during the test. Certifications shall be signed in accordance with Part VII.G. of this permit. Such certification may not be feasible if the facility operating the storm water discharge associated with industrial activity does not have access to an outfall, manhole, or other point of access to the ultimate conduit which receives the discharge. In such cases, the source identification section of the storm water pollution prevention plan shall indicate why the certification required by this part was not feasible, along with the identification of potential significant sources of non-storm water at the site. A discharger that is unable to provide the certification required by this paragraph must notify the Director in accordance with paragraph XI.L.3.a.(3)(g)(iii) (below).

(ii) Except for flows from fire fighting activities, sources of non-storm water listed in Part III.A.2 (Prohibition of Non-storm Water Discharges) of this permit that are combined with storm water

discharges associated with industrial activity must be identified in the plan. The plan shall identify and ensure the implementation of appropriate pollution prevention measures for the non-storm water component(s) of the discharge.

(iii) Failure to Certify—Any facility that is unable to provide the certification required (testing for non-storm water discharges), must notify the Director by [Insert date 180 days after permit issuance] or, for facilities which begin to discharge storm water associated with industrial activity after [Insert date of permit issuance], 180 days after submitting an NOI to be covered by this permit. If the failure to certify is caused by the inability to perform adequate tests or evaluations, such notification shall describe: the procedure of any test conducted for the presence of non-storm water discharges; the results of such test or other relevant observations; potential sources of non-storm water discharges to the storm sewer; and why adequate tests for such storm sewers were not feasible. Non-storm water discharges to waters of the Unites States which are not authorized by an NPDES permit are unlawful, and must be terminated.

(h) Sediment and Erosion Control—The plan shall identify areas which, due to topography activities, or other factors, have a high potential for significant soil erosion, and identify structural, vegetative, and/or stabilization measures to be used to limit erosion.

Landfill operators shall provide for temporary stabilization of materials stockpiled for daily, intermediate and final cover. Stabilization practices to consider include, but are not limited to, temporary seeding, mulching, and placing geotextiles on the inactive portions of the stockpiles.

Landfill operators shall provide for temporary stabilization of inactive areas of the landfill which have an intermediate cover but no final cover.

Landfill operators shall provide for temporary stabilization of any landfill areas which have received a final cover until vegetation has established itself. Land application site operators shall also stabilize areas where waste application has been completed until vegetation has been established.

(i) Management of Runoff—The plan shall also contain a narrative consideration of the appropriateness of traditional storm water management practices (practices other than those which control the generation or source(s) of pollutants) used to divert, infiltrate, reuse, or otherwise manage storm water runoff in a manner that reduces pollutants in storm water discharges from the site. The plan shall provide that measures that the permittee determines to be reasonable and appropriate shall be implemented and maintained. The potential of various sources at the facility to contribute pollutants to storm water discharges associated with industrial activity [see paragraph XI.L.3.a.(2) of this section (Description of Potential Pollutant Sources)] shall be considered when determining reasonable and appropriate measures. Appropriate measures may include: silt fences, earth dikes, gradient terraces, drainage swales, sediment traps, check dams, pipe slope drains, level spreaders, storm drain inlet protection, rock outlet protection, reinforced soil retaining systems, gabions and temporary or permanent sediment basins, or other equivalent measures. Structural practices should be placed on upland soils as practicable.

(4) Comprehensive Site Compliance Evaluation. Qualified personnel shall conduct site compliance evaluations at appropriate intervals specified in the plan, but in no case less than once a year. Such evaluations shall provide:

(a) Areas contributing to a storm water discharge associated with industrial activity at landfill and land application sites shall be visually inspected for evidence of, or the potential for, pollutants entering the drainage system. Measures to reduce pollutant loadings shall be evaluated to determine whether they are adequate and properly implemented in accordance with the terms of the permit or whether additional control measures are needed. Structural storm water management measures, sediment and erosion control measures, and other structural pollution prevention measures identified in the plan shall be observed to ensure that they are operating correctly. A visual inspection of equipment needed to implement the plan, such as spill response equipment, shall be made.

(b) Based on the results of the evaluation, the description of potential pollutant sources identified in the plan in accordance with paragraph XI.L.3.a.(2) of this section (Description of Potential Pollutant Sources) and pollution prevention measures and controls identified in the plan in accordance with paragraph XI.L.3.a.(3) of this section (Measures and Controls) shall be revised as appropriate within 2 weeks of such evaluation and shall provide for implementation of any changes to the plan in timely manner, but in no case more than 12 weeks after the evaluation.

(c) A report summarizing the scope of the evaluation, personnel making the evaluation, the date(s) of the evaluation, major observations relating to the implementation of the storm water pollution prevention plan for at least 3 years from the date of the evaluation. The report shall identify any incidents of noncompliance. Where a report does not identify any incidents of noncompliance, the report shall contain a certification that the facility is in compliance with the storm water pollution prevention plan and this permit. The report shall be signed in accordance with Part VII.G. (Signatory Requirements) of this permit.

(d) Where compliance evaluation schedules overlap with inspections required under 3.a.(3)(d), the compliance evaluation may be conducted in place of one such inspection.

4. Numeric Effluent Limitations

There are no additional numeric effluent limitations beyond those in Part V.B of this permit.

5. Monitoring and Reporting Requirements

(a) Analytical Monitoring Requirements. During the period beginning [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] and the period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance], permittees with landfill/land application sites must monitor their storm water discharges associated with industrial activity at least quarterly (4 times per year) during years 2 and 4 except as provided in paragraphs 5.a.(3) (Sampling Waiver), 5.a.(4) (Representative Discharge), and 5.a.(5) (Alternative Certification). Landfill/land application sites are required to monitor their storm water discharges for the pollutants of concern listed in Table L-1 below. Facilities must report in accordance with 5.b. (Reporting). In addition to the parameters listed in Table L-1 below, the permittee shall provide the date and duration (in hours) of the storm event(s) sampled; rainfall measurements or estimates (in inches) of the storm event that generated the sampled runoff; the duration between the storm event sampled and the end of the previous measurable (greater than 0.1 inch rainfall) storm event; and an estimate of the total volume (in gallons) of the discharge sampled.

TABLE L–1.—INDUSTRY MONITORING REQUIREMENTS

Pollutants of concern	Cut-off concentration
Total Suspended Solids (TSS) [i]	100 mg/L
Total Recoverable Iron [ii]	1.0 mg/L

[i] Applicable to all landfill and land application sites.

[ii] Applicable to all facilities except MSWLF areas closed in accordance with 40 CFR 258.60 requirements.

(1) Monitoring Periods. Landfill/land application sites shall monitor samples collected during the sampling periods of: January through March, April through June, July through September, and October through December for the years specified in paragraph a (above).

(2) Sample Type. A minimum of one grab sample shall be taken. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The required 72-hour storm event interval is waived where the preceding measurable storm event did not result in a measurable discharge from the facility. The required 72-hour storm event interval may also be waived where the permittee documents that less than a 72-hour interval is representative for local storm events during the season when sampling is being conducted. The grab sample shall be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable. If storm water discharges associated with industrial activity commingle with process or nonprocess water, then where practicable, permittees must attempt to sample the storm water discharge before it mixes with the non-storm water discharge.

(3) Sampling Waiver.

(a) Adverse Conditions—When a discharger is unable to collect samples within a specified sampling period due to adverse climatic conditions, the discharger shall collect a substitute sample from a separate qualifying event in the next period and submit the data along with data for the routine sample in that period. Adverse weather conditions that may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (e.g., drought, extended frozen conditions, etc.).

(b) Low Concentration Waiver—When the average concentration for a pollutant calculated from all monitoring data collected from an outfall during the monitoring period [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] is less than the corresponding value for that pollutant listed in Table L–1 under the column Monitoring Cut-off Concentration, a facility may waive monitoring and reporting requirements in the monitoring period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance]. The facility must submit to the Director, in lieu of the monitoring data, a certification that there has not been a significant change in industrial activity or the pollution prevention measures in area of the facility which drains to the outfall for which sampling was waived.

(c) When a discharger is unable to conduct quarterly chemical storm water sampling at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirements as long as the facility remains inactive and unstaffed. The facility must submit to the Director, in lieu of monitoring data, a certification statement on the DMR stating that the site is inactive and unstaffed so that collecting a sample during a qualifying event is not possible.

(4) Representative Discharge. When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may test the effluent of one of such outfalls and report that the quantitative data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan. The permittee shall include the description of the location of the outfalls, explanation of why outfalls are expected to discharge substantially identical effluents, and estimate of the size of the drainage area and runoff coefficient with the Discharge Monitoring Report.

(5) Alternative Certification. A discharger is not subject to the monitoring requirements of this section provided the discharger makes a certification for a given outfall or on a pollutant-by-pollutant basis in lieu of monitoring reports required under paragraph (b) below, under penalty of law, signed in accordance with Part VII.G. (Signatory Requirements), that material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, industrial machinery or operations, or significant materials from past industrial activity, that are located in areas of the facility within the drainage area of the outfall are not presently exposed to storm water and are not expected to be exposed to storm water for the certification period. Such certification must be retained in the storm water pollution prevention plan, and submitted to EPA in accordance with Part VI.C. of the fact sheet to this permit. In the case of certifying that a pollutant is not present, the permittee must submit the certification along with the monitoring reports required under paragraph (b) below. If the permittee cannot certify for an entire period, they must submit the date exposure was eliminated and any monitoring required up until that date. This certification option is not applicable to compliance monitoring requirements associated with effluent limitations.

(b) Reporting. Permittees with landfill/land application sites shall submit monitoring results for each outfall associated with industrial activity [or a certification in accordance with Sections (3), (4), or (5) above] obtained during the reporting period beginning [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] on Discharge Monitoring Report Form(s) postmarked no later than the 31st day of the following March [insert the date 2 years after permit issuance]. Monitoring results [or a certification in accordance with Sections (3), (4), or (5) above] obtained during the period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance] shall be submitted on Discharge Monitoring Report Form(s) postmarked no later than the 31st day of the following March. For each outfall, one Discharge Monitoring

Report form must be submitted per storm event sampled. Signed copies of Discharge Monitoring Reports, or said certifications, shall be submitted to the Director of the NPDES program at the address of the appropriate Regional Office listed in Part VI.G. of the fact sheet to this permit.

(1) Additional Notification. In addition to filing copies of discharge monitoring reports in accordance with paragraph b (above) landfill/land application sites, with at least one storm water discharge associated with industrial activity through a large or medium municipal separate storm sewer system (systems serving a population of 100,000 or more) must submit signed copies of discharge monitoring reports to the operator of the municipal separate storm sewer system in accordance with the dates provided in paragraph b (above).

(c) Quarterly Visual Examination of Storm Water Quality. Facilities shall perform and document a visual examination of a storm water discharge associated with industrial activity from each outfall, except discharges exempted below. The examination must be made at least once in each designated period [described in *(1)* below] during daylight hours unless there is insufficient rainfall or snow melt to produce a runoff event.

(1) Examinations shall be conducted in each of the following periods for the purposes of visually inspecting storm water quality associated with storm water runoff or snow melt: January through March; April through June; July through September; October through December.

(2) Examinations shall be made of samples collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 1 hour) of when the runoff or snowmelt begins discharging. The examinations shall document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on the samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. Where practicable, the same individual should carry out the collection and examination of discharges for the entire permit term.

(3) Visual examination reports must be maintained onsite in the pollution prevention plan. The report shall include the examination date and time, examination personnel, the nature of the discharge (i.e., runoff or snow melt), visual quality of the storm water discharge (including observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution), and probable sources of any observed storm water contamination.

(4) When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may collect a sample of effluent of one of such cutfalls and report that the examination data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

(5) When a discharger is unable to conduct a visual examination as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the records of the visual examination. Adverse weather conditions which may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(6) When a discharger is unable to conduct visual storm water examinations at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirement as long as the facility remains inactive and unstaffed. The facility must maintain a certification with the pollution prevention plan stating that the site is inactive and unstaffed so that performing visual examinations during a qualifying event is not feasible.

6. Definition

"Inactive Landfill"— For the purposes of this permit, a landfill is considered inactive when, on a permanent basis, it will no longer receive waste and has completed closure in accordance with any applicable Federal, State, and/or local requirements.

M. Storm Water Discharges Associated With Industrial Activity From Automobile Salvage Yards

1. Discharges Covered Under This Section

The requirements of this section apply to point source discharges of storm water associated with industrial activity from facilities engaged in dismantling or wrecking used motor vehicles for parts recycling or resale and for scrap (Standard Industrial Classification (SIC) Code 5015).

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

2. Storm Water Pollution Prevention Plan Requirements

(a.) Contents of Plan. The plan shall include, at a minimum, the following items:

(1) Pollution Prevention Team. Each plan shall identify a specific individual or individuals within the facility organization as members of a storm water Pollution Prevention Team that are responsible for developing the storm water pollution prevention plan and assisting the facility or plant manager in its implementation, maintenance, and revision. The plan shall clearly identify the responsibilities of each team member. The activities and responsibilities of the team shall address all aspects of the facility's storm water pollution prevention plan.

(2) Description of Potential Pollutant Sources. Each storm water pollution prevention plan must describe industrial activities, significant

materials, and physical features of the facility that may contribute to storm water runoff or, during periods of dry weather, result in dry weather flows. Plans must include the following elements:

(a) Site Map—The plan must contain a map of the site that shows structural features that control pollutants in storm water runoff[4] and process wastewater discharges, surface water bodies (including wetlands), places where significant materials are exposed to rainfall and runoff, and locations of major spills and leaks that occurred in the 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit. The map must also indicate the flow direction of storm water runoff. The location of each storm water outfall associated with an industrial activity, as well as an outline of the drainage area for each storm water outfall and an indication of the types of discharges in each drainage area must be indicated. The map must indicate the location of each monitoring point. The map must include an estimation (in acres) of the total area used for industrial activity including, but not limited to, dismantling, storage, and maintenance of used motor vehicles and motor vehicle parts. The map must also indicate the location of the following activities where such activities are exposed to precipitation: vehicle storage areas; dismantling areas; parts storage areas, including engine blocks, tires, hub caps, batteries, hoods, and mufflers; fueling stations; vehicle and equipment maintenance areas; cleaning areas (parts, vehicles, and/or equipment); loading and unloading areas; locations used for the treatment, storage, and disposal of wastes; and liquid storage tanks and drums for fuel and other fluids.

(b) Inventory of Potential Pollutant Sources—Facility operators are required to carefully conduct an inspection of the site to identify significant materials exposed to precipitation that may contribute pollutants to storm water discharges. The inventory must address materials that within 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit have been handled, stored, processed, treated, or disposed of in a manner to allow exposure to storm water. Findings of the inventory must be documented in detail in the pollution prevention plan. At a minimum, the plan must describe the method and location of onsite storage or disposal; practices used to minimize contact of materials with rainfall and runoff; existing structural and nonstructural controls that reduce pollutants in storm water runoff; existing structural controls that prohibit/control process wastewater discharges; and any treatment the runoff receives before it is discharged to surface waters or through a separate storm sewer system. The description must be updated whenever there is a significant change in the types or amounts of materials, or material management practices, that may affect the exposure of materials to storm water.

(c) Significant Spills and Leaks—The plan must include a list of any significant spills and leaks of toxic or hazardous pollutants that occurred in the 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit. Significant spills include, but are not limited to, releases of oil or hazardous substances in excess of quantities that are reportable under Section 311 of CWA (see 40 CFR 110.10 and 40 CFR 117.21) or Section 102 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (see 40 CFR 302.4). Significant spills may also include releases of oil or hazardous substances that are not in excess of reporting requirements and releases of materials that are not classified as oil or a hazardous substance. This list shall be updated as appropriate during the term of the permit.

(d) Sampling Data—Any existing data or data collected during the term of this permit describing the quality or quantity of storm water discharges from the facility must be summarized in the plan. The description should include a discussion of the methods used to collect and analyze the data. Sample collection points should be identified in the plan and shown on the site map.

(e) Summary of Potential Pollutant Sources—The description of potential pollution sources should clearly point to activities, materials, and physical features of the facility that have a reasonable potential to contribute significant amounts of pollutants to storm water discharges. Any such industrial activities, significant materials, or features must be addressed by the measures and controls subsequently described in the plan. In conducting the assessment, the facility operator must consider the potential for the following activities to contribute pollutants: vehicle storage areas; dismantling areas; parts storage areas, including engine blocks, tires, hub caps, batteries, and hoods; fueling stations; vehicle and equipment maintenance areas; cleaning areas (parts and vehicles and/or equipment); loading/unloading areas; locations used for the treatment, storage, and disposal of wastes; and liquid storage tanks and drums for fuel and other fluids.

The assessment must identify the pollutant parameter or parameters (i.e., copper, iron, lead, oil and grease, total suspended solids, etc.) associated with each pollutant source.

(3) Measures and Controls. Following completion of the source identification and assessment phase, the permittee must evaluate, select, and describe the pollution prevention measures, best management practices (BMPs), and other controls that will be implemented at the facility. BMPs include processes, procedures, schedules of activities, prohibitions on practices, and other management practices that prevent or reduce the discharge of pollutants in storm water runoff.

The pollution prevention plan must discuss the reasons each selected control or practice is appropriate for the facility and how each will address the potential sources of storm water pollution. The plan also must include a schedule specifying the time or times during which each control or practice will be implemented. In addition, the plan should discuss ways in which the controls and practices relate to one another and, when taken as a whole, produce an integrated and consistent approach for preventing or controlling potential storm water contamination problems.

(a) Good Housekeeping—Good housekeeping requires the maintenance of areas which may contribute pollutants to storm water discharges in a clean, orderly manner.

(b) Preventive Maintenance—The preventive maintenance program shall schedule periodic inspections and ensure appropriate maintenance of storm water management devices and facility equipment and systems. This program will address conditions that could cause breakdowns or failures resulting in the discharge of pollutants to surface waters. The maintenance program shall include periodic removal of debris from discharge diversions, conveyance systems, and impoundments/ponds. These activities should be conducted in the spring, after snow melt, and during the fall season. Maintenance schedules for sedimentation/impoundments must be provided in the pollution prevention plan.

(c) Spill and Leak Prevention and Response Procedures—Areas where potential spills which can contribute

[4] Features such as grass swales and vegetative buffer strips also should be shown.

pollutants to storm water discharges can occur, and their accompanying drainage points shall be identified clearly in the storm water pollution prevention plan. Where appropriate, specifying material handling procedures, storage requirements, and use of equipment such as diversion valves in the plan should be considered. Procedures for cleaning up spills shall be identified in the plan and made available to the appropriate personnel. The necessary equipment to implement a clean up should be available to personnel. After clean up from a spill, absorbents must be promptly placed in containers for proper disposal. All vehicles that are intended to be dismantled must be properly drained of all fluids upon arrival at the site, or as soon as feasible thereafter, or other equivalent means must be taken to prevent leaks or spills of such fluids.

(d) Inspections—Upon arrival at the site, or as soon as feasible thereafter, vehicles must be inspected for leaks. Any equipment containing oily parts, hydraulic fluids, or any other types of fluids shall be inspected at least quarterly (four times per year) for signs of leaks. Any outdoor storage of fluids including, but not limited to, brake fluid, transmission fluid, radiator water, and antifreeze, must be inspected at least quarterly for leaks. All outdoor liquid storage containers (e.g., tanks, drums) must be inspected at least quarterly for leaks.

Qualified facility personnel are required to conduct quarterly visual inspections of BMPs. The inspections shall include: (1) An assessment of the integrity of storm water flow diversion and source minimization systems; (2) visual inspections of dismantling areas, vehicle and equipment maintenance areas, vehicle, equipment, and parts cleaning and storage areas, and other potential sources of pollution for evidence of actual or potential pollutant discharges of contaminated storm water.

Inspections shall be conducted in each of the following periods: January through March; April through June; July through September; and October through December.

Reports of the quarterly inspections (or more frequent if appropriate) shall be retained as part of the plan. Based on the results of each inspection the plan must be revised as appropriate within 2 weeks after each inspection. Changes in the measures and controls must be implemented on the site in a timely manner, and never more than 12 weeks after completion of the inspection.

(e) Employee Training—Employee training programs shall inform personnel responsible for implementing activities identified in the storm water pollution prevention plan or otherwise responsible for storm water management at all levels of responsibility of the components and goals of the storm water pollution prevention plan. The pollution prevention plan shall include a schedule for training. Employee training must, at a minimum, address the following areas when applicable to a facility: proper handling (collection, storage, and disposal) of oil, used mineral spirits, anti-freeze, and solvents; spill prevention and response; fueling procedures; good housekeeping practices; and used battery management.

(f) Recordkeeping and Internal Reporting Procedures—A description of incidents such as spills, or other discharges, along with other information describing the quality and quantity of storm water discharges shall be included in the plan required under this part. The permittee must describe procedures for developing and retaining records on the status and effectiveness of plan implementation. The plan must address monitoring, and BMP inspection and maintenance activities. Ineffective BMPs must be reported and the date of their corrective action noted.

(g) Non-storm Water Discharges

(i) The plan shall include a certification that the discharge has been tested or evaluated for the presence of non-storm water discharges. The certification shall include the identification of potential significant sources of non-storm water at the site, a description of the results of any test and/or evaluation for the presence of non-storm water discharges, the evaluation criteria or testing method used, the date of any testing and/or evaluation, and the onsite drainage points that were directly observed during the test. Certifications shall be signed in accordance with Part VII.G. of this permit. Such certification may not be feasible if the facility operating the storm water discharge associated with industrial activity does not have access to an outfall, manhole, or other point of access to the ultimate conduit which receives the discharge. In such cases, the source identification section of the storm water pollution prevention plan shall indicate why the certification required by this part was not feasible, along with the identification of potential significant sources of non-storm water at the site. A discharger that is unable to provide the certification required by this paragraph must notify the Director in accordance with Part XI.M.2.b.(3)(g)(iii) (Failure to Certify) of this permit.

(ii) Except for flows from fire fighting activities, sources of non-storm water listed in Part III.A.2 (Prohibition of Non-storm Water Discharges) of this permit that are combined with storm water discharges associated with industrial activity must be identified in the plan. The plan shall identify and ensure the implementation of appropriate pollution prevention measures for the non-storm water component(s) of the discharge.

(iii) Failure to Certify—Any facility that is unable to provide the certification required (testing for non-storm water discharges), must notify the Director by [Insert date 270 days after permit issuance] or, for facilities which begin to discharge storm water associated with industrial activity after [Insert date 270 days after permit issuance], 180 days after submitting an NOI to be covered by this permit. If the failure to certify is caused by the inability to perform adequate tests or evaluations, such notification shall describe: the procedure of any test conducted for the presence of non-storm water discharges; the results of such test or other relevant observations; potential sources of non-storm water discharges to the storm sewer; and why adequate tests for such storm sewers were not feasible. Non-storm water discharges to waters of the United States which are not authorized by an NPDES permit are unlawful, and must be terminated.

(h) Sediment and Erosion Control—The plan shall identify areas which, due to topography, activities, or other factors, have a high potential for significant soil erosion, and identify structural, vegetative, and/or stabilization measures to be used to limit erosion. Permittees must consider measures to maximize stabilization of industrial areas using vegetative cover, gravel, impervious surfaces or other appropriate measures.

(i) Management of Runoff—The plan shall contain a narrative consideration of the appropriateness of traditional storm water management practices (practices other than those which control the generation or source(s) of pollutants) used to divert, infiltrate, reuse, or otherwise manage storm water runoff in a manner that reduces pollutants in storm water discharges from the site. The plan shall provide measures that the permittee determines to be reasonable and appropriate and shall be implemented and maintained. The potential of various sources at the facility to contribute pollutants to storm water discharges associated with industrial activity (see Part XI.M.2.a.(2) (Description of Potential Pollutant Sources) of this permit) shall be considered when determining reasonable and appropriate measures. Appropriate measures may include:

vegetative swales and practices, reuse of collected storm water (such as for a process or as an irrigation source), inlet controls (such as oil/water separators), snow management activities, infiltration devices, wet detention/retention devices, or other equivalent measures. In addition, the permittee must describe the storm water pollutant source area or activity (e.g., dismantling area, storage area, cleaning operations) to be controlled by each storm water management practice.

The plan must consider management practices, such as berms or drainage ditches on the property line, that may be used to prevent runon from neighboring properties. Berms must be considered for uncovered outdoor storage of oily parts, engine blocks, and above ground liquid storage. The installation of detention ponds must also be considered. The permittee shall consider the installation of a filtering device to receive runoff from industrial areas. The installation of oil/water separators must also be considered.

(4) Comprehensive Site Compliance Evaluation. Qualified personnel shall conduct comprehensive site compliance evaluations at appropriate intervals specified in the plan, but in no case less than once a year. The storm water pollution prevention plan must describe the scope and content of comprehensive site evaluations that qualified personnel will conduct to (1) confirm the accuracy of the description of potential pollution sources contained in the plan, (2) determine the effectiveness of the plan, and (3) assess compliance with the terms and conditions of the permit. The individual or individuals who will conduct the evaluations must be identified in the plan and should be members of the pollution prevention team. Such evaluations shall provide:

(a) Areas contributing to a storm water discharge associated with industrial activity shall be visually inspected for evidence of, or the potential for, pollutants entering the drainage system. Measures to reduce pollutant loadings shall be evaluated to determine whether they are adequate and properly implemented in accordance with the terms of the permit or whether additional control measures are needed. Structural storm water management measures, sediment and erosion control measures, and other structural pollution prevention measures identified in the plan shall be observed to ensure that they are operating correctly. A visual inspection of equipment needed to implement the plan, such as spill response equipment, shall be made.

(b) Based on the results of the evaluation, the description of potential pollutant sources identified in the plan in accordance with Part XI.M.2.a.(2) (Description of Potential Pollutant Sources) of this permit and pollution prevention measures and controls identified in the plan in accordance with paragraph XI.M.2.a.(3) (Measures and Controls) of this permit shall be revised as appropriate within 2 weeks of such evaluation and shall provide for implementation of any changes to the plan in a timely manner, but in no case more than 12 weeks after the evaluation.

(c) A report summarizing the scope of the evaluation, personnel making the evaluation, the date(s) of the evaluation, major observations relating to the implementation of the storm water pollution prevention plan, and actions taken in accordance with paragraph XI.M.2.a.(4)(b) (above) of the permit shall be made and retained as part of the storm water pollution prevention plan for at least 3 years after the date of the evaluation. The report shall identify any incidents of noncompliance. Where a report does not identify any incidents of noncompliance, the report shall contain a certification that the facility is in compliance with the storm water pollution prevention plan and this permit. The report shall be signed in accordance with Part VII.G. (Signatory Requirements) of this permit.

(d) Where compliance evaluation schedules overlap with inspections required under 3.a.(3)(d), the compliance evaluation may be conducted in place of one such inspection.

3. Numeric Effluent Limitations

There are no additional numeric effluent limitations beyond those described in Part V.B of this permit.

4. Monitoring and Reporting Requirements

a. Analytical Monitoring Requirements. During the period beginning [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] and the period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance], permittees operating automobile salvage yards must monitor their storm water discharges associated with industrial activity at least quarterly (4 times per year) during years 2 and 4 except as provided in paragraphs 4.a.(3) (Sampling Waiver), 4.a.(4) (Representative Discharge), and 4.a.(5) (Alternative Certification). Automobile salvage yards are required to monitor their storm water discharges for the pollutants of concern listed in Table M-1 below. Facilities must report in accordance with 5.b. (Reporting). In addition to the parameters listed in Table M-1 below, the permittee shall provide the date and duration (in hours) of the storm event(s) sampled; rainfall measurements or estimates (in inches) of the storm event that generated the sampled runoff; the duration between the storm event sampled and the end of the previous measurable (greater than 0.1 inch rainfall) storm event; and an estimate of the total volume (in gallons) of the discharge sampled.

TABLE M-1.—Monitoring Requirements

Pollutants of concern	Monitoring cut-off concentration (mg/L)
Total Suspended Solids	100
Total Recoverable Aluminum	0.75
Total Recoverable Iron	1.0
Total Recoverable Lead	0.0816

(1) Monitoring Periods. Automobile salvage yards shall monitor samples collected during the sampling periods of: January through March, April through June, July through September, and October through December for the years specified in paragraph a. (above).

(2) Sample Type. A minimum of one grab sample shall be taken. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The required 72-hour storm event interval is waived where the preceding measurable storm event did not result in a measurable discharge from the facility. The required 72-hour storm event interval may also be waived where the permittee documents that less than a 72-hour interval is representative for local storm events during the season when sampling is being conducted. The grab sample shall be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable. If storm water discharges associated with industrial activity commingle with process or nonprocess water, then where practicable permittees must attempt to sample the storm water

discharge before it mixes with the non-storm water discharge.

(3) Sampling Waiver

(a) Adverse Conditions—When a discharger is unable to collect samples within a specified sampling period due to adverse climatic conditions, the discharger shall collect a substitute sample from a separate qualifying event in the next period and submit the data along with data for the routine sample in that period. Adverse weather conditions that may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (e.g., drought, extended frozen conditions, etc.).

(b) Low Concentration Waiver—When the average concentration for a pollutant calculated from all monitoring data collected from an outfall during the monitoring period [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] is less than the corresponding value for that pollutant listed in Table M–1 under the column Monitoring Cut-off Concentration, a facility may waive monitoring and reporting requirements in the monitoring period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance]. The facility must submit to the Director, in lieu of the monitoring data, a certification that there has not been a significant change in industrial activity or the pollution prevention measures in the area of the facility which drains to the outfall for which sampling was waived.

(c) When a discharger is unable to conduct quarterly chemical storm water sampling at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirements as long as the facility remains inactive and unstaffed. The facility must submit to the Director, in lieu of monitoring data, a certification statement on the DMR stating that the site is inactive and unstaffed so that collecting a sample during a qualifying event is not possible.

(4) Representative Discharge. When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may test the effluent of one of such outfalls and report that the quantitative data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan. The permittee shall include the description of the location of the outfalls, explanation of why outfalls are expected to discharge substantially identical effluents, and estimate of the size of the drainage area and runoff coefficient with the Discharge Monitoring Report.

(5) Alternative Certification. A discharger is not subject to the monitoring requirements of this section provided the discharger makes a certification for a given outfall or on a pollutant-by-pollutant basis in lieu of monitoring reports required under b below, under penalty of law, signed in accordance with Part VII.G. (Signatory Requirements), that material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, industrial machinery or operations, or significant materials from past industrial activity, that are located in areas of the facility within the drainage area of the outfall are not presently exposed to storm water and are not expected to be exposed to storm water for the certification period. Such certification must be retained in the storm water pollution prevention plan, and submitted to EPA in accordance with Part VI.C. of this permit. In the case of certifying that a pollutant is not present, the permittee must submit the certification along with the monitoring reports required under paragraph (b) below. If the permittee cannot certify for an entire period, they must submit the date exposure was eliminated and conduct any monitoring required up until that date. This certification option is not applicable to compliance monitoring requirements associated with effluent limitations.

b. Reporting. Permittees with automobile salvage yards shall submit monitoring results for each outfall associated with industrial activity [or a certification in accordance with Sections (3), (4), or (5) above] obtained during the reporting period beginning [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] on Discharge Monitoring Report Form(s) postmarked no later than the 31st day of the following March [insert the date 2 years after permit issuance]. Monitoring results (or a certification in accordance with Sections (3), (4), or (5) above] obtained during the period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance] shall be submitted on Discharge Monitoring Report Form(s) postmarked no later than the 31st day of the following March. For each outfall, one signed Discharge Monitoring Report Form must be submitted per storm event sampled. Signed copies of Discharge Monitoring Reports, or said certifications, shall be submitted to the Director of the NPDES program at the address of the appropriate Regional Office listed in Part VI.C. of the fact sheet.

(1) Additional Notification. In addition to filing copies of discharge monitoring reports in accordance with paragraph b (above), automobile salvage yards with at least one storm water discharge associated with industrial activity through a large or medium municipal separate storm sewer system (systems serving a population of 100,000 or more) must submit signed copies of discharge monitoring reports to the operator of the municipal separate storm sewer system in accordance with the dates provided in paragraph b (above).

c. Quarterly Visual Examination of Storm Water Quality. All automobile salvage yard facilities shall perform and document a visual examination of a storm water discharge associated with industrial activity from each outfall, except discharges exempted below. The examination(s) must be made at least once in each of the following 3-month periods: January through March, April through June, July through September, and October through December. The examination shall be made during daylight hours unless there is insufficient rainfall or snow melt to produce a runoff event.

(1) Examinations shall be made of samples collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 1 hour) of when the runoff or snowmelt begins discharging. The examinations shall document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on the samples. All such samples shall be collected from the discharge resulting from a storm event

that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. Where practicable, the same individual should carry out the collection and examination of discharges for the entire permit term.

(2) Visual examination reports must be maintained onsite in the pollution prevention plan. The report shall include the examination date and time, examination personnel, the nature of the discharge (i.e., runoff or snow melt), visual quality of the storm water discharge (including observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution), and probable sources of any observed storm water contamination.

(3) When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may collect a sample of effluent of one of such outfalls and report that the examination data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

(4) When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the records of the visual examinations. Adverse weather conditions which may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (e.g., drought, extended frozen conditions, etc.).

(5) When a discharger is unable to conduct visual storm water examinations at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirement as long as the facility remains inactive and unstaffed. The facility must maintain a certification with the pollution prevention plan stating that the site is inactive and unstaffed so that performing visual examinations during a qualifying event is not feasible.

5. Retention of Records

The permittee shall retain records of all inspections and monitoring information, including certification reports, noncompliance reports, calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports, and supporting data, requested by the permitting authority for at least 3 years after the date of the inspection or monitoring event.

N. Storm Water Discharges Associated With Industrial Activity From Scrap Recycling and Waste Recycling Facilities

1. Discharges Covered Under This Section

The requirements listed under this section are applicable to storm water discharges from the following activities: facilities that are engaged in the processing, reclaiming and wholesale distribution of scrap and waste materials such as ferrous and nonferrous metals, paper, plastic, cardboard, glass, animal hides (these types of activities are typically identified as SIC code 5093). Facilities that are engaged in reclaiming and recycling liquid wastes such as used oil, antifreeze, mineral spirits, and industrial solvents (also identified as SIC code 5093) are also covered under this section. Separate permit requirements have been established for recycling facilities that only receive source-separated recyclable materials primarily from non-industrial and residential sources (also identified as SIC 5093) (e.g., common consumer products including paper, newspaper, glass, cardboard, plastic containers, aluminum and tin cans). This includes recycling facilities commonly referred to as material recovery facilities (MRF).

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

2. Special Conditions

a. Prohibition of Non-storm Water Discharges

(1) Except as provided in paragraph XI.N.2.b., all discharges covered by this permit shall be composed entirely of storm water. Non storm water discharges from turnings containment areas are not covered under this permit.

(a) Except as provided in paragraph XI.N.2.b. (below), discharges of material other than storm water to waters of the United States, or through municipal separate storm sewer systems, are not authorized by this permit. The operators of such discharges must obtain coverage under a separate National Pollutant Discharge Elimination System (NPDES) permit (other than this permit) issued for the discharge.

(b) The following non-storm water discharges are authorized by this permit provided the non-storm water component of the discharge is in compliance with paragraph XI.N.3.a.(3) (Measures and Controls for Storm Water Discharges): discharges from fire fighting activities; fire hydrant flushing; potable water sources including waterline flushings; irrigation drainage; lawn watering; routine external building washdown which does not use detergents or other compounds; pavement washwaters where spills or leaks of toxic or hazardous materials have not occurred (unless all spilled materials have been removed) and where detergents are not used; air conditioning condensate; springs; and uncontaminated ground water.

3. Storm Water Pollution Prevention Plan Requirements

a. Contents of Plan. The following general requirements for the storm water pollution prevention plan are applicable to activities which reclaim and recycle either recyclable nonliquid and liquid waste materials. In addition to the general requirements, Paragraph XI.N.3.a.(3)(a) (below) identifies special requirements for scrap recycling and waste recycling facilities (nonsource-separated facilities) that handle nonliquid wastes. Paragraph XI.N.3.a.(3)(b) (below) identifies special requirements for waste recycling facilities that handle only liquid wastes. Paragraph XI.N.3.a.(3)(c) identifies special requirements for recycling facilities, including MRFs, that receive only source-separated recyclable materials primarily from non-industrial and residential sources. The plan shall include, at a minimum, the following items:

(1) Pollution Prevention Team. Each plan shall identify a specific individual or individuals within the facility organization as members of a storm water Pollution Prevention Team that are responsible for developing the storm water pollution prevention plan and assisting the facility or plant manager in its implementation, maintenance, and revision. The plan shall clearly identify the responsibilities of each team member. The activities and responsibilities of the team shall address all aspects of the facility's storm water pollution prevention plan.

(2) Description of Potential Pollutant Sources. Each plan shall provide a description of potential sources which may reasonably be expected to add significant amounts of pollutants to storm water discharges or which may result in the discharge of pollutants during dry weather from separate storm sewers draining the facility. Each plan shall identify all activities and significant materials which may potentially be significant pollutant sources or, during periods of dry weather, result in dry weather flows. Each plan shall include, at a minimum:

(a) Drainage

(i) A site map indicating the outfall locations and the types of discharges contained in the drainage areas of the outfalls, an outline of the portions of the drainage area of each storm water outfall that are within the facility boundaries, each existing structural control measure to reduce pollutants in storm water runoff, surface water bodies (including wetlands), locations where significant materials are exposed to precipitation including scrap and waste material storage and outdoor scrap and waste processing equipment, locations where major spills or leaks identified in paragraph XI.N.3.a.(2)(c) of this section have occurred, and the locations of the following activities where such activities are exposed to precipitation: fueling stations, vehicle and equipment maintenance and/or cleaning areas, loading/unloading areas, locations used for the treatment, storage or disposal of wastes, material storage (including tanks or other vessels used for liquid or waste storage). Scrap recycling facilities that handle turnings that have been previously exposed to cutting fluids will delineate these containment areas as required in paragraph XI.N.3.a.(iii). The site map must also identify monitoring locations.

(ii) For each area of the facility that generates storm water discharges associated with industrial activity with a reasonable potential for containing significant amounts of pollutants, a prediction of the direction of flow, and an identification of the types of pollutants which are likely to be present in storm water discharges associated with industrial activity. Factors to consider include the toxicity of a chemical; quantity of chemicals used, produced or discharged; the likelihood of contact with storm water; and history of significant leaks or spills of toxic or hazardous pollutants. Flows with a significant potential for causing erosion shall be identified.

(b) Inventory of Exposed Materials—An inventory of the types of materials handled at the site that potentially may be exposed to precipitation. Such inventory shall include a narrative description of significant materials that have been handled, treated, stored or disposed in a manner to allow exposure to storm water; method and location of onsite storage or disposal; materials management practices employed to minimize contact of materials with storm water runoff; the location and a description of existing structural and nonstructural control measures to reduce pollutants in storm water runoff; and a description of any treatment the storm water receives.

(c) Spills and Leaks—A list of significant spills and leaks of toxic or hazardous pollutants that occurred at areas that are exposed to precipitation or that otherwise drain to a storm water conveyance at the facility after the date of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit. Significant spills include, but are not limited to, releases of oil or hazardous substances in excess of quantities that are reportable under Section 311 of the Clean Water Act (CWA) (see 40 CFR 110.10 and 117.21) or Section 102 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (see 40 CFR 302.4). Such a list shall be updated as appropriate during the term of the permit.

(d) Sampling Data—A summary of existing discharge sampling data describing pollutants in storm water discharges from the facility, including a summary of sampling data collected during the term of this permit.

(e) Risk Identification and Summary of Potential Pollutant Sources—A narrative description of potential pollutant sources from the following activities: loading and unloading operations; outdoor storage activities, outdoor processing activities; significant dust or particulate generating processes and onsite waste disposal practices. The description shall specifically list any significant potential source of pollutants at the site and for each potential source, any pollutant or pollutant parameter (e.g., Chemical Oxygen Demand (COD), oil and grease, Total Suspended Solids (TSS), zinc, lead, copper, etc.) of concern shall be identified.

(3) Measures and Controls. Each facility covered by this permit shall develop a description of storm water management controls appropriate for the facility, and implement such controls. The appropriateness and priorities of controls in a plan shall reflect identified potential sources of pollutants at the facility. The description of storm water management controls for scrap recycling and waste recycling facilities (nonsource-separated, nonliquid recyclable materials), waste recycling facilities (recyclable liquid wastes), and recycling facilities (source-separated materials) are identified in Parts XI.N.3.a.(3)(a), XI.N.3.a.(3)(b), and XI.N.3.a.(3)(c), respectively. At a minimum, the description shall also include a schedule for implementing such controls:

(a) Scrap and Waste Recycling Facilities (nonsource-separated, nonliquid recyclable wastes)—The following special conditions have been established for the pollution prevention plan for those scrap and waste recycling facilities that receive, process and provide wholesale distribution of nonliquid recyclable wastes, (e.g., ferrous and nonferrous metals, plastics, glass, cardboard, and paper). This section of the permit is intended to distinguish waste recycling facilities that receive both nonrecyclable and recyclable materials from those recycling facilities that only accept recyclable materials primarily from non-industrial and residential sources. Under the description of measures and controls in the storm water pollution prevention plan, the plan will address all areas that have a reasonable potential to contribute pollutants to storm water discharges and will be maintained in a clean and orderly manner. At a minimum, the plan will address the following activities and areas within the plan:

(i) Inbound Recyclable and Waste Material Control Program—The plan shall include a recyclable and waste material inspection program to

minimize the likelihood of receiving materials that may be significant pollutant sources to storm water discharges. At a minimum, the plan shall address the following:

(a) Provision of information/ education (flyers, brochures and pamphlets) to encourage suppliers of scrap and recyclable waste materials to drain residual fluids, whenever applicable, prior to its arrival at the facility. This includes vehicles and equipment engines, radiators, and transmissions, oil-filled transformers, and individual containers or drums;

(b) Activities which accept scrap and materials that may contain residual fluids, e.g., automotive engines containing used oil, transmission fluids, etc., shall describe procedures to minimize the potential for these fluids from coming in contact with either precipitation or runoff. The description shall also identify measures or procedures to properly store, handle and dispose of these residual fluids;

(c) Procedures pertaining to the acceptance of scrap lead-acid batteries. Additional requirements for the handling, storage and disposal or recycling of batteries shall be in conformance with conditions for a scrap lead-acid battery program, see paragraph XI.N.3.a.(3)(a)(vi) (below);

(d) A description of training requirements for those personnel engaged in the inspection and acceptance of inbound recyclable materials.

(e) Liquid wastes, including used oil, shall be stored in materially compatible and nonleaking containers and disposed or recycled in accordance with all requirements under the Resource Recovery and Conservation Act (RCRA), and other State or local requirements.

(ii) Scrap and Waste Material Stockpiles/Storage (outdoors)—The plan shall address areas where significant materials are exposed to either storm water runoff or precipitation. The plan must describe those measures and controls used to minimize contact of storm water runoff with stockpiled materials, processed materials and nonrecyclable wastes. The plan should include measures to minimize the extent of storm water contamination from these areas. The operator may consider the use of permanent or semipermanent covers, or other similar forms of protection over stockpiled materials where the operator determines that such measures are reasonable and appropriate. The operator may consider the use of sediment traps, vegetated swales and strips, to facilitate settling or filtering out of pollutants. The operator shall consider within the plan the use of the following BMPs (either individually or in combination) or their equivalent to minimize contact with storm water runoff:

(a) Promoting the diversion of runoff away from these areas through such practices as dikes, berms, containment trenches, culverts and/or surface grading;

(b) Media filtration such as catch basin filters and sand filters; and,

(c) Silt fencing; and,

(d) Oil/water separators, sumps and dry adsorbents in stockpile areas that are potential sources of residual fluids, e.g., automotive engine storage areas.

(iii) Stockpiling of Turnings Previously Exposed to Cutting Fluids (outdoors)—The plan shall address all areas where stockpiling of industrial turnings previously exposed to cutting fluids occurs. The plan shall implement those measures necessary to minimize contact of surface runoff with residual cutting fluids. The operator shall consider implementation of either of the following two alternatives or a combination of both or equivalent measures:

(a) Alternative 1: Storage of all turnings previously exposed to cutting fluids under some form of permanent or semi-permanent cover. Discharges of residual fluids from these areas to the storm sewer system in the absence of a storm event is prohibited. Discharges to the storm sewer system as a consequence of a storm event is permitted provided the discharge is first directed through an oil/water separator or its equivalent. Procedures to collect, handle, and dispose or recycle residual fluids that may be present shall be identified in the plan, or,

(b) Alternative 2: Establish dedicated containment areas for all turnings that have been exposed to cutting fluids where runoff from these areas is directed to a storm sewer system, providing the following:

(i) containment areas constructed of either concrete, asphalt or other equivalent type of impermeable material;

(ii) a perimeter around containment areas to prevent runoff from moving across these areas. This would include the use of shallow berms, curbing, or constructing an elevated pad or other equivalent measure;

(iii) a suitable drainage collection system to collect all runoff generated from within containment areas. At a minimum, the drainage system shall include a plate-type oil/water separator or its equivalent. The oil/water separator or its equivalent shall be installed according to the manufacturer's recommended specifications, whenever available, specifications will be kept with the plan.

(iv) a schedule to maintain the oil/ water separator (or its equivalent) to prevent the accumulation of appreciable amounts of fluids. In the absence of a storm event, no discharge from containment areas to the storm sewer system are prohibited unless covered by a separate NPDES permit;

(v) identify procedures for the proper disposal or recycling of collected residual fluids.

(iv) Scrap and Waste Material Stockpiles/Storage (covered or indoor storage)—The plan shall address measures and controls to minimize residual liquids and accumulated particulate matter, originating from scrap and recyclable waste materials stored indoors or under cover, from coming in contact with surface runoff. The operator shall consider including in the plan the following or equivalent measures:

(a) Good housekeeping measures, including the use of dry absorbent or wet vacuum clean up methods, to collect, handle, store and dispose or recycle residual liquids originating from recyclable containers, e.g., beverage containers, paint cans, household cleaning products containers, etc.;

(b) Prohibiting the practice of allowing washwater from tipping floors or other processing areas from discharging to any portion of a storm sewer system;

(c) Disconnecting or sealing off all existing floor drains connected to any portion of the storm sewer system.

(v) Scrap and Recyclable Waste Processing Areas—The plan shall address areas where scrap and waste processing equipment are sited. This includes measures and controls to minimize surface runoff from coming in contact with scrap processing equipment. In the case of processing equipment that generate visible amounts of particulate residue, e.g., shredding facilities, the plan shall describe good housekeeping and preventive maintenance measures to minimize contact of runoff with residual fluids and accumulated particulate matter. At a minimum, the operator shall consider including in the plan the following or other equivalent measures:

(a) A schedule of periodic inspections of equipment for leaks, spills, malfunctioning, worn or corroded parts or equipment;

(b) Preventive maintenance program to repair and/or maintain processing equipment;

(c) Measures to minimize shredder fluff from coming in contact with surface runoff;

(d) Use of dry-absorbents or other cleanup practices to collect and to dispose or recycle spilled or leaking fluids;

(e) Installation of low-level alarms or other equivalent protection devices on unattended hydraulic reservoirs over 150 gallons in capacity. Alternatively, provide secondary containment with sufficient volume to contain the entire volume of the reservoir.

The operator shall consider employing the following additional BMPs or equivalent measures: diversion structures such as dikes, berms, culverts, containment trenches, elevated concrete pads, grading to minimize contact of storm water runoff with outdoor processing equipment; oil/water separators, sumps or equivalent, in processing areas that are potential sources of residual fluids and grease; permanent or semipermanent covers, or other similar measures; retention and detention basins or ponds, sediment traps or vegetated swales and strips, to facilitate settling or filtering out of pollutants in runoff from processing areas; or media filtration such as catch basin filters and sand filters.

(vi) Scrap Lead-Acid Battery Program—The plan shall address measures and controls for the proper handling, storage and disposition of scrap lead-acid batteries (note. this permit does apply to the reclaiming of scrap lead-acid batteries, i.e., breaking up battery casings to recover lead). The operator shall consider including in the plan the following or equivalent measures:

(a) Segregating all scrap lead-acid batteries from other scrap materials;

(b) A description of procedures and/or measures for the handling, storage and proper disposal of cracked or broken batteries;

(c) A description of measures to collect and dispose of leaking battery fluid (lead-acid);

(d) A description of measures to minimize and, whenever possible, eliminate exposure of scrap lead-acid batteries to precipitation or runoff; and

(e) A description of employee training for the management of scrap batteries.

(vii) Erosion and Sediment Control—The plan shall identify all areas associated with industrial activity that have a high potential for soil erosion and suspended solids loadings, i.e., areas that tend to accumulate significant particulate matter. Appropriate source control, stabilization measures, nonstructural, structural controls or an equivalent shall be provided in these areas. The plan shall also contain a narrative discussion of the reason(s) for selected erosion and sediment controls. At a minimum, the operator shall consider in the plan, either individually or in combination, the following erosion and sediment control measures:

(a) Filtering or diversion practices, such as filter fabric fence, sediment filter boom, earthen or gravel berms, curbing or other equivalent measure,

(b) Catch basin filters, filter fabric fence, or equivalent measure, place in or around inlets or catch basins that receive runoff from scrap and waste storage areas, and processing equipment; or

(c) Sediment traps, vegetative buffer strips, or equivalent, to remove sediment prior to discharge through an inlet or catch basin.

(viii) Structural Controls for Sediment and Erosion Control—In instances where significant erosion and suspended solids loadings continue after installation of one or more of the BMPs identified in paragraph XI.N.3.a.(3)(a)(vii) (above), the operator shall consider providing in the plan for a detention or retention basin or other equivalent structural control. All structural controls shall be designed using good engineering practice. All structural controls and outlets that are likely to receive discharges containing oil and grease must include appropriate measures to minimize the discharge of oil and grease through the outlet. This may include the use of an absorbent boom or other equivalent measures.

Where space limitations (e.g., obstructions caused by permanent structures such as buildings and permanently-sited processing equipment and limitations caused by a restrictive property boundary) prevent the siting of a structural control, i.e., retention basin, such a determination will be noted in the plan. The operator will identify in the plan what existing practices shall be modified or additional measures shall be undertaken to minimize erosion and suspended sediment loadings in lieu of a structural BMP.

(ix) Spill Prevention and Response Procedures—To prevent or minimize storm water contamination at loading and unloading areas, and from equipment or container failures, the operator shall consider including in the plan the following practices:

(a) Description of spill prevention and response measures to address areas that are potential sources of leaks or spills of fluids;

(b) Leaks and spills should be contained and cleaned up as soon as possible. If malfunctioning equipment is responsible for the spill or leak, repairs should also be conducted as soon as possible;

(c) Cleanup procedures should be identified in the plan, including the use of dry absorbent materials or other cleanup methods. Where dry absorbent cleanup methods are used, an adequate supply of dry absorbent material should be maintained onsite. Used absorbent material should be disposed of properly;

(d) Drums containing liquids, including oil and lubricants, should be stored indoors; or in a bermed area; or in overpack containers or spill pallets; or in similar containment devices;

(e) Overfill prevention devices should be installed on all fuel pumps or tanks;

(f) Drip pans or equivalent measures should be placed under any leaking piece of stationary equipment until the leak is repaired. The drip pans should be inspected for leaks and checked for potential overflow and emptied regularly to prevent overflow and all liquids will be disposed of in accordance with all requirements under RCRA.

(g) An alarm and/or pump shut off system should be installed and maintained on all outside equipment with hydraulic reservoirs exceeding 150 gallons (only those reservoirs not directly visible by the operator of the equipment) in order to prevent draining the tank contents in the event of a line break. Alternatively, the equipment may have a secondary containment system capable of containing the contents of the hydraulic reservoir plus adequate freeboard for precipitation. Leaking hydraulic fluids should be disposed of in accordance with all requirements under RCRA.

(x) Quarterly Inspection Program—A quarterly inspection shall include all designated areas of the facility and equipment identified in the plan. The inspection shall include a means of tracking and conducting follow up actions based on the results of the inspection. The inspections shall be conducted by members of the Storm Water Pollution Prevention team. At a minimum, quarterly inspections shall include the following areas: all outdoor scrap processing areas; all material unloading and loading areas (including rail sidings) that are exposed to either precipitation or storm water runoff; areas where structural BMPs have been installed; all erosion and sediment BMPs; outdoor vehicle and equipment maintenance areas; vehicle and equipment fueling areas; and all areas where waste is generated, received, stored, treated, or disposed and which are exposed to either precipitation or storm water runoff.

The objective of the inspection shall be identify any corroded or leaking containers, corroded or leaking pipes, leaking or improperly closed valves and valve fittings, leaking pumps and/or hose connections, and deterioration in diversionary or containment structures that are exposed to precipitation or storm water runoff.

Spills or leaks identified during the visual inspection shall be immediately addressed using the procedures identified in Part XI.N.3.a.(3)(a)(ix) (Spill Prevention and Response Procedures). Structural BMPs shall be visually inspected for signs of washout, breakage, deterioration, damage, or overflowing and breaks shall be repaired or replaced as expeditiously as possible.

(xi) Employee Training—At a minimum, storm water control training appropriate to their job function shall be provided for truck drivers, scale operators, supervisors, buyers and other operating personnel. The plan shall include a proposed schedule for the training. The employee training program shall address at a minimum: BMPs and other requirements of the plan; proper scrap inspection, handling and storage procedures; procedures to follow in the event of a spill, leak, or break in any structural BMP. A training and education program shall be developed for employees and for suppliers for implementing appropriate activities identified in the storm water pollution prevention plan.

(xii) Supplier Notification—The plan shall include a supplier notification program that will be applicable to major suppliers and shall include: description of scrap materials that will not be accepted at the facility or that are accepted only under certain conditions.

(b) Waste Recycling Facilities (liquid recyclable wastes)—The following special conditions have been established for the pollution prevention plan for those facilities that reclaim and recycle liquid wastes (e.g., used oil, antifreeze, mineral spirits, and industrial solvents). For these facilities, the storm water pollution prevention plan shall address all areas that have a reasonable potential to contribute pollutants to storm water discharges and will be maintained in a clean and orderly manner. At a minimum, the plan shall address the following activities and areas within the plan:

(i) Waste Material Storage (indoors)—The plan shall address measures and controls to minimize/eliminate residual liquids from waste materials stored indoors from coming in contact with surface runoff. The plan may refer to applicable portions of other existing plans such as SPCC plans required under 40 CFR Part 112. At a minimum, the operator shall consider including in the plan the following:

(a) Procedures for material handling (including labeling and marking);

(b) A sufficient supply of dry-absorbent materials or a wet vacuum system to collect spilled or leaked materials;

(c) An appropriate containment structure, such as trenches, curbing, gutters or other equivalent measures; and

(d) A drainage system to handle discharges from diked or bermed areas. The drainage system should include appurtenances, (e.g., pumps or ejectors, manually operated valves). Drainage should be discharged to an appropriate treatment facility, sanitary sewer system, or otherwise disposed of properly. Discharges from these areas should be covered by a separate NPDES permit or industrial user permit under the pretreatment program.

(ii) Waste Material Storage (outdoors)—The plan shall address areas where waste materials are exposed to either storm water runoff or precipitation. The plan shall include measures to provide appropriate containment, drainage control and other appropriate diversionary structures. The plan may refer to applicable portions of other existing plans such as SPCC plans required under 40 CFR Part 112. At a minimum, the plan shall describe those measures and controls used to minimize contact of storm water runoff with stored materials. The operator shall consider including in the plan the following preventative measures, or an equivalent:

(a) An appropriate containment structure such as dikes, berms, curbing or pits, or other equivalent measures. The containment should be sufficient to store the volume of the largest single tank and should include sufficient freeboard for precipitation;

(b) A sufficient supply of dry-absorbent materials or a wet vacuum system, or other equivalent measure, to collect liquids from minor spills and leaks in contained areas; and

(c) Discharges of precipitation from containment areas containing used oil shall be in accordance with applicable sections of 40 CFR Part 112.

(iii) Truck and Rail Car Waste Transfer Areas—The plan shall describe measures and controls for truck and rail car loading and unloading areas. This includes appropriate containment and diversionary structures to minimize contact with precipitation or storm water runoff. The plan shall also address measures to clean up minor spills and/or leaks originating from the transfer of liquid wastes. This may include the use of dry-clean up methods, roof coverings, runoff controls, or other equivalent measures.

(iv) Erosion and Sediment Control—The plan shall identify all areas associated with industrial activity that have a high potential for soil erosion. Appropriate stabilization measures, nonstructural and structural controls shall be provided in these areas. The plan shall contain a narrative consideration of the appropriateness for selected erosion and sediment controls. Where applicable, the facility shall consider the use of the following types of preventive measures: sediment traps; vegetative buffer strips; filter fabric fence; sediment filtering boom; gravel outlet protection; or other equivalent measures that effectively trap or remove sediment prior to discharge through an inlet or catch basin.

(v) Spill Prevention and Response Procedures—The plan shall address measures and procedures to address potential spill scenarios that could occur at the facility. This includes all applicable handling and storage procedures, containment and/or diversion equipment, and clean-up procedures. The plan shall specifically address all outdoor and indoor storage areas, waste transfer areas, material receiving areas (loading and unloading), and waste disposal areas.

(vi) Quarterly Inspections—Quarterly visual inspections shall be conducted by a member, or members, of the storm water pollution prevention team. The quarterly inspection shall include all designated areas of the facility and equipment identified in the plan. The inspection shall include a means of tracking and conducting follow up actions based on the results of the inspection. At a minimum, the inspections shall include the following areas: material storage areas; material unloading and loading areas (including rail sidings) that are exposed to either precipitation or storm water runoff; areas where structural BMPs have been installed; all erosion and sediment BMPs; outdoor vehicle and equipment maintenance areas (if applicable); vehicle and equipment fueling areas (if applicable); and all areas where waste is generated, received, stored, treated, or disposed and which are exposed to either precipitation or storm water runoff.

The inspection shall identify the presence of any corroded or leaking containers, corroded or leaking pipes, leaking or improperly closed valves and valve fittings, leaking pumps and/or hose connections, and deterioration in diversionary or containment structures that are exposed to precipitation or storm water runoff. Spills or leaks shall be immediately addressed according to the facility's spill prevention and response procedures.

(c) Recycling Facilities (source separated materials)—The following special conditions have been established for the pollution prevention plan for recycling facilities, including MRFs, that receive only source-separated recyclable materials primarily from non-industrial and residential sources.

(i) Inbound Recyclable Material Control Program. The plan shall include a recyclable material inspection program to minimize the likelihood of receiving non-recyclable materials (e.g., hazardous materials) that may be a significant source of pollutants in surface runoff. At a minimum, the operator shall consider addressing in the plan the following:

(a) A description of information and education measures to educate the appropriate suppliers of recyclable materials on the types of recyclable materials that are acceptable and those that are not acceptable, e.g., household hazardous wastes;

(b) A description of training requirements for drivers responsible for pickup of recyclable materials;

(c) Clearly mark public drop-off containers as to what materials can be accepted;

(d) Rejecting non-recyclable wastes or household hazardous wastes at the source; and

(e) A description of procedures for the handling and disposal of non-recyclable materials.

(ii) Outdoor Storage. The plan shall include BMPs to minimize or reduce the exposure of recyclable materials to surface runoff and precipitation. The plan, at a minimum, shall include good housekeeping measures to prevent the accumulation of visible quantities of residual particulate matter and fluids, particularly in high traffic areas. The plan shall consider tarpaulins or their equivalent to be used to cover exposed bales of recyclable waste paper. The operator shall consider within the plan the use of the following types of BMPs (individually or in combination) or their equivalent, where practicable:

(a) Provide totally-enclosed drop-off containers for public.

(b) Provide a sump and sump pump with each containment pit. Discharge collected fluids to sanitary sewer system. Prevent discharging to the storm sewer system;

(c) Provide dikes and curbs for secondary containment, i.e., around bales of recyclable waste paper;

(d) Divert surface runoff away from outside material storage areas; and/or

(e) Provide covers over containment bins, dumpsters, roll-off boxes; and,

(f) Store the equivalent one day's volume of recyclable materials indoors.

(iii) Indoor Storage and Material Processing. The plan shall address BMPs to minimize the release of pollutants from indoor storage and processing areas to the storm sewer system. The plan shall establish specific measures to ensure that all floor drains do not discharge to the storm sewer system. The following BMPs shall be considered for inclusion in the plan:

(a) Schedule routine good housekeeping measures for all storage and processing areas;

(b) Prohibit a practice of allowing tipping floor washwaters from draining to any portion of the storm sewer system;

(c) Provide employee training on pollution prevention practices.

(iv) Vehicle and Equipment Maintenance. The plan shall also provide for BMPs in those areas where vehicle and equipment maintenance is occurring outdoors. At a minimum, the following BMPs or equivalent measures shall be considered for inclusion in the plan:

(a) Prohibit vehicle and equipment washwater from discharging to the storm sewer system;

(b) Minimize or eliminate outdoor maintenance areas, wherever possible;

(c) Establish spill prevention and clean-up procedures in fueling areas;

(d) Provide employee training on avoiding topping off fuel tanks;

(e) Divert runoff from fueling areas;

(f) Store lubricants and hydraulic fluids indoors;

(g) Provide employee training on proper, handling, storage of hydraulic fluids and lubricants.

(d) Recordkeeping and Internal Reporting Procedures—The following record and internal reporting procedures are applicable to all discharges seeking coverage under this permit. The plan shall include a description of incidents (such as spills, or other discharges), along with other information describing the quality and quantity of storm water discharges. Inspections and maintenance activities shall be documented and records of such activities shall be incorporated into the plan. The plan must address spills, monitoring, and BMP inspection and maintenance activities. BMPs which are ineffective must be reported and the date of their corrective action noted. Employees must report incidents of leaking fluids to facility management and these reports must be incorporated into the plan.

(e) Non-storm Water Discharges

(i) The plan shall include a certification that the discharge has been tested or evaluated for the presence of non-storm water discharges. The certification shall include the identification of potential significant sources of non-storm water at the site, a description of the results of any test and/or evaluation for the presence of non-storm water discharges, the evaluation criteria or testing method used, the date of any testing and/or evaluation, and the onsite drainage points that were directly observed during the test. Certifications shall be signed in accordance with Part VII.G. of this permit. Such certification may not be feasible if the facility operating the storm water discharge associated with industrial activity does not have access to an outfall, manhole, or other point of access to the ultimate conduit which receives the discharge. In such cases, the source identification section of the storm water pollution prevention plan shall indicate why the certification required by this part was not feasible, along with the identification of potential significant sources of non-storm water at the site. A discharger that is unable to provide the certification required by this paragraph must notify the Director in accordance with paragraph XI.N.3.a.(3)(d)(iii) (below).

(ii) Except for flows from fire fighting activities, sources of non-storm water listed in Part III.A.2 (Prohibition of Non-storm Water Discharges) of this permit that are combined with storm water discharges associated with industrial activity must be identified in the plan. The plan shall identify and ensure the implementation of appropriate pollution prevention measures for the non-storm water component(s) of the discharge.

(iii) Failure to Certify—Any facility that is unable to provide the certification required (testing for non-storm water discharges), must notify the Director [Insert date 270 days after permit issuance] or, for facilities which begin to discharge storm water associated with industrial activity after [Insert date 270 days after permit issuance], 180 days after submitting an NOI to be covered by this permit. If the failure to certify is caused by the inability to perform adequate tests or evaluations, such notification shall describe: the procedure of any test conducted for the presence of non-storm water discharges; the results of such test or other relevant observations; potential sources of non-storm water discharges to the storm sewer; and why adequate

tests for such storm sewers were not feasible. Non-storm water discharges to waters of the United States which are not authorized by an NPDES permit are unlawful, and must be terminated.

(4) Comprehensive Site Compliance Evaluation. Qualified personnel shall conduct site compliance evaluations at appropriate intervals specified in the plan, but in no case less than once a year. Such evaluations shall provide:

(a) Areas contributing to a storm water discharge associated with industrial activity shall be visually inspected for evidence of, or the potential for, pollutants entering the drainage system. Measures to reduce pollutant loadings shall be evaluated to determine whether they are adequate and properly implemented in accordance with the terms of the permit or whether additional control measures are needed. Structural storm water management measures, sediment and erosion control measures, and other structural pollution prevention measures identified in the plan shall be observed to ensure that they are operating correctly. A visual inspection of equipment needed to implement the plan, such as spill response equipment, shall be made.

(b) Based on the results of the evaluation, the description of potential pollutant sources identified in the plan in accordance with paragraph XI.N.3.a.(2) of this section (Description of Potential Pollutant Sources) and pollution prevention measures and controls identified in the plan in accordance with paragraph XI.N.3.a.(3) of this section (Measures and Controls) shall be revised as appropriate within 2 weeks of such evaluation and shall provide for implementation of any changes to the plan in a timely manner, but in no case more than 12 weeks after the evaluation.

(c) A report summarizing the scope of the evaluation, personnel making the evaluation, the date(s) of the evaluation, major observations relating to the implementation of the storm water pollution prevention plan, and actions taken in accordance with paragraph XI.N.3.a.(4)(b) (above) of the permit shall be made and retained as part of the storm water pollution prevention plan for at least 3 years after the date of the evaluation. The report shall identify any incidents of noncompliance. Where a report does not identify any incidents of noncompliance, the report shall contain a certification that the facility is in compliance with the storm water pollution prevention plan and this permit. The report shall be signed in accordance with Part VII.G. (Signatory Requirements) of this permit.

(d) The storm water pollution prevention plan must describe the scope and content of comprehensive site evaluations that qualified personnel shall conduct to (1) confirm the accuracy of the description of potential pollution sources contained in the plan, (2) determine the effectiveness of the plan, and (3) assess compliance with the terms and conditions of the permit. The individual or individuals who shall conduct the evaluation must be identified in the plan and should be members of the pollution prevention team.

4. Numeric Effluent Limitations

There are no additional numeric effluent limitations beyond those described in Part V.B of this permit.

5. Monitoring and Reporting Requirements

a. Analytical Monitoring Requirements. During the period beginning [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] and the period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance], permittees with scrap recycling and waste recycling facilities must monitor their storm water discharges associated with industrial activity at least quarterly (4 times per year) during years 2 and 4 except as provided in paragraphs 5.a.(3) (Sampling Waiver), 5.a.(4) (Representative Discharge), and 5.a.(5) (Alternative Certification). Scrap recycling and waste recycling facilities are required to monitor their storm water discharges for the pollutants of concern listed in Table N-1 below. Facilities must report in accordance with 5.b. (Reporting). In addition to the parameters listed in Table N-1 below, the permittee shall provide the date and duration (in hours) of the storm event(s) sampled; rainfall measurements or estimates (in inches) of the storm event that generated the sampled runoff; the duration between the storm event sampled and the end of the previous measurable (greater than 0.1 inch rainfall) storm event; and an estimate of the total volume (in gallons) of the discharge sampled.

TABLE N-1.—INDUSTRY MONITORING REQUIREMENTS

Pollutants of concern[1]	Cut-off concentration (mg/L
Chemical Oxygen Demand (COD)	120
Total Suspended Solids (TSS)	100
Total Recoverable Aluminum	0.75
Total Recoverable Copper	0.0636
Total Recoverable Iron	1.0
Total Recoverable Lead	0.0816
Total Recoverable Zinc	0.117

[1] Several congeners of PCBs (PCB-1016, -1221, -1242, -1248, -1260) were above established benchmarks, however, EPA believes that these constituents will readily bound up with sediment and particulate matter. Therefore, EPA believes that BMPs will effectively address sources of PCBs and that monitoring for TSS will serve as an adequate indicator of the control of PCBs.

(1) Monitoring Periods. Scrap and waste material processing and recycling facilities shall monitor samples collected during the sampling periods of: January to March, April to June, July to September, and October to December for the years specified in paragraph a. (above).

(2) Sample Type. A minimum of one grab sample shall be taken. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The required 72-hour storm event interval is waived where the preceding measurable storm event did not result in a measurable discharge from the facility. The required 72-hour storm event interval may also be waived where the permittee documents that less than a 72-hour interval is representative for local storm events during the season when sampling is being conducted. The grab sample shall be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable. If storm water discharges associated with industrial activity commingle with process or non-process water, then where practicable, permittees must attempt to sample the storm water discharge before it mixes with the non-storm water discharge.

(3) Sampling Waiver

(a) Adverse Conditions—When a discharger is unable to collect samples within a specified sampling period due

to adverse climatic conditions, the discharger shall collect a substitute sample from a separate qualifying event in the next period and submit the data along with data for the routine sample in that period. Adverse weather conditions that may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (e.g., drought, extended frozen conditions, etc.).

(b) Low Concentration Waiver—When the average concentration for a pollutant calculated from all monitoring data collected from an outfall during the monitoring period [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] is less than the corresponding value for that pollutant listed in Table N-1 under the column Monitoring Cut-off Concentration, a facility may waive monitoring and reporting requirements in the monitoring period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance]. The facility must submit to the Director, in lieu of the monitoring data, a certification that there has not been a significant change in industrial activity or the pollution prevention measures in the area of the facility which drains to the outfall for which sampling was waived.

(c) When a discharger is unable to conduct quarterly chemical storm water sampling at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirements as long as the facility remains inactive and unstaffed. The facility must submit to the Director, in lieu of monitoring data, a certification statement on the DMR stating that the site is inactive and unstaffed so that collecting a sample during a qualifying event is not possible.

(4) Representative Discharge. When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may test the effluent of one of such outfalls and report that the quantitative data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan. The permittee shall include the description of the location of the outfalls, explanation of why outfalls are expected to discharge substantially identical effluents, and estimate of the size of the drainage area and runoff coefficient with the Discharge Monitoring Report.

(5) Alternative Certification. A discharger is not subject to the monitoring requirements of this section provided the discharger makes a certification for a given outfall or on a pollutant-by-pollutant basis in lieu of the monitoring reports required under paragraph *b* below, under penalty of law, signed in accordance with Part VII.G. (Signatory Requirements), that material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, industrial machinery or operations, or significant materials from past industrial activity, that are located in areas of the facility within the drainage area of the outfall are not presently exposed to storm water and are not expected to be exposed to storm water for the certification period. Such certification must be retained in the storm water pollution prevention plan, and submitted to EPA in accordance with Part VI.C. of this permit. In the case of certifying that a pollutant is not present, the permittee must submit the certification along with the monitoring reports required under paragraph b. below. If the permittee cannot certify for an entire period, they must submit the date exposure was eliminated and any monitoring required up until that date. This certification option is not applicable to compliance monitoring requirements associated with effluent limitations.

b. Reporting. Permittees with scrap and waste material processing and recycling facilities shall submit monitoring results for each outfall associated with industrial activity [or a certification in accordance with Sections (3), (4), or (5) above] obtained during the reporting period beginning [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] on Discharge Monitoring Report Form(s) postmarked no later than the 31st day of the following March [insert the date 2 years after permit issuance]. Monitoring results (or a certification in accordance with Sections (3), (4), or (5) above] obtained during the period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance] shall be submitted on Discharge Monitoring Report Form(s) postmarked no later than the 31st day of the following March. For each outfall, one signed Discharge Monitoring Report form must be submitted to the Director per storm event sampled. Signed copies of Discharge Monitoring Reports, or said certifications, shall be submitted to the Director of the NPDES program at the address of the appropriate Regional Office listed in Part VI.G. of the fact sheet.

(1) Additional Notification. In addition to filing copies of discharge monitoring reports in accordance with paragraph b (above), scrap and waste material processing and recycling facilities with at least one storm water discharge associated with industrial activity through a large or medium municipal separate storm sewer system (systems serving a population of 100,000 or more) must submit signed copies of discharge monitoring reports to the operator of the municipal separate storm sewer system in accordance with the dates provided in paragraph b (above).

c. Quarterly Visual Examination of Storm Water Quality. Facilities shall perform and document a visual examination of a representative storm water discharge associated with industrial activity exposed to storm water. The examination must be made at least once each quarter during daylight hours unless there is insufficient rainfall or snow melt to produce a runoff event. Examinations must be conducted at least once in each of the following periods: January through March; April through June; July through September; and October through December.

(1) Examinations shall be made of samples collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 1 hour) of when the runoff or snowmelt begins discharging. The examinations shall document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on the samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm

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event. Where practicable, the same individual should carry out the collection and examination of discharges for the entire permit term.

(2) Visual examination reports must be maintained onsite in the pollution prevention plan. The report shall include the examination date and time, examination personnel, the nature of the discharge (i.e., runoff or snow melt), visual quality of the storm water discharge (including observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution), and probable sources of any observed storm water contamination.

(3) When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may collect a sample of effluent of one of such outfalls and report that the examination data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

(4) When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain the documentation on-site with the records of the visual examinations. Adverse weather conditions which may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(5) When a discharger is unable to conduct visual storm water examinations at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirement as long as the facility remains inactive and unstaffed. The facility must maintain a certification with the pollution prevention plan stating that the site is inactive and unstaffed so that performing visual examinations during a qualifying event is not feasible.

O. Storm Water Discharges Associated With Industrial Activity From Steam Electric Power Generating Facilities, Including Coal Handling Areas

1. Discharges Covered Under This Section

The requirements listed under this section shall apply to storm water discharges from steam electric power generating facilities, including coal handling areas. Non-storm water discharges subject to effluent limitations guidelines are not covered by this permit. Storm water discharges from coal pile runoff subject to numeric limitations are eligible for coverage under this permit, but are subject to the limitations established by 40 CFR 423.

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

a. Limitations on Coverage. Storm water discharges from ancillary facilities such as fleet centers, gas turbine stations, and substations that are not contiguous to a steam electric power generating facility are not covered by this permit. Heat capture co-generation facilities are not covered by this permit; however, dual fuel co-generation facilities are included.

2. Special Conditions

a. Prohibition of Non-storm Water Discharges. Except as provided under Part III.A.2 of this permit, non-storm water discharges are not authorized by this permit. The operators of such discharges must obtain coverage under a separate National Pollutant Discharge Elimination System (NPDES) permit if discharged to waters of the United States or through a municipal separate storm sewer system. Storm water discharges associated with industrial activities that are mixed with sources of non-storm water are not authorized by this permit, except if mixed with non-storm water discharges that are in compliance with a different NPDES permit or identified by and in compliance with Part III.A.2 (Prohibition of Non-storm Water Discharges) of this permit.

Storm Water Pollution Prevention Plan Requirements

a. Contents of Plan. The plan shall include, at a minimum, the following items:

(1) Pollution Prevention Team. Each plan shall identify a specific individual or individuals within the facility organization as members of a storm water Pollution Prevention Team that are responsible for developing the storm water pollution prevention plan and assisting the facility or plant manager in its implementation, maintenance, and revision. The plan shall clearly identify the responsibilities of each team member. The activities and responsibilities of the team shall address all aspects of the facility's storm water pollution prevention plan.

(2) Description of Potential Pollutant Sources. Each plan shall provide a description of potential sources which may reasonably be expected to add significant amounts of pollutants to storm water discharges or which may result in the discharge of pollutants during dry weather from separate storm sewers draining the facility. Each plan shall identify all activities and significant materials which may potentially be significant pollutant sources. Each plan shall include, at a minimum:

(a) Drainage.

(i) A site map which clearly outlines the locations of the following, as they apply to the facility: The outfall locations and the types of discharges contained in the drainage areas of the outfalls, and an outline of the drainage area of each storm water outfall that is within the facility boundaries (and indicating the direction of storm water flow); processing areas and buildings; treatment ponds; locations where significant materials are exposed to precipitation; storage tanks; scrap yards, and general refuse areas; fuel storage and distribution areas; vehicle and equipment maintenance and storage areas; loading/unloading areas; locations used for treatment, storage or disposal of wastes; location of short and long term storage of general materials (including but not limited to: supplies, construction materials, plant

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equipment, oils, fuels, used and unused solvents, cleaning materials, paint, water treatment chemicals, fertilizers, and pesticides); landfills; location of construction sites; locations of stock pile areas (such as coal piles and limestone piles); locations where major spills or leaks identified under Part XI.O.3.a.(2)(c) (Spills and Leaks) of this permit have occurred; surface water bodies; and existing structural control measures to reduce pollutants in storm water runoff (such as bermed areas, grassy swales, etc.).

(ii) For each storm water outfall identify the types of pollutants which are likely to be present in the storm water discharges. Factors to consider include the toxicity of a chemical; quantity of chemicals used, produced or discharged; the likelihood of contact with storm water; and history of significant leaks or spills of toxic or hazardous pollutants. Flows with a significant potential for causing erosion shall be identified.

(b) Inventory of Exposed Materials—An inventory of the types of materials handled at the site that potentially may be exposed to precipitation. Such inventory shall include a narrative description of significant materials that have been handled, treated, stored or disposed in a manner to allow exposure to storm water between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; method and location of onsite storage or disposal; materials management practices employed to minimize contact of materials with storm water runoff between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; the location and a description of existing structural and nonstructural control measures to reduce pollutants in storm water runoff; and a description of any treatment the storm water receives.

(c) Spills and Leaks—A list of significant spills and significant leaks of toxic or hazardous pollutants that occurred at areas that are exposed to precipitation or that otherwise drain to a storm water conveyance at the facility after the date of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit. Such list shall be updated as appropriate during the term of the permit.

(d) Sampling Data—A summary of existing discharge sampling data describing pollutants in storm water discharges from the facility, including a summary of sampling data collected during the term of this permit.

(e) Risk Identification and Summary of Potential Pollutant Sources—A narrative description of the potential pollutant sources from the following activities: loading and unloading operations; outdoor storage activities; outdoor manufacturing or processing activities; significant dust or particulate generating processes; and onsite waste disposal practices. The description shall specifically list any significant potential source of pollutants at the site and for each potential source, any pollutant or pollutant parameter (e.g., total suspended solids, copper, etc.) of concern shall be identified.

(3) Measures and Controls. Each facility covered by this permit shall develop a description of storm water management controls appropriate for the facility, and implement such controls. The appropriateness and priorities of controls in a plan shall reflect identified potential sources of pollutants at the facility. The description of storm water management controls shall address the following minimum components, including a schedule for implementing such controls:

(a) Good Housekeeping—Good housekeeping requires the maintenance of areas which may contribute pollutants to storm water discharges in a clean, orderly manner. The following areas must be specifically addressed:

(i) Fugitive Dust Emissions—The plan must describe measures that prevent or minimize fugitive dust emissions from coal handling areas. The permittee shall consider establishing procedures to minimize offsite tracking of coal dust. To prevent offsite tracking the facility may consider specially designed tires, or washing vehicles in a designated area before they leave the site, and controlling the wash water.

(ii) Delivery Vehicles—The plan must describe measures that prevent or minimize contamination of storm water runoff from delivery vehicles arriving on the plant site. At a minimum the permittee should consider the following:

(a) Develop procedures for the inspection of delivery vehicles arriving on the plant site, and ensure overall integrity of the body or container; and

(b) Develop procedures to deal with leakage or spillage from vehicles or containers, and ensure that proper protective measures are available for personnel and environment.

(iii) Fuel Oil Unloading Areas—The plan must describe measures that prevent or minimize contamination of storm water runoff from fuel oil unloading areas. At a minimum the facility operator must consider using the following measures, or an equivalent:

(a) Use containment curbs in unloading areas;

(b) During deliveries station personnel familiar with spill prevention and response procedures must be present to ensure that any leaks or spills are immediately contained and cleaned up; and

(c) Use spill and overflow protection (drip pans, drip diapers, and/or other containment devices shall be placed beneath fuel oil connectors to contain any spillage that may occur during deliveries or due to leaks at such connectors).

(iv) Chemical Loading/Unloading Areas—The plan must describe measures that prevent or minimize the contamination of storm water runoff from chemical loading/unloading areas. Where practicable, chemical loading/unloading areas should be covered, and chemicals should be stored indoors.

At a minimum the permittee must consider using the following measures or an equivalent:

(a) Use containment curbs at chemical loading/unloading areas to contain spills; and

(b) During deliveries station personnel familiar with spill prevention and response procedures must be present to ensure that any leaks or spills are immediately contained and cleaned up.

(v) Miscellaneous Loading/Unloading Areas—The plan must describe measures that prevent or minimizes the contamination of storm water runoff from loading and unloading areas. The facility may consider covering the loading area, minimizing storm water runon to the loading area by grading, berming, or curbing the area around the loading area to direct storm water away from the area, or locate the loading/unloading equipment and vehicles so that leaks can be contained in existing containment and flow diversion systems.

(vi) Liquid Storage Tanks—The plan must describe measures that prevent or minimize contamination of storm water runoff from above ground liquid storage tanks. At a minimum the facility operator must consider employing the following measures or an equivalent:

(a) Use protective guards around tanks;

(b) Use containment curbs;

(c) Use spill and overflow protection (drip pans, drip diapers, and/or other containment devices shall be placed beneath chemical connectors to contain any spillage that may occur during deliveries or due to leaks at such connectors); and

(d) Use dry cleanup methods.

(vii) Large Bulk Fuel Storage Tanks—The plan must describe measures that prevent or minimize contamination of storm water runoff from liquid storage tanks. At a minimum the facility operator must consider employing the following measures, or an equivalent:

(a) Comply with applicable State and Federal laws, including Spill Prevention Control and Countermeasures (SPCC); and

(b) Containment berms.

(viii) The plan must describe measures to reduce the potential for an oil spill, or a chemical spill, or reference the appropriate section of their SPCC plan. At a minimum the structural integrity of all above ground tanks, pipelines, pumps and other related equipment shall be visually inspected on a weekly basis. All repairs deemed necessary based on the findings of the inspections shall be completed immediately to reduce the incidence of spills and leaks occurring from such faulty equipment.

(ix) Oil Bearing Equipment in Switchyards—The plan must describe measures to reduce the potential for storm water contamination from oil bearing equipment in switchyard areas. The facility operator may consider level grades and gravel surfaces to retard flows and limit the spread of spills; collection of storm water runoff in perimeter ditches.

(x) Residue Hauling Vehicles—All residue hauling vehicles shall be inspected for proper covering over the load, adequate gate sealing and overall integrity of the body or container. Vehicles without load coverings or adequate gate sealing, or with leaking containers or beds must be repaired as soon as practicable.

(xi) Ash Loading Areas—Plant procedures shall be established to reduce and/or control the tracking of ash or residue from ash loading areas including, where practicable, requirements to clear the ash building floor and immediately adjacent roadways of spillage, debris and excess water before each loaded vehicle departs.

(xii) Areas Adjacent to Disposal Ponds or Landfills—The plan must describe measures that prevent or minimize contamination of storm water runoff from areas adjacent to disposal ponds or landfills. The facility must develop procedures to:

(a) Reduce ash residue which may be tracked on to access roads traveled by residue trucks or residue handling vehicles; and

(b) Reduce ash residue on exit roads leading into and out of residue handling areas.

(xiii) Landfills, Scrapyards, Surface Impoundments, Open Dumps, General Refuse Sites—The plan must address landfills, scrapyards, surface impoundments, open dumps and general refuse sites. The permittee is referred to Parts XI.L. and XI.N of the permit for applicable Best Management Practices (BMPs).

(xiv) Maintenance Activities—For vehicle maintenance activities performed on the plant site, the permittee shall use the applicable BMPs outlined in Part XI.P. of the permit (Storm Water Discharges Associated With Industrial Activity From Motor Freight Transportation Facilities, Passenger Transportation Facilities, Rail Transportation Facilities, and United States Postal Service Transportation Facilities).

(xv) Material Storage Areas—The plan must describe measures that prevent or minimize contamination of storm water from material storage areas (including areas used for temporary storage of miscellaneous products, and construction materials stored in lay down areas). The facility operator may consider flat yard grades, runoff collection in graded swales or ditches, erosion protection measures at steep outfall sites (e.g., concrete chutes, riprap, stilling basins), covering lay down areas, storing the materials indoors, covering the material with a temporary covering made of polyethylene, polyurethane, polypropylene, or hypalon. Storm water runon may be minimized by constructing an enclosure or building a berm around the area.

(b) Preventive Maintenance—A preventive maintenance program shall be implemented and shall include timely inspection and maintenance of storm water management devices (e.g., cleaning oil/water separators, catch basins) as well as inspecting and testing facility equipment and systems to uncover conditions that could cause breakdowns or failures resulting in discharges of pollutants to surface waters, and ensuring appropriate maintenance of such equipment and systems.

(c) Spill Prevention and Response Procedures—Areas where potential spills which can contribute pollutants to storm water discharges can occur, and their accompanying drainage points, shall be identified clearly in the storm water pollution prevention plan. Where appropriate, specifying material handling procedures, storage requirements, and use of equipment such as diversion valves in the plan should be considered. Procedures for cleaning up spills shall be identified in the plan and made available to the appropriate personnel. The necessary equipment to implement a clean up should be available to personnel.

(d) Inspections—In addition to or as part of the comprehensive site evaluation required under Part XI.O.3.a.(4) of this section, qualified facility personnel shall be identified to inspect the following areas on a monthly basis: coal handling areas, loading/unloading areas, switchyards, fueling areas, bulk storage areas, ash handling areas, areas adjacent to disposal ponds and landfills, maintenance areas, liquid storage tanks, and long term and short term material storage areas. A set of tracking or follow-up procedures shall be used to ensure that appropriate actions are taken in response to the inspections. Records of inspections shall be maintained onsite. Such records are subject to review by the U.S. Environmental Protection Agency, and State, and local agencies with jurisdiction, and must be retained onsite a minimum of 3 years after the date of the inspection.

(e) Employee Training—Employee training programs shall inform personnel responsible for implementing activities identified in the storm water pollution prevention plan or otherwise responsible for storm water management at all levels of responsibility of the components and goals of the storm water pollution prevention plan. Training should address topics such as goals of the pollution prevention plan, spill prevention and control, proper handling procedures for hazardous wastes, good housekeeping and material management practices, and storm water sampling techniques. The pollution prevention plan shall identify periodic dates for such training, but in all cases training must be held at least annually.

(f) Recordkeeping and Internal Reporting Procedures—A description of incidents (such as spills, or other discharges), along with other information describing the quality and quantity of storm water discharges shall be included in the plan required under this part. Inspections and maintenance activities shall be documented and records of such activities shall be incorporated into the plan.

(g) Non-storm Water Discharges.

(i) The plan shall include a certification that the discharge has been tested or evaluated for the presence of non-storm water discharges. The certification shall include the identification of potential significant sources of non-storm water at the site, a description of the results of any test and/or evaluation for the presence of non-storm water discharges, the

evaluation criteria or testing method used, the date of any testing and/or evaluation, and the onsite drainage points that were directly observed during the test. Certifications shall be signed in accordance with Part VII.G. of this permit. Such certification may not be feasible if the facility operating the storm water discharge associated with industrial activity does not have access to an outfall, manhole, or other point of access to the ultimate conduit which receives the discharge. In such cases, the source identification section of the storm water pollution prevention plan shall indicate why the certification required by this part was not feasible, along with the identification of potential significant sources of non-storm water at the site. A discharger that is unable to provide the certification required by this paragraph must notify the Director in accordance with paragraph XI.O.3.a.(3)(g)(iii) (below).

(ii) Except for flows from fire fighting activities, sources of non-storm water listed in Part III.A.2 (Prohibition of Non-storm Water Discharges) of this permit that are combined with storm water discharges associated with industrial activity must be identified in the plan. The plan shall identify and ensure the implementation of appropriate pollution prevention measures for the non-storm water component(s) of the discharge.

(iii) Failure to Certify—Any facility that is unable to provide the certification required (testing for non-storm water discharges), must notify the Director by [Insert date 270 days after permit issuance] or, for facilities which begin to discharge storm water associated with industrial activity after [Insert date 270 days after permit issuance], 180 days after submitting an NOI to be covered by this permit. If the failure to certify is caused by the inability to perform adequate tests or evaluations, such notification shall describe: the procedure of any test conducted for the presence of non-storm water discharges; the results of such test or other relevant observations; potential sources of non-storm water discharges to the storm sewer; and, why adequate tests for such storm sewers were not feasible. Non-storm water discharges to waters of the United States which are not authorized by an NPDES permit are unlawful, and must be terminated.

(h) Sediment and Erosion Control—The plan shall identify areas which, due to topography, activities, or other factors, have a high potential for significant soil erosion, and identify structural, vegetative, and/or stabilization measures to be used to limit erosion.

(i) Management of Runoff—The plan shall contain a narrative consideration of the appropriateness of traditional storm water management practices (practices other than those which control the generation or source(s) of pollutants) used to divert, infiltrate, reuse, or otherwise manage storm water runoff in a manner that reduces pollutants in storm water discharges from the site. The plan shall provide that measures the permittee determines to be reasonable and appropriate shall be implemented and maintained. The potential of various sources at the facility to contribute pollutants to storm water discharges associated with industrial activity (see Part XI.O.3.a.(2)) shall be considered when determining reasonable and appropriate measures. Appropriate measures may include: vegetative swales and practices, reuse of collected storm water (such as for a process or as an irrigation source), inlet controls (such as oil/water separators), snow management activities, infiltration devices, wet detention/retention devices, or other equivalent measures.

(4) Comprehensive Site Compliance Evaluation. Qualified personnel shall conduct site compliance evaluations at appropriate intervals specified in the plan, but in no case less than once a year. Such evaluations shall provide:

(a) Areas contributing to a storm water discharge associated with industrial activity shall be visually inspected for evidence of, or the potential for, pollutants entering the drainage system. Measures to reduce pollutant loadings shall be evaluated to determine whether they are adequate and properly implemented in accordance with the terms of the permit or whether additional control measures are needed. Structural storm water management measures, sediment and erosion control measures, and other structural pollution prevention measures identified in the plan shall be observed to ensure that they are operating correctly. A visual evaluation of equipment needed to implement the plan, such as spill response equipment, shall be made.

(b) Based on the results of the evaluation, the description of potential pollutant sources identified in the plan in accordance with Part XI.O.3.a.(2) of this section (Description of Potential Pollutant Sources) and pollution prevention measures and controls identified in the plan in accordance with Part XI.O.3.a.(3) of this section (Measures and Controls) shall be revised as appropriate within 2 weeks of such evaluation and shall provide for implementation of any changes to the plan in a timely manner, but in no case more than 12 weeks after the evaluation.

(c) A report summarizing the scope of the evaluation, personnel making the evaluation, the date(s) of the evaluation, major observations relating to the implementation of the storm water pollution prevention plan, and actions taken in accordance with paragraph XI.O.3.a.(4)(b) (above) of the permit shall be made and retained as part of the storm water pollution prevention plan for at least 3 years from the date of the evaluation. The report shall identify any incidents of noncompliance. Where a report does not identify any incidents of noncompliance, the report shall contain a certification that the facility is in compliance with the storm water pollution prevention plan and this permit. The report shall be signed in accordance with Part VII.G. (Signatory Requirements) of this permit.

(d) Where compliance evaluation schedules overlap with inspections required under 3.a.(3)(d), the compliance evaluation may be conducted in place of one such inspection.

4. Numeric Effluent Limitations

Coal pile runoff is subject to the effluent guidelines described in Part V.B. of this permit. However, steam electric generating facilities must comply with the requirement of Part V.B. immediately upon permit issuance. Steam electric generating facilities are not permitted to take 3 years to meet this requirement.

5. Monitoring and Reporting Requirements

a. Analytical Monitoring Requirements. During the period beginning [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] and the period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance], permittees with steam electric power generating facilities must monitor their storm water discharges associate with industrial activity at least quarterly (4 times per year) during years 2 and 4 except as provided in paragraphs 5.a.(3). (sampling waiver), 5.a.(4). (representative discharge), and 5.a.(5).(alternative certification), steam electric power generating facilities are required to monitor their storm water discharges for the pollutant of concern listed in Table O–1 below. Facilities must report in accordance with 5.b.(reporting). In addition to the parameter listed in Table O–1 below, the permittee shall provide the date and duration (in hours) of the storm event(s) sampled; rainfall measurements or estimates (in inches) of the storm event which generated the sampled runoff; the duration between the storm event sampled and the end of the previous measurable (greater than 0.1 inch rainfall) storm event; and an estimate of the total volume (in gallons) of the discharge sampled;

TABLE O–1.—MONITORING REQUIREMENTS FOR STEAM ELECTRIC POWER GENERATING FACILITIES

Pollutant of concern	Cut-Off concentration (mg/L²)
Total Recoverable Iron	1.0

(1) Monitoring Periods. Steam electric power generating facilities shall monitor samples collected during the sampling periods of: January through March, April through June, July through September, and October through December for the years specified in paragraph a (above).

(2) Sample Type. A minimum of one grab sample shall be taken. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The required 72-hour storm event interval is waived where the preceding measurable storm event did not result in a measurable discharge from the facility. The required 72-hour storm event interval may also be waived where the permittee documents that less than a 72-hour interval is representative for local storm events during the season when sampling is being conducted. The grab sample shall be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable. If storm water discharges associated with industrial activity commingle with process or nonprocess water, then where practicable permittees must attempt to sample the storm water discharge before it mixes with the non-storm water discharge.

(3) Sampling Waiver.

(a) Adverse Conditions—When a discharger is unable to collect samples within a specified sampling period due to adverse climatic conditions, the discharger shall collect a substitute sample from a separate qualifying event in the next period and submit the data along with data for the routine sample in that period. Adverse weather conditions which may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(b) Low Concentration Waiver—When the average concentration for a pollutant calculated from all monitoring data collected from an outfall during the monitoring period [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] is less than the corresponding value for that pollutant listed in Table O–1 under the column Monitoring Cut-off Concentration, a facility may waive monitoring and reporting requirements in the monitoring period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance]. The facility must submit to the Director, in lieu of the monitoring data, a certification that there has not been a significant change in industrial activity or the pollution prevention measures in area of the facility which drains to the outfall for which sampling was waived.

(c) When a discharger is unable to conduct quarterly chemical storm water sampling at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirements as long as the facility remains inactive and unstaffed. The facility must submit to the Director, in lieu of monitoring data, a certification statement on the DMR stating that the site is inactive and unstaffed so that collecting a sample during a qualifying event is not possible.

(4) Representative Discharge. When a facility has 2 or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may test the effluent of one of such outfalls and report that the quantitative data also applies to the substantially identical outfalls provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explaining in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area (e.g., low (under 40 percent), medium (40 to 65 percent) or high (above 65 percent)) shall be provided in the plan. The permittee shall include the description of the location of the outfalls, explanation of why outfalls are expected to discharge substantially identical effluents, and estimate of the size of the drainage area and runoff coefficient with the Discharge Monitoring Report.

(5) Alternative Certification. A discharger is not subject to the monitoring requirements of this section provided the discharger makes a certification for a given outfall, or on a pollutant-by-pollutant basis in lieu of monitoring reports required under paragraph b below, under penalty of law, signed in accordance with Part VII.G. (signatory requirements), that material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, industrial machinery or operations, significant materials from past industrial activity that are located in areas of the facility within the drainage area of the outfall are not presently exposed to storm water and are not expected to be exposed to storm water for the certification period. Such certification must be retained in the storm water pollution prevention plan, and submitted to EPA in accordance with Part VI.C. of this permit. In the case of certifying that a pollutant is not present, the permittee must submit the certification along with the monitoring reports required under paragraph (*b*) below. If the permittee cannot certify for an entire period, they must submit the date exposure was eliminated and any monitoring required up until that date. This certification option is not applicable to compliance monitoring requirements associated with effluent limitations.

b. Reporting. Permittees with steam electric power generating facilities shall submit monitoring results, or a certification that there has not been a significant change in industrial activity or the pollution prevention measures in area of the facility which drains to the outfall for which sampling was waived, obtained during the reporting period beginning [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] on Discharge Monitoring Report Form(s) postmarked no later than the 31st day of the following March [insert the date 2 years after permit issuance]. Monitoring results, or a certification that there has not been a significant change in industrial activity or the pollution prevention measures in area of the facility which drains to the outfall for which sampling was waived, obtained during the period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance] shall be submitted on Discharge Monitoring Report Form(s) postmarked no later than the 31st day of the following March. For each outfall, one signed Discharge Monitoring Report form must be submitted to the Director per storm event sampled. Signed copies of Discharge Monitoring Reports, or said certifications, shall be submitted to the Director of the NPDES program at the address of the appropriate Regional Office listed in VI.G. of the fact sheet to this permit.

(1) Additional Notification. In addition to filing copies of discharge monitoring reports in accordance with paragraph b (above) steam electric power generating facilities with at least one storm water discharge associated with industrial activity through a large or medium municipal separate storm sewer system (systems serving a population of 100,000 or more) must submit signed copies of discharge monitoring reports to the operator of the municipal separate storm sewer system in accordance with the dates provided in paragraph b (above).

c. Compliance Monitoring Requirements. Permittees with point sources of coal pile runoff associated with steam electric power generation must monitor these storm water discharges for the presence of TSS and for pH at least annually (one time per year). Facilities must report in accordance with 5.c.(2) (reporting). In addition to the parameters listed above, the permittee shall provide the date and duration (in hours) of the storm event(s) sampled; rainfall measurements or estimates (in inches) of the storm event that generated the sampled runoff; the duration between the storm event sampled and the end of the previous measurable (greater than 0.1 inch rainfall) storm event; and an estimate of the total volume (in gallons) of the discharge sampled.

(1) Sample Type. A minimum of one grab sample shall be taken. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The grab sample shall be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable.

(2) Reporting. Permittees with asphalt paving or roofing emulsion production facilities shall submit monitoring results obtained during the reporting period beginning [insert date of permit issuance] on Discharge Monitoring Report Form(s) postmarked no later than the last day of the following [insert month after permit issuance date]. Signed copies of Discharge Monitoring Reports shall be submitted to the Director of the NPDES program at the address of the appropriate Regional Office indicated in Part VI.B. of this permit. For each outfall one Discharge monitoring form shall be submitted per storm event sampled.

(3) Additional Notification. In addition to filing copies of discharge monitoring reports in accordance with paragraph (2) (above), permittees that discharge through a large or medium municipal separate storm sewer system (systems serving a population of 100,000 or more) must submit signed copies of discharge monitoring reports to the operator of the municipal separate storm sewer system in accordance with the dates provided in paragraph (3) (above).

d. Quarterly Visual Examination of Storm Water Quality. Facilities shall perform and document a visual examination of a storm water discharge associated with industrial activity from each outfall, except discharges exempted below. The examination must be made at least once in each designated period [described in paragraph *(1)* below] during daylight hours unless there is insufficient rainfall or snow melt to produce a runoff event.

(1) Examinations shall be conducted in each of the following periods for the purposes of visually inspecting storm water quality associated with storm water runoff or snow melt: January through March; April through June; July through September; and October through December.

(2) Examinations shall be made of samples collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed one hour) of when the runoff or snowmelt begins discharging. The examination must be conducted in a well lit area. No analytical tests are required to be performed on the samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. Where practicable the same individual should carry out the collection and examination of discharges for entire permit term.

(3) Visual examination reports must be maintained on-site in the pollution prevention plan. The report shall include the examination date and time, examination personnel, the nature of the discharge (i.e., runoff or snow melt), visual quality of the storm water discharge including observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution, and probable sources of any observed storm water contamination.

(4) When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may collect a sample of effluent of one of such outfalls and report that the examination data also applies to the substantially identical outfalls provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explaining in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area (e.g., low (under 40 percent), medium (40 to 65 percent) or high (above 65 percent)) shall be provided in the plan.

(5) When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation with the records of the visual examination. Adverse weather conditions which may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(6) When a discharger is unable to conduct visual storm water examinations at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirement as long as the facility

remains inactive and unstaffed. The facility must maintain a certification with the pollution prevention plan stating that the site is inactive and unstaffed so that performing visual examinations during a qualifying event is not feasible.

P. Storm Water Discharges Associated With Industrial Activity From Motor Freight Transportation Facilities, Passenger Transportation Facilities, Petroleum Bulk Oil Stations and Terminals, Rail Transportation Facilities, and United States Postal Service Transportation Facilities

1. Discharges Covered Under This Section

Storm water discharges from ground transportation facilities and rail transportation facilities (generally identified by Standard Industrial Classification (SIC) codes 40, 41, 42, 43, and 5171), that have vehicle and equipment maintenance shops (vehicle and equipment rehabilitation, mechanical repairs, painting, fueling and lubrication) and/or equipment cleaning operations are eligible for coverage under this section.

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

2. Storm Water Pollution Prevention Plan Requirements

a. Deadlines for Plan Preparation and Compliance. There are no additional deadlines for plan preparation and compliance, other than those stated in Part IV.A.

b. Contents of the Plan. The plan shall include, at a minimum, the following items:

(1) Pollution Prevention Team. Each plan shall identify a specific individual or individuals within the facility organization as members of a storm water Pollution Prevention Team who are responsible for developing the storm water pollution prevention plan and assisting the facility or plant manager in its implementation, maintenance, and revision. The plan shall clearly identify the responsibilities of each team member. The activities and responsibilities of the team shall address all aspects of the facility's storm water pollution prevention plan.

(2) Description of Potential Pollutant Sources. Each plan shall provide a description of potential sources which may reasonably be expected to add significant amounts of pollutants to storm water discharges or which may result in the discharge of pollutants during dry weather from separate storm sewers draining the facility. Each plan shall identify all activities and significant materials which may potentially be significant pollutant sources. Each plan shall include, at a minimum:

(a) Drainage—A site map indicating the location of each point of discharge of storm water associated with industrial activity, an outline of the portions of the drainage area of each storm water outfall that are within the facility boundaries (with a prediction of the direction of flow), each existing structural control measure to reduce pollutants in storm water runoff, surface water bodies, locations where significant materials are exposed to precipitation, locations where major spills or leaks identified under Part XI.P.3.b.(2)(c) (Spills and Leaks) of this permit have occurred, and the locations of the following activities: fueling stations, vehicle and equipment maintenance and/or cleaning areas, storage areas for vehicles and equipment with actual or potential fluid leaks loading/unloading areas, locations used for the treatment, storage or disposal of wastes, liquid storage tanks, processing areas, storage areas, and all monitoring locations. The site map must also indicate the types of discharges contained in the drainage areas of the outfalls (e.g., storm water and air conditioner condensate). In order to increase the readability of the map, the inventory of the types of discharges contained in each outfall may be kept as an attachment to the site map.

(b) Inventory of Exposed Materials—An inventory of the types of materials handled at the site that potentially may be exposed to precipitation. Such inventory shall include a narrative description of significant materials that have been handled, treated, stored or disposed in a manner to allow exposure to storm water between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; method and location of onsite storage or disposal; dirt or gravel parking areas for storage of vehicles to be maintained; materials management practices employed to minimize contact of materials with storm water runoff between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; the location and a description of existing structural and nonstructural control measures to reduce pollutants in storm water runoff; and a description of any treatment the storm water receives.

(c) Spills and Leaks—A list of significant spills and significant leaks of toxic or hazardous pollutants that occurred at areas that are exposed to precipitation or that otherwise drain to a storm water conveyance at the facility after the date of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit. Such list shall be updated as appropriate during the term of the permit.

(d) Sampling Data—A summary of existing discharge sampling data describing pollutants in storm water discharges from the facility, including a summary of sampling data collected during the term of this permit.

(e) Summary of Potential Pollutant Sources—A narrative description of the potential pollutant sources from the following activities associated with vehicle and equipment maintenance and equipment cleaning: fueling stations; maintenance shops; equipment or vehicle cleaning areas; paved dirt or gravel parking areas for vehicles to be maintained; loading and unloading operations; outdoor storage activities; outdoor manufacturing or processing activities; significant dust or particulate generating processes; and onsite waste disposal practices. The description shall specifically list any significant potential source of pollutants at the site and for each potential source, any pollutant or pollutant parameter (e.g., oil and grease, etc.) of concern shall be identified.

(3) Measures and Controls. Each facility covered by this permit shall develop a description of storm water management controls appropriate for the facility, and implement such controls. The appropriateness and priorities of controls in a plan shall reflect identified potential sources of pollutants at the facility. The description of storm water management controls shall address the following minimum components, including a schedule for implementing such controls:

(a) Good Housekeeping—All areas that may contribute pollutants to storm

water discharges shall be maintained in a clean, orderly manner. The following areas must be specifically addressed:

(i) Vehicle and Equipment Storage Areas—The storage of vehicles and equipment awaiting maintenance with actual or potential fluid leaks must be confined to designated areas (delineated on the site map). The plan must describe measures that prevent or minimize contamination of the storm water runoff from these areas. The facility shall consider the use of drip pans under vehicles and equipment, indoor storage of the vehicles and equipment, installation of berming and diking of this area, use of absorbents, roofing or covering storage areas, cleaning pavement surface to remove oil and grease, or other equivalent methods.

(ii) Fueling Areas—The plan must describe measures that prevent or minimize contamination of the storm water runoff from fueling areas. The facility shall consider covering the fueling area, using spill and overflow protection and cleanup equipment, minimizing runon/runoff of storm water to the fueling area, using dry cleanup methods, collecting the storm water runoff and providing treatment or recycling, or other equivalent measures.

(iii) Material Storage Areas—Storage units of all materials (e.g., used oil, used oil filters, spent solvents, paint wastes, radiator fluids, transmission fluids, hydraulic fluids) must be maintained in good condition, so as to prevent contamination of storm water, and plainly labeled (e.g., "used oil," "spent solvents," etc.). The plan must describe measures that prevent or minimize contamination of the storm water runoff from such storage areas. The facility shall consider indoor storage of the materials, installation of berming and diking of the area, minimizing runon/runoff of storm water to the areas, using dry cleanup methods, collecting the storm water runoff and providing treatment, or other equivalent methods.

(iv) Vehicle and Equipment Cleaning Areas—The plan must describe measures that prevent or minimize contamination of the storm water runoff from all areas used for vehicle and equipment cleaning. The facility shall consider performing all cleaning operations indoors, covering the cleaning operation, ensuring that all washwaters drain to the intended collection system (i.e., not the storm water drainage system unless NPDES permitted), collecting the storm water runoff from the cleaning area and providing treatment or recycling, or other equivalent measures. The discharge of vehicle and equipment wash waters, including tank cleaning operations, are not authorized by this permit and must be covered under a separate NPDES permit or discharged to a sanitary sewer in accordance with applicable industrial pretreatment requirements.

(v) Vehicle and Equipment Maintenance Areas—The plan must describe measures that prevent or minimize contamination of the storm water runoff from all areas used for vehicle and equipment maintenance. The facility shall consider performing all maintenance activities indoors, using drip pans, maintaining an organized inventory of materials used in the shop, draining all parts of fluids prior to disposal, prohibiting wet clean up practices where the practices would result in the discharge of pollutants to storm water drainage systems, using dry cleanup methods, collecting the storm water runoff from the maintenance area and providing treatment or recycling, minimizing runon/runoff of storm water areas or other equivalent measures.

(vi) Locomotive Sanding (loading sand for traction) Areas—The plan must describe measures that prevent or minimize contamination of the storm water runoff from areas used for locomotive sanding. The facility shall consider covering sanding areas, minimizing storm water runon/runoff, appropriate sediment removal practices to minimize the offsite transport of sanding material by storm water, or other equivalent measures.

(b) Preventive Maintenance—A preventive maintenance program shall include timely inspection and maintenance of storm water management devices (e.g., cleaning oil/water separators, catch basins, drip pans, vehicle-mounted drip containment devices) as well as inspecting and testing facility equipment and systems to uncover conditions that could cause breakdowns or failures resulting in discharges of pollutants to surface waters, and ensuring appropriate maintenance of such equipment and systems.

(c) Spill Prevention and Response Procedures—Areas where potential spills could contribute pollutants to storm water discharges, and their accompanying drainage points, shall be identified clearly in the storm water pollution prevention plan. Where appropriate, specifying material handling procedures, storage requirements, and use of equipment such as diversion valves in the plan should be considered. Procedures and equipment for cleaning up spills shall be identified in the plan and made available to the appropriate personnel.

(d) Inspections—Qualified facility personnel shall be identified to inspect designated equipment and areas of the facility on a quarterly basis. The following areas shall be included in all inspections: storage area for vehicles and equipment awaiting maintenance, fueling areas, vehicle and equipment maintenance areas (both indoors and outdoors), material storage areas, vehicle and equipment cleaning areas, and loading and unloading areas. Follow-up procedures shall be used to ensure that appropriate actions are taken in response to the inspections. Records of inspections shall be maintained. The use of a checklist should be considered by the facility.

(e) Employee Training—Employee training programs shall inform personnel responsible for implementing activities identified in the storm water pollution prevention plan or otherwise responsible for storm water management of the components and goals of the storm water pollution prevention plan. Training should address topics such as spill response, good housekeeping and material management practices. The pollution prevention plan shall identify how often training will take place; at a minimum, training must be held annually (once per calendar year). Employee training must, at a minimum, address the following areas when applicable to a facility: summary of the facility's pollution prevention plan requirements; used oil management; spent solvent management; spill prevention, response and control; fueling procedures; general good housekeeping practices; proper painting procedures; and used battery management.

(f) Recordkeeping and Internal Reporting Procedures—A description of incidents (such as spills, or other discharges), along with other information describing the quality and quantity of storm water discharges shall be included in the plan required under this part. Inspections and maintenance activities shall be documented and records of such activities shall be incorporated into the plan.

(g) Non-storm Water Discharges.

(i) The plan shall include a certification that the discharge has been tested or evaluated for the presence of non-storm water discharges. The certification shall include the identification of potential significant sources of non-storm water at the site, a description of the results of any test and/or evaluation for the presence of non-storm water discharges, the evaluation criteria or testing method used, the date of any testing and/or evaluation, and the onsite drainage

points that were directly observed during the test. Certifications shall be signed in accordance with Part VII.G. (Signatory Requirements) of this permit. Such certification may not be practical if the facility operating the storm water discharge associated with industrial activity does not have access to an outfall, manhole, or other point of access to the ultimate conduit which receives the discharge. In such cases, the source identification section of the storm water pollution prevention plan shall indicate why the certification required by this part was not practical, along with the identification of potential significant sources of non-storm water at the site. A discharger that is unable to provide the certification required by this paragraph must notify the Director in accordance with Part XI.P.3.b.(3)(iv) (Failure to Certify) of this permit.

(ii) Except for flows from fire fighting activities, sources of non-storm water listed in Part III.A.2. (Prohibition of Non-storm Water Discharges) of this permit that are combined with storm water discharges associated with industrial activity must be identified in the plan. The plan shall identify and ensure the implementation of appropriate pollution prevention measures for the non-storm water component(s) of the discharge.

(iii) A copy of the NPDES permit issued for vehicle and equipment washwaters or, if an NPDES permit has not yet been issued, a copy of the pending application must be attached to or referenced in the plan. For facilities that discharge vehicle and equipment washwaters to the sanitary sewer system, the operator of the sanitary system and associated treatment plant must be notified. In such cases, a copy of the notification letter must be attached to the plan. If an industrial user permit is issued under a pretreatment program, a copy of that permit must be attached in the plan. In all cases, any permit conditions or pretreatment requirements must be considered in the plan. If the washwaters are handled in another manner (e.g., hauled offsite), the disposal method must be described and all pertinent documentation (e.g., frequency, volume, destination, etc.) must be attached to the plan.

(iv) Failure to Certify—Any facility that is unable to provide the certification required (testing for non-storm water discharges), must notify the Director by [Insert date 270 days after permit issuance] or, for facilities which begin to discharge storm water associated with industrial activity after [Insert date 270 days after permit issuance], 180 days after submitting an NOI to be covered by this permit. If the failure to certify is caused by the inability to perform adequate tests or evaluations, such notification shall describe: the procedure of any test conducted for the presence of non-storm water discharges; the results of such test or other relevant observations; potential sources of non-storm water discharges to the storm sewer; and why adequate tests for such storm sewers were not feasible. Non-storm water discharges to waters of the United States which are not authorized by an NPDES permit are unlawful, and must be terminated.

(h) Sediment and Erosion Control—The plan shall identify areas which, due to topography, activities, or other factors, have a high potential for significant soil erosion, and identify structural, vegetative, and/or stabilization measures to be used to limit erosion.

(i) Management of Runoff—The plan shall contain a narrative consideration of the appropriateness of storm water management practices (practices other than those which control the generation or source(s) of pollutants) used to divert, infiltrate, reuse, or otherwise manage storm water runoff in a manner that reduces pollutants in storm water discharges from the site. The plan shall provide for the implementation and maintenance of measures that the permittee determines to be reasonable and appropriate. The potential of various sources at the facility to contribute pollutants to storm water discharges associated with industrial activity (see XI.P.3.b.(2) (description of potential pollutant sources) of this permit) shall be considered when determining reasonable and appropriate measures. Appropriate measures or other equivalent measures may include: vegetative swales and practices, reuse of collected storm water (such as for a process or as an irrigation source), inlet controls (such as oil/water separators), snow management activities, infiltration devices, and wet detention/retention devices.

(4) Comprehensive Site Compliance Evaluation. Qualified personnel shall conduct comprehensive site compliance evaluations at appropriate intervals specified in the plan, but, in no case less than once a year. Such evaluations shall provide:

(a) Areas contributing to a storm water discharge associated with industrial activity shall be visually inspected for evidence of, or the potential for, pollutants entering the drainage system. Measures to reduce pollutant loadings shall be evaluated to determine whether they are adequate and properly implemented in accordance with the terms of the permit or whether additional control measures are needed. Structural storm water management measures, sediment and erosion control measures, and other structural pollution prevention measures identified in the plan shall be observed to ensure that they are operating correctly. A visual inspection of equipment needed to implement the plan, such as spill response equipment, shall be made.

(b) Based on the results of the evaluation, the description of potential pollutant sources identified in the plan in accordance with Part XI.P.3.b.(2) (Description of Potential Pollutant Sources) of this permit and pollution prevention measures and controls identified in the plan in accordance with paragraph XI.P.3.b.(3) (Measures and Controls) of this permit shall be revised as appropriate within 2 weeks of such evaluation and shall provide for implementation of any changes to the plan in a timely manner, but in no case more than 12 weeks after the evaluation.

(c) A report summarizing the scope of the evaluation, personnel making the evaluation, the date(s) of the evaluation, major observations relating to the implementation of the storm water pollution prevention plan, and actions taken in accordance with paragraph XI.P.3.b.(3)(b) (above) of the permit shall be made and retained as part of the storm water pollution prevention plan for at least 3 years after the date of the evaluation. The report shall identify any incidents of noncompliance. Where a report does not identify any incidents of noncompliance, the report shall contain a certification that the facility is in compliance with the storm water pollution prevention plan and this permit. The report shall be signed in accordance with Part VII.G. (Signatory Requirements) of this permit.

(d) Where compliance evaluation schedules overlap with inspections required under 3.a.(3)(d), the compliance evaluation may be conducted in place of one such inspection.

3. Numeric Effluent Limitations

There are no additional numeric effluent limitations beyond those described in Part V.B of this permit.

4. Monitoring and Reporting Requirements

a. Monitoring Requirements.

(1) Quarterly Visual Examination of Storm Water Quality. Facilities shall perform and document a visual examination of a storm water discharge associated with industrial activity from each outfall, except discharges

exempted under paragraph (d) below. The examination(s) must be made at least once in each designated period [described in (a), below] during facility operation in the daylight hours unless there is insufficient rainfall or snow melt to produce a runoff event.

(a) Examinations shall be conducted in each of the following periods for the purposes of visually inspecting storm water quality associated with storm water runoff or snow melt: January through March; April through June; July through September; and October through December.

(b) Examinations shall be made of samples collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed one hour) of when the runoff or snowmelt begins discharging. The examinations shall document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on the samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. Where practicable, the same individual will carry out the collection and examination of discharges for the life of the permit.

When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the records of the visual examinations. Adverse weather conditions which may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricanes, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(c) Visual examination reports must be maintained onsite in the pollution prevention plan. The report shall include the examination date and time, examination personnel, the nature of the discharge (i.e., runoff or snow melt), visual quality of the storm water discharge (including observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution), and probable sources of any observed storm water contamination.

(d) When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may collect a sample of effluent of one of such outfalls and report that the examination data also applies to the substantially identical outfalls provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explaining in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

(e) When a discharger is unable to conduct visual storm water examinations at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirement as long as the facility remains inactive and unstaffed. The facility must maintain a certification with the pollution prevention plan stating that the site is inactive and unstaffed so that performing visual examinations during a qualifying event is not feasible.

Q. Storm Water Discharges Associated With Industrial Activity From Water Transportation Facilities That Have Vehicle Maintenance Shops and/or Equipment Cleaning Operations

1. Discharges Covered Under This Section

The requirements listed under this section shall apply to storm water discharges from water transportation facilities that have vehicle (vessel) maintenance shops and/or equipment cleaning operations. The water transportation industry includes facilities engaged in foreign or domestic transport of freight or passengers in deep sea or inland waters; marine cargo handling operations; ferry operations; towing and tugboat services; and marinas (facilities commonly identified by Standard Industrial Classification (SIC) code Major Group 44).

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

2. Special Conditions

a. Prohibition of Non-storm Water Discharges. In addition to the general discharge prohibitions in part III.A, this section specifically prohibits non-storm water discharges of wastewaters, such as bilge and ballast water, sanitary wastes, pressure wash water, and cooling water originating from vessels. The operators of such discharges must obtain coverage under a separate NPDES permit if discharged to waters of the United States or through a municipal separate storm sewer system.

3. Storm Water Pollution Prevention Plan Requirements

a. Contents of Plan. The plan shall include, at a minimum, the following items:

(1) Pollution Prevention Team. Each plan shall identify a specific individual or individuals within the facility organization as members of a storm water Pollution Prevention Team who are responsible for developing the storm water pollution prevention plan and assisting the facility or plant manager in its implementation, maintenance, and revision. The plan shall clearly identify the responsibilities of each team member. The activities and responsibilities of the team shall address all aspects of the facility's storm water pollution prevention plan.

(2) Description of Potential Pollutant Sources. Each plan shall provide a description of potential sources which may reasonably be expected to add significant amounts of pollutants to storm water discharges or which may result in the discharge of pollutants during dry weather from separate storm sewers draining the facility. Each plan shall identify all activities and significant materials which may potentially be significant pollutant sources. Each plan shall include, at a minimum:

(a) Drainage.

(i) A site map indicating an outline of the portions of the drainage area of each storm water outfall that are within the facility boundaries, each existing structural control measure to reduce pollutants in storm water runoff, surface water bodies, locations where significant materials are exposed to precipitation, locations where major spills or leaks identified under Part XI.Q.3.a.(2)(c) (Spills and Leaks) of this section have occurred, and the locations of the following activities where such activities are exposed to precipitation: fueling, engine maintenance and repair, vessel maintenance and repair, pressure washing, painting, sanding, blasting, welding, metal fabrication, loading/unloading areas, locations used for the treatment, storage or disposal of wastes; liquid storage tanks, liquid storage areas (i.e., paint, solvents, resins), and material storage areas (i.e., blasting media, aluminum, steel, scrap iron). In addition, the map must indicate the outfall locations and the types of discharges contained in the drainage areas of the outfalls.

(ii) For each area of the facility that generates storm water discharges associated with industrial activity with a reasonable potential for containing significant amounts of pollutants, a prediction of the direction of flow, and an identification of the types of pollutants which are likely to be present in storm water discharges associated with industrial activity. Factors to consider include the toxicity of chemical; quantity of chemicals used, produced or discharged; the likelihood of contact with storm water; and history of significant leaks or spills of toxic or hazardous pollutants. Flows with a significant potential for causing erosion shall be identified.

(b) Inventory of Exposed Materials—An inventory of the types of materials handled at the site that potentially may be exposed to precipitation. Such inventory shall include a narrative description of significant materials that have been handled, treated, stored or disposed in a manner to allow exposure to storm water between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; method and location of onsite storage or disposal; materials management practices employed to minimize contact of materials with storm water runoff between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; the location and a description of existing structural and nonstructural control measures to reduce pollutants in storm water runoff; and a description of any treatment the storm water receives.

(c) Spills and Leaks—A list of significant spills and significant leaks of toxic or hazardous pollutants that occurred at areas that are exposed to precipitation or that otherwise drain to a storm water conveyance at the facility after the date of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit. Such list shall be updated as appropriate during the term of the permit.

(d) Sampling Data—A summary of existing discharge sampling data describing pollutants in storm water discharges from the facility, including a summary of sampling data collected during the term of this permit.

(e) Risk Identification and Summary of Potential Pollutant Sources—A narrative description of the potential pollutant sources from the following activities if applicable: loading and unloading operations; outdoor storage activities; outdoor manufacturing or processing activities (i.e., welding, metal fabricating); significant dust or particulate generating processes (i.e., abrasive blasting, sanding, painting); loading/unloading areas; and onsite waste disposal practices. The description shall specifically list any significant potential source of pollutants at the site and for each potential source, any pollutant or pollutant parameter (e.g., biochemical oxygen demand, etc.) of concern shall be identified.

(3) Measures and Controls. Each facility covered by this permit shall develop a description of storm water management controls appropriate for the facility, and implement such controls. The appropriateness and priorities of controls in a plan shall reflect identified potential sources of pollutants at the facility. The description of storm water management controls shall address the following minimum components, including a schedule for implementing such controls:

(a) Good Housekeeping—Good housekeeping requires the maintenance of areas which may contribute pollutants to storm water discharges in a clean, orderly manner. The following areas must be specifically addressed, when applicable at a facility:

(i) Pressure Washing Area—When pressure washing is used to remove marine growth from vessels, the discharge water must be permitted by an NPDES permit. The pollution prevention plan must describe the measures to collect or contain the discharge from the pressure washing area, detail the method for the removal of the visible solids, describe the method of disposal of the collected solids, and identify where the discharge will be released (i.e., the receiving waterbody, storm sewer system, sanitary sewer system).

(ii) Blasting and Painting Areas—The facility must consider containing all blasting and painting activities to prevent abrasives, paint chips, and overspray from reaching the receiving water or the storm sewer system. The plan must describe measures taken at the facility to prevent or minimize the discharge of spent abrasive, paint chips, and paint into the receiving waterbody and storm sewer system. The facility may consider hanging plastic barriers or tarpaulins during blasting or painting operations to contain debris. Where required, a schedule for cleaning storm water conveyances to remove deposits of abrasive blasting debris and paint chips should be addressed within the plan. The plan should include any standard operating practices with regard to blasting and painting activities. Such included items may be the prohibition of performing uncontained blasting and painting over open water or blasting and painting during windy conditions which can render containment ineffective.

(iii) Material Storage Areas—All stored and containerized materials (fuels, paints, solvents, waste oil, antifreeze, batteries) must be stored in a protected, secure location away from drains and plainly labeled. The plan must describe measures that prevent or minimize contamination of the storm water runoff from such storage areas. The facility must specify which materials are stored indoors and consider containment or enclosure for materials that are stored outdoors. Above ground storage tanks, drums, and barrels permanently stored outside must be delineated on the site map with a description of the containment measures in place to prevent leaks and spills. The facility must consider implementing an inventory control plan to prevent excessive purchasing, storage, and handling of potentially hazardous materials. Those facilities where abrasive blasting is performed must specifically include a discussion on the storage and disposal of spent abrasive materials generated at the facility.

(iv) Engine Maintenance and Repair Areas—The plan must describe measures that prevent or minimize contamination of the storm water runoff from all areas used for engine maintenance and repair. The facility may consider performing all maintenance activities indoors,

maintaining an organized inventory of materials used in the shop, draining all parts of fluids prior to disposal, prohibiting the practice of hosing down the shop floor, using dry cleanup methods, and/or collecting the storm water runoff from the maintenance area and providing treatment or recycling.

(v) Material Handling Areas—The plan must describe measures that prevent or minimize contamination of the storm water runoff from material handling operations and areas (i.e., fueling, paint and solvent mixing, disposal of process wastewater streams from vessels). The facility may consider covering fueling areas; using spill and overflow protection; mixing paints and solvents in a designated area, preferably indoors or under a shed; and minimizing runon of storm water to material handling areas or other equivalent measures. Where applicable, the plan must address the replacement or repair of leaking connections, valves, pipes, hoses, and soil chutes carrying wastewater from vessels.

(vi) Drydock Activities—The plan must address the routine maintenance and cleaning of the drydock to minimize the potential for pollutants in the storm water runoff. The plan must describe the procedures for cleaning the accessible areas of the drydock prior to flooding and final cleanup after the vessel is removed and the dock is raised. Cleanup procedures for oil, grease, or fuel spills occurring on the drydock must also be included within the plan. The facility should consider items such as sweeping rather than hosing off debris and spent blasting material from the accessible areas of the drydock prior to flooding and having absorbent materials and oil containment booms readily available to contain and cleanup any spills or other equivalent measures.

(vii) General Yard Area—The plan must include a schedule for routine yard maintenance and cleanup. Scrap metal, wood, plastic, miscellaneous trash, paper, glass, industrial scrap, insulation, welding rods, packaging, etc., must be routinely removed from the general yard area. The facility may consider such measures as providing covered trash receptacles in each yard, on each pier, and on board each vessel being repaired.

(b) Preventive Maintenance—A preventive maintenance program shall involve timely inspection and maintenance of storm water management devices (e.g., cleaning oil/water separators, sediment traps to ensure that spent abrasives, paint chips, and solids will be intercepted and retained prior to entering the storm drainage system) as well as inspecting and testing facility equipment and systems to uncover conditions that could cause breakdowns or failures resulting in discharges of pollutants to surface waters, and ensuring appropriate maintenance of such equipment and systems.

(c) Spill Prevention and Response Procedures—Areas where potential spills which can contribute pollutants to storm water discharges can occur, and their accompanying drainage points shall be identified clearly in the storm water pollution prevention plan. Where appropriate, specifying material handling procedures, storage requirements, and use of equipment such as diversion valves in the plan should be considered. Procedures for cleaning up spills shall be identified in the plan and made available to the appropriate personnel. The necessary equipment to implement a clean up should be available to personnel.

(d) Inspections—Qualified facility personnel shall be identified to inspect designated equipment and areas of the facility on a monthly basis. The following areas shall be included in all inspections: pressure washing area; blasting, sanding, and painting areas; material storage areas; engine maintenance and repair areas; material handling areas; drydock area; and general yard area. A set of tracking or follow-up procedures shall be used to ensure that appropriate actions are taken in response to the inspections. Records of inspections shall be maintained.

(e) Employee Training—Employee training programs shall inform personnel responsible for implementing activities identified in the storm water pollution prevention plan or otherwise responsible for storm water management at all levels of responsibility of the components and goals of the storm water pollution prevention plan. Training should address topics such as spill response, good housekeeping and material management practices. The pollution prevention plan shall identify how often training will take place, but in all cases training must be held at least annually (once per calendar year). Employee training must, at a minimum, address the following areas when applicable to a facility: used oil management; spent solvent management; proper disposal of spent abrasives; proper disposal of vessel wastewaters, spill prevention and control; fueling procedures; general good housekeeping practices; proper painting and blasting procedures; and used battery management. Employees, independent contractors, and customers must be informed about BMPs and be required to perform in accordance with these practices. The facility must consider posting instructions, easy to read descriptions or graphic depictions of BMPs, spill control/clean-up equipment and emergency phone numbers in the work areas.

(f) Recordkeeping and Internal Reporting Procedures—A description of incidents (such as spills, or other discharges), along with other information describing the quality and quantity of storm water discharges shall be included in the plan required under this part. Inspections and maintenance activities shall be documented and records of such activities shall be incorporated into the plan.

(g) Non-storm Water Discharges.

(i) The plan shall include a certification that the discharge has been tested or evaluated for the presence of non-storm water discharges. The certification shall include the identification of potential significant sources of non-storm water at the site, a description of the results of any test and/or evaluation for the presence of non-storm water discharges, the evaluation criteria or testing method used, the date of any testing and/or evaluation, and the onsite drainage points that were directly observed during the test. Certifications shall be signed in accordance with Part VII.G. of this permit. Such certification may not be feasible if the facility operating the storm water discharge associated with industrial activity does not have access to an outfall, manhole, or other point of access to the ultimate conduit which receives the discharge. In such cases, the source identification section of the storm water pollution prevention plan shall indicate why the certification required by this part was not feasible, along with the identification of potential significant sources of non-storm water at the site. A discharger that is unable to provide the certification required by this paragraph must notify the Director in accordance with paragraph XI.Q.3.a.(3)(g)(iii) (below).

(ii) Except for flows from fire fighting activities, sources of non-storm water listed in Part III.A.2 (Prohibition of Non-storm Water Discharges) of this permit that are combined with storm water discharges associated with industrial activity must be identified in the plan. The plan shall identify and ensure the implementation of appropriate pollution prevention measures for the non-storm water component(s) of the discharge.

(iii) Failure to Certify—Any facility that is unable to provide the certification required (testing for non-storm water discharges), must notify the

Director by [Insert date 270 days after permit issuance] or, for facilities which begin to discharge storm water associated with industrial activity after [Insert date 270 days after permit issuance], 180 days after submitting an NOI to be covered by this permit. If the failure to certify is caused by the inability to perform adequate tests or evaluations, such notification shall describe: the procedure of any test conducted for the presence of non-storm water discharges; the results of such test or other relevant observations; potential sources of non-storm water discharges to the storm sewer; and why adequate tests for such storm sewers were not feasible. Non-storm water discharges to waters of the United States which are not authorized by an NPDES permit are unlawful, and must be terminated.

(h) Sediment and Erosion Control—The plan shall identify areas which, due to topography, activities, or other factors, have a high potential for significant soil erosion, and identify structural, vegetative, and/or stabilization measures to be used to limit erosion.

(i) Management of Runoff—The plan shall contain a narrative consideration of the appropriateness of traditional storm water management practices (practices other than those which control the generation or source(s) of pollutants) used to divert, infiltrate, reuse, or otherwise manage storm water runoff in a manner that reduces pollutants in storm water discharges from the site. The plan shall provide that measures that the permittee determines to be reasonable and appropriate shall be implemented and maintained. The potential of various sources at the facility to contribute pollutants to storm water discharges associated with industrial activity [see paragraph XI.Q.3.a.(2) of this section (Description of Potential Pollutant Sources)] shall be considered when determining reasonable and appropriate measures. Appropriate measures or equivalent measures may include: vegetative swales and practices, reuse of collected storm water (such as for a process or as an irrigation source), inlet controls (such as oil/water separators), snow management activities, infiltration devices, and wet detention/retention devices.

(4) Comprehensive Site Compliance Evaluation. Qualified personnel shall conduct site compliance evaluations at appropriate intervals specified in the plan, but in no case less than once a year. Such evaluations shall provide:

(a) Areas contributing to a storm water discharge associated with industrial activity (pressure washing area, blasting and sanding areas, painting areas, material storage areas, engine maintenance and repair areas, material handling areas, and drydock area) shall be visually inspected for evidence of, or the potential for, pollutants entering the drainage system. Measures to reduce pollutant loadings shall be evaluated to determine whether they are adequate and properly implemented in accordance with the terms of the permit or whether additional control measures are needed. Structural storm water management measures, sediment and erosion control measures, and other structural pollution prevention measures identified in the plan shall be observed to ensure that they are operating correctly. A visual inspection of equipment needed to implement the plan, such as spill response equipment, shall be made.

(b) Based on the results of the evaluation, the description of potential pollutant sources identified in the plan in accordance with paragraph XI.Q.3.a.(2) of this section (Description of Potential Pollutant Sources) and pollution prevention measures and controls identified in the plan in accordance with paragraph XI.Q.3.a.(3) of this section (Measures and Controls) shall be revised as appropriate within 2 weeks of such evaluation and shall provide for implementation of any changes to the plan in a timely manner, but in no case more than 12 weeks after the evaluation.

(c) A report summarizing the scope of the evaluation, personnel making the evaluation, the date(s) of the evaluation, major observations relating to the implementation of the storm water pollution prevention plan, and actions taken in accordance with paragraph XI.Q.3.a.(4)(b) (above) of the permit shall be made and retained as part of the storm water pollution prevention plan for at least 3 years from the date of the inspection. The report shall identify any incidents of noncompliance. Where a report does not identify any incidents of noncompliance, the report shall contain a certification that the facility is in compliance with the storm water pollution prevention plan and this permit. The report shall be signed in accordance with Part VII.G. (Signatory Requirements) of this permit.

(d) Where compliance evaluation schedules overlap with inspections required under 3.a.(3)(d), the compliance evaluation may be conducted in place of one such inspection.

4. Numeric Effluent Limitations

There are no additional numeric effluent limitations beyond those described in Part V.B of this permit.

5. Monitoring and Reporting Requirements

a. Analytical Monitoring Requirements. During the period beginning [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] and the period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance], permittees with water transportation facilities must monitor their storm water discharges associated with industrial activity at least quarterly (4 times per year) during years 2 and 4 except as provided in paragraphs 5.a.(3) (Sampling Waiver), 5.a.(4) (Representative Discharge), and 5.a.(5) (Alternative Certification). Water transportation facilities are required to monitor their storm water discharges for the pollutants of concern listed in Table Q–1 below. Facilities must report in accordance with 5.b. (Reporting). In addition to the parameters listed in Table Q–1 below, the permittee shall provide the date and duration (in hours) of the storm event(s) sampled; rainfall measurements or estimates (in inches) of the storm event that generated the sampled runoff; the duration between the storm event sampled and the end of the previous measurable (greater than 0.1 inch rainfall) storm event; and an estimate of the total volume (in gallons) of the discharge sampled.

TABLE Q–1.—MONITORING REQUIREMENTS

Pollutants of concern	Monitoring cut-off concentration
Total Recoverable Aluminum	0.75 mg/L
Total Recoverable Iron	1.0 mg/L
Total Recoverable Lead	0.0816 mg/L
Total Recoverable Zinc	0.117 mg/L

(1) Monitoring Periods. Water transportation facilities shall monitor samples collected during the sampling periods of: January to March, April to June, July to September, and October to December for the years specified in paragraph a. (above).

(2) Sample Type. A minimum of one grab sample shall be taken. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm

event. The required 72-hour storm event interval is waived where the preceding measurable storm event did not result in a measurable discharge from the facility. The required 72-hour storm event interval may also be waived where the permittee documents that less than a 72-hour interval is representative for local storm events during the season when sampling is being conducted. The grab sample shall be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable. If storm water discharges associated with industrial activity commingle with process or non-process water, then where practicable permittees must attempt to sample the storm water discharge before it mixes with the non-storm water discharge.

(3) Sampling Waiver.

(a) Adverse Conditions—When a discharger is unable to collect samples within a specified sampling period due to adverse climatic conditions, the discharger shall collect a substitute sample from a separate qualifying event in the next period and submit the data along with data for the routine sample in that period. Adverse weather conditions that may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(b) Low Concentration Waiver—When the average concentration for a pollutant calculated from all monitoring data collected from an outfall during the monitoring period [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] is less than the corresponding value for that pollutant listed in Table Q–1 under the column Monitoring Cut-off Concentration, a facility may waive monitoring and reporting requirements in the monitoring period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance]. The facility must submit to the Director, in lieu of the monitoring data, a certification that there has not been a significant change in industrial activity or the pollution prevention measures in area of the facility which drains to the outfall for which sampling was waived.

(c) When a discharger is unable to conduct quarterly chemical storm water sampling at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirements as long as the facility remains inactive and unstaffed. The facility must submit to the Director, in lieu of monitoring data, a certification statement on the DMR stating that the site is inactive and unstaffed so that collecting a sample during a qualifying event is not possible.

(4) Representative Discharge. When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may test the effluent of one of such outfalls and report that the quantitative data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan. The permittee shall include the description of the location of the outfalls, explanation of why outfalls are expected to discharge substantially identical effluents, and estimate of the size of the drainage area and runoff coefficient with the Discharge Monitoring Report.

(5) Alternative Certification. A discharger is not subject to the monitoring requirements of this section provided the discharger makes a certification for a given outfall or on a pollutant-by-pollutant basis in lieu of monitoring reports required under paragraph b below, under penalty of law, signed in accordance with Part VII.G. (Signatory Requirements), that material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, industrial machinery or operations, or significant materials from past industrial activity that are located in areas of the facility within the drainage area of the outfall are not presently exposed to storm water and are not expected to be exposed to storm water for the certification period. Such certification must be retained in the storm water pollution prevention plan, and submitted to EPA in accordance with Part VI.C. of this permit. In the case of certifying that a pollutant is not present, the permittee must submit the certification along with the monitoring reports required under paragraph (*b*) below. If the permittee cannot certify for an entire period, they must submit the date exposure was eliminated and any monitoring required up until that date. This certification option is not applicable to compliance monitoring requirements associated with effluent limitations.

b. *Reporting.* Permittees with water transportation facilities shall submit monitoring results for each outfall associated with industrial activity [or a certification in accordance with Sections (3), (4), or (5) above] obtained during the reporting period beginning [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] on Discharge Monitoring Report Form(s) postmarked no later than the 31st day of the following March [insert the date 2 years after permit issuance]. Monitoring results [or a certification in accordance with Sections (3), (4), or (5) above] obtained during the period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance] shall be submitted on Discharge Monitoring Report Form(s) postmarked no later than the 31st day of the following March. For each outfall, one signed Discharge Monitoring Report form must be submitted to the Director per storm event sampled. Signed copies of Discharge Monitoring Reports, or said certifications, shall be submitted to the Director of the NPDES program at the address of the appropriate Regional Office listed in Part VI.G. of the fact sheet.

(1) Additional Notification. In addition to filing copies of discharge monitoring reports in accordance with paragraph b (above), water transportation facilities with at least one storm water discharge associated with industrial activity through a large or medium municipal separate storm sewer system (systems serving a population of 100,000 or more) must submit signed copies of discharge monitoring reports to the operator of the municipal separate storm sewer system in accordance with the dates provided in paragraph b (above).

c. *Quarterly Visual Examination of Storm Water Quality.* Facilities shall perform and document a visual examination of a storm water discharge associated with industrial activity from each outfall, except discharges exempted below. The examination must be made at least once in each designated period [described in paragraph (1) below] during daylight hours unless there is insufficient rainfall or snow melt to produce a runoff event.

(1) Examinations shall be conducted in each of the following periods for the purposes of visually inspecting storm water quality associated with storm water runoff or snowmelt: January through March; April through June; July through September; and October through December.

(2) Examinations shall be made of samples collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 1 hour) of when the runoff or snowmelt begins discharging. The examinations shall document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on the samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. Where practicable, the same individual should carry out the collection and examination of discharges for entire permit term.

(3) Visual examination reports must be maintained onsite in the pollution prevention plan. The report shall include the examination date and time, examination personnel, the nature of the discharge (i.e., runoff or snow melt), visual quality of the storm water discharge (including observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution), and probable sources of any observed storm water contamination.

(4) When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may collect a sample of effluent of one of such outfalls and report that the examination data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

(5) When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the records of the visual examination. Adverse weather conditions which may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(6) When a discharger is unable to conduct visual storm water examinations at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirement as long as the facility remains inactive and unstaffed. The facility must maintain a certification with the pollution prevention plan stating that the site is inactive and unstaffed so that performing visual examinations during a qualifying event is not feasible.

R. Storm Water Discharges Associated With Industrial Activity From Ship and Boat Building or Repairing Yards

1. Discharges Covered Under This Section

The requirements listed under this section apply to storm water discharges from facilities engaged in ship building and repairing and boat building and repairing[5] (Standard Industrial Classification (SIC) code 373).

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

2. Special Conditions

a. Prohibition of Non-storm Water Discharges. In addition to the prohibitions listed in Part III.A of the permit, this section specifically prohibits non-storm water discharges of wastewaters, such as bilge and ballast water, pressure wash water, sanitary wastes, and cooling water originating from vessels, are not authorized by this permit. The operators of such discharges must obtain coverage under a separate NPDES permit if discharged to waters of the United States or through a municipal separate storm sewer system.

3. Storm Water Pollution Prevention Plan Requirements

a. Contents of Plan. The plan shall include, at a minimum, the following items:

(1) Pollution Prevention Team. Each plan shall identify a specific individual or individuals within the facility organization as members of a storm water Pollution Prevention Team that are responsible for developing the storm water pollution prevention plan and assisting the facility or plant manager in its implementation, maintenance, and revision. The plan shall clearly identify the responsibilities of each team member. The activities and responsibilities of the team shall address all aspects of the facility's storm water pollution prevention plan.

(2) Description of Potential Pollutant Sources. Each plan shall provide a description of potential sources which may reasonably be expected to add significant amounts of pollutants to storm water discharges or which may result in the discharge of pollutants during dry weather from separate storm sewers draining the facility. Each plan shall identify all activities and significant materials which may potentially be significant pollutant sources. Each plan shall include, at a minimum:

(a) Drainage.

(i) A site map indicating the location of the outfalls and the types of discharges contained in the drainage areas of the outfalls, an outline of the portions of the drainage area of each storm water outfall that are within the facility boundaries, each existing structural control measure to reduce pollutants in storm water runoff, surface

[5] According to the U.S. Coast Guard, a vessel 65 feet or greater in length is referred to as a ship, and a vessel smaller than 65 feet is a boat.

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water bodies, locations where significant materials are exposed to precipitation, locations where major spills or leaks identified under Part XI.R.3.a.(2)(c) (Spills and Leaks) of this section have occurred, and the locations of the following activities where such activities are exposed to precipitation: fueling, engine maintenance and repair, vessel maintenance and repair, pressure washing, painting, sanding, blasting, welding, metal fabrication, loading/unloading areas, locations used for the treatment, storage or disposal of wastes; liquid storage tanks, liquid storage areas (i.e., paint, solvents, resins), and material storage areas (i.e., blasting media, aluminum, steel, scrap iron).

(ii) For each area of the facility that generates storm water discharges associated with industrial activity with a reasonable potential for containing significant amounts of pollutants, a prediction of the direction of flow, and an identification of the types of pollutants which are likely to be present in storm water discharges associated with industrial activity. Factors to consider include the toxicity of a chemical; quantity of chemicals used, produced or discharged; the likelihood of contact with storm water; and history of significant leaks or spills of toxic or hazardous pollutants. Flows with a significant potential for causing erosion shall be identified.

(b) Inventory of Exposed Materials—An inventory of the types of materials handled at the site that potentially may be exposed to precipitation. Such inventory shall include a narrative description of significant materials that have been handled, treated, stored or disposed in a manner to allow exposure to storm water between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; method and location of onsite storage or disposal; materials management practices employed to minimize contact of materials with storm water runoff between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; the location and a description of existing structural and nonstructural control measures to reduce pollutants in storm water runoff; and a description of any treatment the storm water receives.

(c) Spills and Leaks—A list of significant spills and significant leaks of toxic or hazardous pollutants that occurred at areas that are exposed to precipitation or that otherwise drain to a storm water conveyance at the facility after the date of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit. Such list shall be updated as appropriate during the term of the permit.

(d) Sampling Data—A summary of existing discharge sampling data describing pollutants in storm water discharges from the facility, including a summary of sampling data collected during the term of this permit.

(e) Risk Identification and Summary of Potential Pollutant Sources—A narrative description of the potential pollutant sources from the following activities if applicable: loading and unloading operations; outdoor storage activities; outdoor manufacturing or processing activities (i.e., welding, metal fabricating); significant dust or particulate generating processes (i.e., abrasive blasting, sanding, painting); loading/unloading areas; and onsite waste disposal practices. The description shall specifically list any significant potential source of pollutants at the site and for each potential source, any pollutant or pollutant parameter (e.g., biochemical oxygen demand, etc.) of concern shall be identified.

(3) Measures and Controls. Each facility covered by this permit shall develop a description of storm water management controls appropriate for the facility, and implement such controls. The appropriateness and priorities of controls in a plan shall reflect identified potential sources of pollutants at the facility. The description of storm water management controls shall address the following minimum components, including a schedule for implementing such controls:

(a) Good Housekeeping—Good housekeeping requires the maintenance of areas which may contribute pollutants to storm water discharges in a clean, orderly manner. The following areas must be specifically addressed, when applicable at a facility:

(i) Pressure Washing Area—When pressure washing is used to remove marine growth from vessels, the discharge water must be permitted as a process wastewater by an NPDES permit.

(ii) Blasting and Painting Areas—The facility must consider containing all blasting and painting activities to prevent abrasives, paint chips, and overspray from reaching the receiving water or the storm sewer system. The plan must describe measures taken at the facility to prevent or minimize the discharge of spent abrasive, paint chips, and paint into the receiving waterbody and storm sewer system. The facility may consider hanging plastic barriers or tarpaulins during blasting or painting operations to contain debris. Where required, a schedule for cleaning storm systems to remove deposits of abrasive blasting debris and paint chips should be addressed within the plan. The plan should include any standard operating practices with regard to blasting and painting activities. Practices may include the prohibition of performing uncontained blasting and painting over open water or blasting and painting during windy conditions which can render containment ineffective.

(iii) Material Storage Areas—All stored and containerized materials (fuels, paints, solvents, waste oil, antifreeze, batteries) must be stored in a protected, secure location away from drains and plainly labeled. The plan must describe measures that prevent or minimize contamination of the storm water runoff from such storage areas. The facility must specify which materials are stored indoors and consider containment or enclosure for materials that are stored outdoors. Above ground storage tanks, drums, and barrels permanently stored outside must be delineated on the site map with a description of the containment measures in place to prevent leaks and spills. The facility must consider implementing an inventory control plan to prevent excessive purchasing, storage, and handling of potentially hazardous materials. Those facilities where abrasive blasting is performed must specifically include a discussion on the storage and disposal of spent abrasive materials generated at the facility.

(iv) Engine Maintenance and Repair Areas—The plan must describe measures that prevent or minimize contamination of the storm water runoff from all areas used for engine maintenance and repair. The facility must consider performing all maintenance activities indoors, maintaining an organized inventory of materials used in the shop, draining all parts of fluids prior to disposal, prohibiting wet clean up practice where the practice would result in the exposure of pollutants to storm water, using dry cleanup methods, and/or collecting the storm water runoff from the maintenance area and providing treatment or recycling.

(v) Material Handling Areas—The plan must describe measures that prevent or minimize contamination of the storm water runoff from material handling operations and areas (i.e., fueling, paint & solvent mixing, disposal of process wastewater streams from vessels). The facility must consider covering fueling areas; using spill and overflow protection; mixing paints and

solvents in a designated area, preferably indoors or under a shed; and minimizing runon of storm water to material handling areas. Where applicable, the plan must address the replacement or repair of leaking connections, valves, pipes, hoses, and soil chutes carrying wastewater from vessels.

(vi) Drydock Activities—The plan must address the routine maintenance and cleaning of the drydock to minimize the potential for pollutants in the storm water runoff. The plan must describe the procedures for cleaning the accessible areas of the drydock prior to flooding and final cleanup after the vessel is removed and the dock is raised. Cleanup procedures for oil, grease, or fuel spills occurring on the drydock must also be included within the plan. The facility must consider items such as sweeping rather than hosing off debris and spent blasting material from the accessible areas of the drydock prior to flooding and having absorbent materials and oil containment booms readily available to contain and cleanup any spills.

(vii) General Yard Area—The plan must include a schedule for routine yard maintenance and cleanup. Scrap metal, wood, plastic, miscellaneous trash, paper, glass, industrial scrap, insulation, welding rods, packaging, etc., must be routinely removed from the general yard area. The facility must consider such measures as providing covered trash receptacles in each yard, on each pier, and on board each vessel being repaired.

(b) Preventive Maintenance—A preventive maintenance program shall involve timely inspection and maintenance of storm water management devices (e.g., cleaning oil/water separators, sediment traps to ensure that spent abrasives, paint chips, and solids will be intercepted and retained prior to entering the storm drainage system) as well as inspecting and testing facility equipment and systems to uncover conditions that could cause breakdowns or failures resulting in discharges of pollutants to surface waters, and ensuring appropriate maintenance of such equipment and systems.

(c) Spill Prevention and Response Procedures—Areas where potential spills which can contribute pollutants to storm water discharges can occur, and their accompanying drainage points shall be identified clearly in the storm water pollution prevention plan. Where appropriate, specifying material handling procedures, storage requirements, and use of equipment such as diversion valves in the plan should be considered. Procedures for cleaning up spills shall be identified in the plan and made available to the appropriate personnel. The necessary equipment to implement a clean up should be available to personnel.

(d) Inspections—Qualified facility personnel shall be identified to inspect designated equipment and areas of the facility on a monthly basis. The following areas shall be included in all inspections: pressure washing area; blasting, sanding, and painting areas; material storage areas; engine maintenance and repair areas; material handling areas; drydock area; and general yard area. A set of tracking or follow-up procedures shall be used to ensure that appropriate actions are taken in response to the inspections. Records of inspections shall be maintained.

(e) Employee Training—Employee training programs shall inform personnel responsible for implementing activities identified in the storm water pollution prevention plan or otherwise responsible for storm water management at all levels of responsibility of the components and goals of the storm water pollution prevention plan. The pollution prevention plan shall identify how often training will take place, but in all cases training must be held at least annually (once per calendar year). Employee training must, at a minimum, address the following areas when applicable to a facility: used oil management; spent solvent management; proper disposal of spent abrasives; proper disposal of vessel wastewaters, spill prevention and control; fueling procedures; general good housekeeping practices; proper painting and blasting procedures; and used battery management. Employees, independent contractors, and customers must be informed about BMPs and be required to perform in accordance with these practices. The facility should consider posting easy to read descriptions or graphic depictions of BMPs and emergency phone numbers in the work areas.

(f) Recordkeeping and Internal Reporting Procedures—A description of incidents (such as spills, or other discharges), along with other information describing the quality and quantity of storm water discharges shall be included in the plan required under this part. Inspections and maintenance activities shall be documented and records of such activities shall be incorporated into the plan.

(g) Non-storm Water Discharges.

(i) The plan shall include a certification that the discharge has been tested or evaluated for the presence of non-storm water discharges. The certification shall include the identification of potential significant sources of non-storm water at the site, a description of the results of any test and/or evaluation for the presence of non-storm water discharges, the evaluation criteria or testing method used, the date of any testing and/or evaluation, and the onsite drainage points that were directly observed during the test. Certifications shall be signed in accordance with Part VII.G. of this permit. Such certification may not be feasible if the facility operating the storm water discharge associated with industrial activity does not have access to an outfall, manhole, or other point of access to the ultimate conduit which receives the discharge. In such cases, the source identification section of the storm water pollution prevention plan shall indicate why the certification required by this part was not feasible, along with the identification of potential significant sources of non-storm water at the site. A discharger that is unable to provide the certification required by this paragraph must notify the Director in accordance with paragraph XI.R.3.a.(3)(g)(iii) (below).

(ii) Except for flows from fire fighting activities, sources of non-storm water listed in Part III.A.2 (Prohibition of Non-storm Water Discharges) of this permit that are combined with storm water discharges associated with industrial activity must be identified in the plan. The plan shall identify and ensure the implementation of appropriate pollution prevention measures for the non-storm water component(s) of the discharge.

(iii) Failure to Certify—Any facility that is unable to provide the certification required (testing for non-storm water discharges), must notify the Director by [Insert date 270 days after permit issuance] or, for facilities which begin to discharge storm water associated with industrial activity after [Insert date 270 days after permit issuance], 180 days after submitting an NOI to be covered by this permit. If the failure to certify is caused by the inability to perform adequate tests or evaluations, such notification shall describe: the procedure of any test conducted for the presence of non-storm water discharges; the results of such test or other relevant observations; potential sources of non-storm water discharges to the storm sewer; and why adequate tests for such storm sewers were not feasible. Non-storm water discharges to waters of the United States which are not authorized by an NPDES permit are unlawful, and must be terminated.

(h) Sediment and Erosion Control—The plan shall identify areas which, due

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to topography, activities, or other factors, have a high potential for significant soil erosion, and identify structural, vegetative, and/or stabilization measures to be used to limit erosion.

(i) Management of Runoff—The plan shall contain a narrative consideration of the appropriateness of traditional storm water management practices (practices other than those which control the generation or source(s) of pollutants) used to divert, infiltrate, reuse, or otherwise manage storm water runoff in a manner that reduces pollutants in storm water discharges from the site. The plan shall provide that measures that the permittee determines to be reasonable and appropriate shall be implemented and maintained. The potential of various sources at the facility to contribute pollutants to storm water discharges associated with industrial activity [see paragraph XI.R.3.a.(2) of this section (Description of Potential Pollutant Sources)] shall be considered when determining reasonable and appropriate measures. Appropriate measures or other equivalent measures may include: vegetative swales and practices, reuse of collected storm water (such as for a process or as an irrigation source), inlet controls (such as oil/water separators), snow management activities, infiltration devices, and wet detention/retention devices.

(4) Comprehensive Site Compliance Evaluation. Qualified personnel shall conduct site compliance evaluations at appropriate intervals specified in the plan, but in no case less than once a year. Such evaluations shall provide:

(a) Areas contributing to a storm water discharge associated with industrial activity including, but not limited to, pressure washing area, blasting and sanding areas, painting areas, material storage areas, engine maintenance and repair areas, material handling areas, and drydock area, shall be visually inspected for evidence of, or the potential for, pollutants entering the drainage system. Measures to reduce pollutant loadings shall be evaluated to determine whether they are adequate and properly implemented in accordance with the terms of the permit or whether additional control measures are needed. Structural storm water management measures, sediment and erosion control measures, and other structural pollution prevention measures identified in the plan shall be observed to ensure that they are operating correctly. A visual inspection of equipment needed to implement the plan, such as spill response equipment, shall be made.

(b) Based on the results of the evaluation, the description of potential pollutant sources identified in the plan in accordance with paragraph XI.R.3.a.(2) of this section (Description of Potential Pollutant Sources) and pollution prevention measures and controls identified in the plan in accordance with paragraph XI.R.3.a.(3) of this section (Measures and Controls) shall be revised as appropriate within 2 weeks of such evaluation and shall provide for implementation of any changes to the plan in a timely manner, but in no case more than 12 weeks after the evaluation.

(c) A report summarizing the scope of the evaluation, personnel making the evaluation, the date(s) of the evaluation, major observations relating to the implementation of the storm water pollution prevention plan, and actions taken in accordance with paragraph XI.R.3.a.(4)(b) (above) of the permit shall be made and retained as part of the storm water pollution prevention plan for at least 3 years from the date of the evaluation. The report shall identify any incidents of noncompliance. Where a report does not identify any incidents of noncompliance, the report shall contain a certification that the facility is in compliance with the storm water pollution prevention plan and this permit. The report shall be signed in accordance with Part VII.G. (Signatory Requirements) of this permit.

(d) Where compliance evaluation schedules overlap with inspections required under 3.a.(3)(d), the compliance evaluation may be conducted in place of one such inspection.

4. Numeric Effluent Limitations

There are no additional numeric effluent limitations beyond those described in Part V.B. of this permit.

5. Monitoring and Reporting Requirements

(a) Quarterly Visual Examination of Storm Water Quality. Facilities shall perform and document a visual examination of a representative storm water discharge associated with industrial activity from each outfall except discharges exempted below. The examination must be made at least once in each designated period [described in (1) below] during daylight hours unless there is insufficient rainfall or snow melt to produce a runoff event.

(1) Examinations shall be conducted in each of the following periods for the purposes of visually inspecting storm water quality associated with storm water runoff or snow melt: January through March; April through June; July through September; October through December.

(2) Examinations shall be made of samples collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 1 hour) of when the runoff or snow melt begins discharging. The examinations shall document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on the samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inch in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. Where practicable, the same individual should carry out the collection and examination of discharges for the entire permit term.

(3) Visual examination reports must be maintained onsite in the pollution prevention plan. The report shall include the examination date and time, examination personnel, the nature of the discharge (i.e., runoff or snow melt), visual quality of the storm water discharge (including observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution), and probable sources of any observed storm water contamination.

(4) When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may collect a sample of effluent of one of such outfalls and report that the examination data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

(5) When a discharger is unable to collect samples over the course of the monitoring period as a result of adverse

climatic conditions, the discharger must document the reason for not performing the visual examination. Adverse weather conditions which may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(6) When a discharger is unable to conduct visual storm water examinations at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirement as long as the facility remains inactive and unstaffed. The facility must maintain a certification with the pollution prevention plan stating that the site is inactive and unstaffed so that performing visual examinations during a qualifying event is not feasible.

S. Storm Water Discharges Associated With Industrial Activity From Vehicle Maintenance Areas, Equipment Cleaning Areas, or Deicing Areas Located at Air Transportation Facilities

1. Discharges Covered Under This Section

The requirements listed under this section shall apply to storm water discharges from establishments and/or facilities including airports, air terminals, air carriers, flying fields, and establishments engaged in servicing or maintaining airports and/or aircraft (generally classified under Standard Industrial Classification (SIC) code 45) which have vehicle maintenance shops, material handling facilities, equipment cleaning operations or airport and/or aircraft deicing/anti-icing operations. For the purpose of this permit, the term "deicing" is defined as the process to remove frost, snow, or ice and "anti-icing" is the process which prevents the accumulation of frost, snow, or ice.

(a) *Coverage.* Only those portions of the facility or establishment that are either involved in vehicle maintenance (including vehicle rehabilitation, mechanical repairs, painting, fueling, and lubrication), equipment cleaning operations, or deicing/anti-icing operations are addressed under this section.

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

2. Special Conditions

(a) *Prohibition of Non-storm Water Discharges.* In addition to those discharges prohibited under Part III.A.2, non-storm water discharges including aircraft, ground vehicle, runway and equipment washwaters, and dry weather discharges of deicing/anti-icing chemicals are not authorized by this permit. Dry weather discharges are those discharges generated by processes other than those included in the definition of storm water. The definition of storm water includes storm water runoff, snow melt runoff, and surface runoff and drainage. All other discharges constitute non-storm water discharges. Operators of non-storm water discharges must obtain coverage under a separate National Pollutant Discharge Elimination System (NPDES) permit if discharged to waters of the United States or through a municipal separate storm sewer system.

(b) *Releases of Reportable Quantities of Hazardous Substances and Oil.* Each individual permittee is required to report spills equal to or exceeding the reportable quantity levels specified at 40 CFR 110, 117, and 302 as described at Part VI.B.2. If an airport authority is the sole permittee, then the sum total of all spills at the airport must be assessed against the RQ. If the airport authority is a co-permittee with other deicing/anti-icing operators at the airport, such as numerous different airlines, the assessed amount must be the summation of spills by each co-permittee. If separate, distinct individual permittees exist at the airport, then the amount spilled by each separate permittee must be the assessed amount for the RQ determination.

3. Storm Water Pollution Prevention Plan Requirements

Storm water pollution prevention plans developed for areas of the facility occupied by tenants of the airport shall be integrated with the plan for the entire airport. For the purposes of today's permit, tenants of the airport facility include airline companies, fixed based operators and other parties which have contracts with the airport authority to conduct business operations on airport property which result in storm water discharges associated with industrial activity as described in paragraph 1 of this section. Plans should be developed in accordance with Part IV. Storm Water Pollution Prevention Plans).

(a) *Contents of Plan.* Each plan shall include, at a minimum, the following items:

(1) *Pollution Prevention Team.* Each plan shall identify a specific individual or individuals as member(s) of a storm water Pollution Prevention Team who are responsible for developing the storm water pollution prevention plan and assisting the facility management in its implementation, maintenance, and revision. The plan shall clearly identify the responsibilities of each team member. The activities and responsibilities of the team shall address all aspects of the facility's storm water pollution prevention plan.

(2) *Description of Potential Pollutant Sources.* Each plan shall provide a description of potential sources which may reasonably be expected to add significant amounts of pollutants to storm water discharges or which may result in the discharge of pollutants during dry weather from separate storm sewers draining the facility. Each plan shall identify all activities and significant materials which may potentially be significant pollutant sources. Each plan shall include, at a minimum:

(a) *Drainage.*

(i) A site map indicating an outline of the drainage area of each storm water outfall within the facility boundaries, each existing structural control measure to reduce pollutants in storm water runoff, surface water bodies, locations where significant materials are exposed to precipitation, locations where major spills or leaks identified under paragraph XI.S.3.a.(2)(c) (Spills and Leaks) of this section have occurred, and the locations of the following activities where such activities are exposed to precipitation: aircraft and runway deicing/anti-icing operations; fueling stations: aircraft, ground vehicle and equipment maintenance and/or cleaning areas; storage areas for aircraft, ground vehicles and equipment awaiting maintenance; loading/unloading areas; locations used for the treatment, storage or disposal of wastes, liquid storage tanks, processing areas and storage areas. The map must indicate the outfall locations and the types of discharges contained in the drainage areas of the outfalls.

(ii) For each area of the facility that generates storm water discharges associated with industrial activity with a reasonable potential for containing significant amounts of pollutants, a prediction of the direction of flow, and an identification of the types of pollutants which are likely to be present in storm water discharges associated with industrial activity. Factors to consider include the toxicity of chemical; quantity of chemicals used, produced or discharged; the likelihood of contact with storm water; and history of significant leaks or spills of toxic or hazardous pollutants. Flows with a significant potential for causing erosion shall be identified.

(*iii*) The site map developed for the entire airport shall indicate the location of each tenant of the facility that conducts industrial activities as described in Part XI.S.1.a., and incorporate information from the tenants site map (including a description of industrial activities, significant materials exposed, and existing management practices).

(*b*) *Inventory of Exposed Materials*—An inventory of the types of materials handled at the site that potentially may be exposed to precipitation. Such inventory shall include a narrative description of significant materials that have been handled, treated, stored or disposed in a manner to allow exposure to storm water between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; method and location of onsite storage or disposal; materials management practices employed to minimize contact of materials with storm water runoff between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; the location and a description of existing structural and nonstructural control measures to reduce pollutants in storm water runoff; and a description of any treatment of storm water runoff.

(*c*) *Spills and Leaks*—A list of significant spills and significant leaks of toxic or hazardous pollutants that occurred at areas that are exposed to precipitation or that otherwise drain to a storm water conveyance at the facility after the date of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit. Such list shall be updated as appropriate during the term of the permit.

(*d*) *Sampling Data*—A summary of existing discharge sampling data describing pollutants in storm water discharges from the facility, including a summary of sampling data collected during the term of this permit.

(*e*) *Risk Identification and Summary of Potential Pollutant Sources*—A narrative description of the potential pollutant sources from the following activities: aircraft, runway, ground vehicle and equipment maintenance and cleaning; aircraft and runway deicing/anti-icing operations (including apron and centralized aircraft deicing/anti-icing stations, runways, taxiways and ramps); outdoor storage activities; loading and unloading operations; and onsite waste disposal. The description shall specifically list any significant potential source of pollutants at the facility and for each potential source, any pollutant or pollutant parameter [e.g., biochemical oxygen demand (BOD_5), oil and grease, etc.] of concern shall be identified.

Facilities which conduct deicing/anti-icing operations shall maintain a record of the types [including the Material Safety Data Sheets (MSDS)] and monthly quantities of deicing/anti-icing chemicals used. Tenants and fixed-base operators who conduct deicing/anti-icing operations shall provide the above information to the airport authority for inclusion in the storm water pollution prevention plan for the entire facility.

(*3*) *Measures and Controls.* Operators covered by this permit shall develop a description of storm water management controls appropriate for their areas of operation, and implement such controls. The priority in selecting controls shall reflect identified potential sources of pollutants at the facility. The description of storm water management controls shall address the following minimum components, including a schedule for implementing such controls:

(*a*) *Good Housekeeping*—Good housekeeping requires the maintenance of areas which may contribute pollutants to storm water discharges in a clean, orderly manner.

(*i*) *Aircraft, Ground Vehicle and Equipment Maintenance Areas*—Permittees should ensure the maintenance of equipment is conducted in designated areas only and clearly identify these areas on the ground and delineate them on the site map. The plan must describe measures that prevent or minimize the contamination of the storm water runoff from all areas used for aircraft, ground vehicle and equipment maintenance (including the maintenance conducted on the terminal apron and in dedicated hangars). Management practices or equivalent measures such as performing maintenance activities indoors, maintaining an organized inventory of materials used in the maintenance areas, draining all parts of fluids prior to disposal, preventing the practice of hosing down the apron or hangar floor, using dry cleanup methods, and/or collecting the storm water runoff from the maintenance area and providing treatment or recycling should be considered.

(*ii*) *Aircraft, Ground Vehicle and Equipment Cleaning Areas*—Permittees should ensure that cleaning of equipment is conducted in designated areas only and clearly identify these areas on the ground and delineate them on the site map. The plan must describe measures that prevent or minimize the contamination of the storm water runoff from all areas used for aircraft, ground vehicle and equipment cleaning. Management practices such as performing cleaning operations indoors, and/or collecting the storm water runoff from the cleaning area and providing treatment or recycling should be considered.

(*iii*) *Aircraft, Ground Vehicle and Equipment Storage Areas*—The storage of aircraft, ground vehicles and equipment awaiting maintenance must be confined to designated areas (delineated on the site map). The plan must describe measures that prevent or minimize the contamination of the storm water runoff from these areas. Management practices such as indoor storage of aircraft and ground vehicles, the use of drip pans for the collection of fluid leaks, and perimeter drains, dikes or berms surrounding storage areas should be considered.

(*iv*) *Material Storage Areas*—Storage units of all materials (e.g., used oils, hydraulic fluids, spent solvents, and waste aircraft fuel) must be maintained in good condition, so as to prevent or minimize contamination of storm water, and plainly labeled (e.g., "used oil," "Contaminated Jet A," etc.). The plan must describe measures that prevent or minimize contamination of the storm water runoff from storage areas. Management practices or equivalent measures such as indoor storage of materials, centralized storage areas for waste materials, and/or installation of berming and diking around storage areas should be considered for implementation.

(*v*) *Airport Fuel System and Fueling Areas*—The plan must describe measures that prevent or minimize the discharge of fuels to the storm sewer resulting from fuel servicing activities or other operations conducted in support of the airport fuel system. Where the discharge of fuels into the storm sewer cannot be prevented, the plan shall indicate measures that will be employed to prevent or minimize the discharge of the contaminated runoff into receiving surface waters. Management practices or equivalent measures such as implementing spill and overflow practices (e.g., placing sorptive materials beneath aircraft during fueling operations), using dry cleanup methods, and/or collecting the storm water runoff should be considered.

(b) Preventive Maintenance—A preventive maintenance program shall involve timely inspection and maintenance of storm water management devices (e.g., cleaning oil/water separators, removing debris from catch basins) as well as inspecting and testing facility equipment and systems to uncover conditions that could cause breakdowns or failures resulting in discharges of pollutants to surface waters, and ensuring appropriate maintenance of such equipment and systems.

(c) Spill Prevention and Response Procedures—Areas where potential spills which can contribute pollutants to storm water discharges can occur, and their accompanying drainage points shall be identified clearly in the storm water pollution prevention plan. The plan shall describe material handling procedures, storage requirements, and consider the use of equipment such as diversion valves. Procedures for cleaning up spills shall be identified in the plan and made available to the appropriate personnel. The necessary equipment to implement a clean up should be available to personnel.

(d) Source Reduction—Operators who conduct aircraft and/or runway (including taxiways and ramps) deicing/anti-icing operations shall evaluate present operating procedures to consider alternative practices to reduce the overall amount of deicing/anti-icing chemicals used and/or lessen the environmental impact of the pollutant source.

(i) With regard to runway deicing operations, operators, at a minimum, shall evaluate: present application rates to ensure against excessive over application; metered application of deicing chemical; pre-wetting dry chemical constituents prior to application; installation of runway ice detection systems; implementing anti-icing operations as a preventive measure against ice buildup; the use of substitute deicing compounds such as potassium acetate in lieu of ethylene glycol, propylene glycol and/or urea.

(ii) In considering source reduction management practices for aircraft deicing operations, operators, at a minimum, should evaluate current application rates and practices to ensure against excessive over application, and consider pretreating aircraft with hot water prior to the application of a deicing chemical, thus reducing the overall amount of chemical used per operation.

Source reduction measures that the operator determines to be reasonable and appropriate shall be implemented and maintained. The plan shall provide a narrative explanation of the options considered and the reasoning for whether or not to implement them.

(e) Management of Runoff—The plan shall contain a narrative consideration of the appropriateness of traditional storm water management practices (practices other than those which prevent or reduce source(s) of pollutants) used to divert, infiltrate, reuse, or otherwise manage storm water runoff in a manner that reduces pollutants in storm water discharges from the site. The potential of various sources at the facility to contribute pollutants to storm water discharges associated with industrial activity [see paragraph XI.S.3.a.(2) (Description of Potential Pollutant Sources)] shall be considered. Appropriate measures or equivalent measures may include: vegetative swales, reuse of collected storm water (such as for a process or as an irrigation source), inlet controls (such as oil/water separators), snow management activities, infiltration devices, and wet detention/retention devices. Measures that the permittee determines to be reasonable and appropriate shall be implemented and maintained.

(i) Operators that conduct aircraft and/or runway deicing/anti-icing operations shall also provide a narrative consideration of management practices to control or manage contaminated runoff from areas where deicing/anti-icing operations occur to reduce the amount of pollutants being discharged from the site. Structural controls such as establishing a centralized aircraft deicing facility, and/or collection of contaminated runoff for treatment or recycling should be considered. Collection and treatment alternatives include, but are not limited to, retention basins, detention basins with metered controlled release, Underground Storage Tanks (USTs) and/or disposal to Publicly Owned Treatment Works (POTW) by way of sanitary sewer or hauling tankers. Runoff management controls that the operator determines to be reasonable and appropriate shall be implemented and maintained. The plan should consider the recovery of deicing/anti-icing materials when these materials are applied during non-precipitation events to prevent these materials from later becoming a source of storm water contamination. The plan shall provide a narrative explanation of the controls selected and the reasons for their selection.

(f) Inspections—In addition to or as part of the comprehensive site evaluation required under paragraph XI.S.3.a.(4) of this section, qualified facility personnel shall be identified to inspect designated equipment and areas of the facility specified in the plan. The inspection frequency shall be specified in the plan, but at a minimum be conducted once per week during deicing/anti-icing application periods for areas where deicing/anti-icing operations are being conducted. A set of tracking or follow-up procedures shall be used to ensure that appropriate actions are taken in response to the inspections. Records of inspections shall be maintained. The use of a checklist developed by the pollution prevention team is encouraged.

(g) Pollution Prevention Training—Pollution prevention training programs shall be developed to inform management and personnel responsible for implementing activities identified in the storm water pollution prevention plan of the components and goals of the plan. Training should address topics such as spill response, good housekeeping, aircraft and runway deicing/anti-icing procedures, and material management practices. The pollution prevention plan shall identify periodic dates for such training.

(h) Recordkeeping and Internal Reporting Procedures—A description of incidents (such as spills, or other discharges), along with other information describing the quality and quantity of storm water discharges shall be included in the plan. Inspections and maintenance activities shall be documented and records shall be incorporated into the plan.

(i) Non-storm Water Discharges.

(i) The plan shall include a certification that the discharge points have been tested or evaluated for the presence of non-storm water discharges. The certification shall include the identification of potential significant sources of non-storm water at the site, a description of the results of any test and/or evaluation for the presence of non-storm water discharges, the evaluation criteria or testing method used, the date of any testing and/or evaluation, and the onsite drainage points that were directly observed during the test. Certifications shall be signed in accordance with Part VII.G. of this permit. Such certification may not be feasible if the facility operating the storm water discharge associated with industrial activity does not have access to an outfall, manhole, or other point of

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access to the ultimate conduit which receives the discharge. In such cases, the source identification section of the storm water pollution prevention plan shall indicate why the certification required by this part was not feasible, along with the identification of potential significant sources of non-storm water at the site. A discharger that is unable to provide the certification required by this paragraph must notify the Director in accordance with paragraph XI.S.3.a.(3)(iii) (below).

(ii) Except for flows from fire fighting activities, other sources of non-storm water listed in Part III.A.2 (Non-storm Water Discharges) of this permit that are combined with storm water discharges associated with industrial activity must be identified in the plan. The plan shall identify and ensure the implementation of appropriate pollution prevention measures for the non-storm water component(s) of the discharge.

(iii) Failure to Certify—Any facility that is unable to provide the certification required (testing for non-storm water discharges), must notify the Director by [Insert date 270 days after permit issuance] or, for facilities which begin to discharge storm water associated with industrial activity after [Insert date 270 days after permit issuance], 180 days after submitting a notice of intent to be covered by this permit. If the failure to certify is caused by the inability to perform adequate tests or evaluations, such notification shall describe: the procedure of any test conducted for the presence of non-storm water discharges; the results of such test or other relevant observations; potential sources of non-storm water discharges to the storm sewer; and why adequate tests for such storm sewers were not feasible. Non-storm water discharges to waters of the United States which are not authorized by an NPDES permit are unlawful, and must be terminated.

(j) Sediment and Erosion Control—The plan shall identify areas which, due to topography, activities, or other factors, have a high potential for significant soil erosion, and identify structural, vegetative, and/or stabilization measures to be used to limit erosion.

(4) Comprehensive Site Compliance Evaluation. Qualified personnel shall conduct site compliance evaluations during periods of deicing/anti-icing operations at appropriate intervals specified in the plan, but in no case less than once a year. Such evaluations shall provide:

(a) Areas contributing to a storm water discharge associated with industrial activity shall be visually inspected for evidence of, or the potential for, pollutants entering the drainage system. Measures to reduce pollutant loadings shall be evaluated to determine whether they are adequate and properly implemented in accordance with the terms of the permit or whether additional control measures are needed. Structural storm water management measures, sediment and erosion control measures, and other structural pollution prevention measures identified in the plan shall be observed to ensure that they are operating correctly. A visual inspection of equipment needed to implement the plan, such as spill response equipment, shall be made.

(b) Based on the results of the evaluation, the description of potential pollutant sources identified in the plan in accordance with paragraph XI.S.3.a.(2) of this section (Description of Potential Pollutant Sources) and pollution prevention measures and controls identified in the plan in accordance with paragraph XI.S.3.a.(3) of this section (Measures and Controls) shall be revised as appropriate within 2 weeks of such evaluation and shall provide for implementation of any changes to the plan in a timely manner, but in no case more than 12 weeks after the evaluation.

(c) A report summarizing the scope of the evaluation, personnel making the evaluation, the date(s) of the evaluation, major observations relating to the implementation of the storm water pollution prevention plan, and actions taken in accordance with paragraph XI.S.3.a.(4)(b) (above) of the permit shall be made and retained as part of the storm water pollution prevention plan for at least 3 years from the date of the evaluation. The report shall identify any incidents of noncompliance. Where a report does not identify any incidents of noncompliance, the report shall contain a certification that the facility is in compliance with the storm water pollution prevention plan and this permit. The report shall be signed in accordance with Part VII.G. (Signatory Requirements) of this permit.

(d) Where compliance evaluation schedules overlap with inspections required under 3.a.(3)(f), the compliance evaluation may be conducted in place of one such inspection.

4. Numeric Effluent Limitations

There are no additional numeric effluent limitations beyond those in Part V.B of this permit.

5. Monitoring and Reporting Requirements

a. During the period beginning on the effective date and lasting through the expiration date of this permit, (airports that use more than 100,000 gallons of glycol-based deicing/anti-icing) chemicals and/or 100 tons or more of urea on an average annual basis):

(1) Shall prepare estimates for annual pollutant loadings resulting from discharges of spent deicing/anti-icing chemicals from the entire airport. The loading estimates shall reflect the amounts of deicing/anti-icing chemicals discharged to separate storm sewer systems or surface waters, prior to and after implementation of the facility's storm water pollution prevention plan. Such estimates shall be reviewed by an environmental professional, and certified by such professional. By means of the certification, the environmental professional, having examined the facility's deicing/anti-icing procedures, and proposed control measures described in the storm water pollution prevention plan, shall attest that the loading estimates have been accurately prepared. Certified loading estimates are to be retained at the airport facility and attached to the storm water pollution prevention plan.

b. Analytical Monitoring Requirements. During the period beginning [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] and the period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance], airports that use more than 100,000 gallons of glycol-based deicing/anti-icing chemicals and/or 100 tons or more of urea on an average annual basis shall monitor outfalls from the airport facility that collect runoff from areas where deicing/anti icing activities occur, except as provided in paragraph 5.a.(3) (Sampling Waiver). Airports which are subject to these monitoring requirements must sample their storm water discharges for the parameters listed in Table S–1 below. Such facilities must report in accordance with 5.b. (Reporting). In addition to the parameters listed in Table S–1 below, the permittee shall provide the date and duration (in hours) of the precipitation event(s) sampled; measurements or estimates (in inches) of the precipitation event that generated the sampled runoff; the duration between the event sampled and the end of the previous measurable (greater than 0.1 inch rainfall) event; and an estimate of the total volume (in gallons) of the discharge sampled.

TABLE S–1.—MONITORING REQUIREMENTS

Pollutants of concern	Monitoring cut-off concentration
Biochemical Oxygen Demand (BOD_5).	30 mg/L
Chemical Oxygen Demand (COD).	120 mg/L
Ammonia	19 mg/L
pH	6.0 to 9 s.u.

For the purposes of today's final permit, the "average annual" usage rate of deicing/anti-icing chemicals is determined by averaging the cumulative amount of deicing/anti-icing chemicals used by all operators at the airport facility in the 3 previous calendar years.

(1) Monitoring Periods. Airports where more than 100,000 gallons of glycol-based deicing/anti-icing chemicals and/or 100 tons or more of urea are used on an average annual basis shall monitor outfalls from the facility that collect runoff from areas where deicing/anti-icing activities occur four times per year during the months of December, January, and February when deicing/anti-icing activities are occurring, in the years specified in paragraph b. (above).

(2) Sample Type. A minimum of one grab sample and one flow-weighted composite sample shall be taken from each outfall that collects runoff from areas where deicing/anti-icing activities occur. All such samples shall be collected from a discharge resulting from a precipitation event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) precipitation event. The required 72-hour storm event interval is waived where the preceding measurable storm event did not result in a measurable discharge from the facility. The required 72-hour storm event interval may also be waived where the permittee documents that less than a 72-hour interval is representative for local storm events during the season when sampling is being conducted. The grab sample should be taken when pollutant concentrations in the storm water/melt water discharges from deicing/anti-icing operations are expected to be at a maximum. The recommended methodology for performing grab and flow-weighted composite sampling is described at 40 CFR 122.21(g)(7). The permittee has the option to submit site-specific deicing/anti-icing discharge monitoring protocol and methodology, better suited to the particular facility, to the Director for approval.

(3) Sampling Waiver.

(a) Adverse Conditions—Adverse weather conditions that may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as high winds, blizzard conditions, ice storms, etc.) or otherwise make the collection of a sample impracticable (extended frozen conditions, etc.).

(b) Low Concentration Waiver—When the average concentration for a parameter calculated from all grab samples collected during the monitoring period [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] is less than the corresponding value for that parameter listed in Table S–1 under the column Monitoring Cut-off Concentration, a facility may waive monitoring and reporting requirements in the monitoring period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance]. The facility must submit to the Director, in lieu of the monitoring data, a certification that there has not been a significant change in industrial activity or the pollution prevention measures in area of the facility which drains to the outfall for which sampling was waived.

(c) When a discharger is unable to conduct quarterly chemical storm water sampling at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirements as long as the facility remains inactive and unstaffed. The facility must submit to the Director, in lieu of monitoring data, a certification statement on the DMR stating that the site is inactive and unstaffed so that collecting a sample during a qualifying event is not possible.

(4) Representative Discharge. When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may test the effluent of one of such outfalls and report that the quantitative data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan. The permittee shall include the description of the location of the outfalls, explanation of why outfalls are expected to discharge substantially identical effluents, and estimate of the size of the drainage area and runoff coefficient with the Discharge Monitoring Report.

(5) Alternative Certification. The Alternative Certification provision discussed in other sections of Part XI is not applicable to discharges included under Part XI.S. (Storm Water Discharges Associated with Industrial Activity from Vehicle Maintenance Areas, Equipment Cleaning Areas, or Deicing/Anti-icing Areas Located at Air Transportation Facilities).

(c) Reporting. Airports identified in Part XI.S.5.6 shall submit monitoring results obtained during the reporting period beginning [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] on Discharge Monitoring Report Form(s) postmarked no later than the 31st day of March [insert the date 2 years after permit issuance]. Monitoring results obtained during the period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance] shall be submitted on Discharge Monitoring Report Form(s) postmarked no later than the 31st day of March [insert date 4 years after permit issuance]. A separate Discharge Monitoring Report Form is required for each sampling period. For each outfall, one signed Discharge Monitoring Report form must be submitted to the Director per storm event sampled. Signed copies of Discharge Monitoring Reports, or waiver, shall be submitted to the Director of the NPDES program at the address of the appropriate Regional Office listed in Part VI.G. of the fact sheet.

(1) Additional Notification. In addition to filing copies of discharge monitoring reports in accordance with paragraph cb (above), facilities identified in Part XI.S.5.6 that discharge storm water to a large or medium municipal separate storm sewer system (systems serving a population of 100,000 or more) must submit signed copies of discharge monitoring reports to the operator of the municipal separate storm sewer system in accordance with the dates provided in paragraph bc (above).

T. Storm Water Discharges Associated With Industrial Activity From Treatment Works

1. Discharges Covered Under This Section

a. This permit covers all existing point source discharges of storm water from treatment works treating domestic sewage or any other sewage sludge or wastewater treatment device or system, used in the storage, treatment, recycling, and reclamation of municipal or domestic sewage, including lands dedicated to the disposal of sewage sludge that are located within the confines of the facility with a design flow of 1.0 MGD or more, or required to have an approved pretreatment program under 40 CFR Part 403. When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

2. Special Conditions

a. Prohibition of Non-storm Water Discharges. Prohibited non-storm water discharges including sanitary and industrial wastewater, and equipment and vehicle washwaters are not authorized by this permit. The operators of such discharges must obtain coverage under a separate NPDES permit if discharged to waters of the United States or through a municipal separate storm sewer system.

3. Storm Water Pollution Prevention Plan Requirements

a. Contents of the Plan. The plan shall include, at a minimum, the following items:

(1) Pollution Prevention Team. Each plan shall identify a specific individual or individuals within the facility organization as members of a storm water Pollution Prevention Team who are responsible for developing the storm water pollution prevention plan and assisting the facility or plant manager in its implementation, maintenance, and revision. The plan shall clearly identify the responsibilities of each team member. The activities and responsibilities of the team shall address all aspects of the facility's storm water pollution prevention plan.

(2) Description of Potential Pollutant Sources. Each plan shall provide a description of potential sources which may reasonably be expected to add significant amounts of pollutants to storm water discharges or which may result in the discharge of pollutants during dry weather from separate storm sewers draining the facility. Each plan shall identify all activities and significant materials which may potentially be significant pollutant sources. Each plan shall include, at a minimum:

(a) Drainage—A site map indicating the location of each point of discharge of storm water associated with industrial activity, types of discharges contained in the drainage areas of the outfalls, an outline of the portions of the drainage area of each storm water outfall that are within the facility boundaries (with a prediction of the direction of flow), each existing structural control measure to reduce pollutants in storm water runoff, surface water bodies, locations where significant materials are exposed to precipitation, locations where major spills or leaks identified under Part III.B. (Spills and Leaks) of this permit have occurred. In addition, the locations of the following activities shall be indicated: fueling areas; vehicle and equipment maintenance and/or cleaning areas; locations used for treatment, storage and disposal areas for wastes, liquid storage tanks, processing areas and storage areas for process chemicals, petroleum products, solvents, fertilizers, herbicides and pesticides; and loading/unloading areas.

(b) Inventory of Exposed Materials—An inventory of the types of materials handled at the site that potentially may be exposed to precipitation. Such inventory shall include a narrative description of significant materials that have been handled, treated, stored or disposed in a manner to allow exposure to storm water between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; method and location of onsite storage or disposal; materials management practices employed to minimize contact of materials with storm water runoff between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; the location and a description of existing structural and nonstructural control measures to reduce pollutants in storm water runoff; and a description of any treatment the storm water receives.

(c) Spills and Leaks—A list of significant spills and significant leaks of toxic or hazardous pollutants that occurred at areas that are exposed to precipitation or that otherwise drain to a storm water conveyance at the facility after the date of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit. Such list shall be updated as appropriate during the term of the permit.

(d) Sampling Data—A summary of existing discharge sampling data describing pollutants in storm water discharges from the facility, including a summary of sampling data collected during the term of this permit.

(e) Summary of Potential Pollutant Sources—A narrative description of the potential pollutant sources from the following activities associated with treatment works: access roads/rail lines; loading and unloading operations; outdoor storage activities; material handling sites; outdoor manufacturing or processing activities; significant dust or particulate generating processes; and onsite waste disposal practices. The description shall specifically list any significant potential source of pollutants at the site and for each potential source, any pollutant or pollutant parameter (e.g., acid, bases, and solvents, etc.) of concern shall be identified.

(3) Measures and Controls. Each facility covered by this permit shall develop a description of storm water management controls appropriate for the facility, and implement such controls. The appropriateness and priorities of controls in a plan shall reflect identified potential sources of pollutants at the facility. The description of storm water management controls shall address the following minimum components, including a schedule for implementing such controls:

(a) Good Housekeeping—All areas that may contribute pollutants to storm waters discharges shall be maintained in a clean, orderly manner.

(b) Preventive Maintenance—A preventive maintenance program shall involve timely inspection and maintenance of storm water management devices (e.g., cleaning oil/water separators, catch basins) as well as inspecting and testing facility equipment and systems to uncover conditions that could cause breakdowns or failures resulting in discharges of pollutants to surface waters, and ensuring appropriate maintenance of such equipment and systems.

(c) Spill Prevention and Response Procedures—Areas where potential spills which can contribute pollutants to storm water discharges can occur, and their accompanying drainage points, shall be identified clearly in the storm water pollution prevention plan. Where appropriate, specifying material handling procedures, storage requirements, and use of equipment such as diversion valves in the plan should be considered. Procedures and equipment for cleaning up spills shall be identified in the plan and made available to the appropriate personnel.

(d) Inspections—In addition to the comprehensive site evaluation required under Part XI.T.3.a.(4) of this permit, qualified facility personnel shall be identified to inspect designated equipment and areas of the facility on a periodic basis. The following areas shall be included in all inspections: access roads/rail lines, equipment storage and maintenance areas (both indoor and outdoor areas); fueling; material handling areas, residual treatment, storage, and disposal areas; and wastewater treatment areas. A set of tracking or follow-up procedures shall be used to ensure that appropriate actions are taken in response to the inspections. Records of inspections shall be maintained. The use of a checklist developed by the facility is encouraged.

(e) Employee Training—Employee training programs shall inform personnel responsible for implementing activities identified in the storm water pollution prevention plan or otherwise responsible for storm water management at all levels of responsibility of the components and goals of the storm water pollution prevention plan. Training should address topics such as spill response, good housekeeping and material management practices. The pollution prevention plan shall identify how often training will take place, but training should be held at least annually (once per calendar year). Employee training must, at a minimum, address the following areas when applicable to a facility: petroleum product management; process chemical management; spill prevention and control; fueling procedures; general good housekeeping practices; proper procedures for using fertilizers, herbicides and pesticides.

(f) Recordkeeping and Internal Reporting Procedures—A description of incidents (such as spills, or other discharges), along with other information describing the quality and quantity of storm water discharges shall be included in the plan required under this part. Inspections and maintenance activities shall be documented and records of such activities shall be incorporated into the plan.

(g) Non-storm Water Discharges.

(i) The plan shall include a certification that the discharge has been tested or evaluated for the presence of non-storm water discharges. The certification shall include the identification of potential significant sources of non-storm water at the site, a description of the results of any test and/or evaluation for the presence of non-storm water discharges, the evaluation criteria or testing method used, the date of any testing and/or evaluation, and the onsite drainage points that were directly observed during the test. Certifications shall be signed in accordance with Part VII.G. of this permit. Such certification may not be practical if the facility operating the storm water discharge associated with industrial activity does not have access to an outfall, manhole, or other point of access to the ultimate conduit which receives the discharge. In such cases, the source identification section of the storm water pollution prevention plan shall indicate why the certification required by this part was not practical, along with the identification of potential significant sources of non-storm water at the site. A discharger that is unable to provide the certification required by this paragraph must notify the Director in accordance with Part XI.T.3.a.(3)(g)(iv) (Failure to Certify) of this permit.

(ii) Except for flows from fire fighting activities, sources of non-storm water listed in Part III.A.2. (Prohibition of Non-storm Water Discharges) of this permit that are combined with storm water discharges associated with industrial activity must be identified in the plan. The plan shall identify and ensure the implementation of appropriate pollution prevention measures for the non-storm water component(s) of the discharge.

(iii) A copy of all the current NPDES permit issued for wastewater, industrial, vehicle and equipment washwater discharges or, if an NPDES permit has not yet been issued, a copy of the pending application must be attached to the plan. For facilities that discharge vehicle and equipment washwaters to the sanitary sewer system, the operator of the sanitary system and associated treatment plant must be notified. In such cases, a copy of the notification letter must be attached to the plan. If an industrial user permit is issued under a pretreatment program, a copy of that permit must be attached in the plan. In all cases, any permit conditions must be considered in the plan. If the washwaters are handled in another manner (e.g., hauled offsite), the disposal method must be described and all pertinent documentation (e.g., frequency, volume, destination, etc.) must be attached to the plan.

(iv) Failure to Certify. Any facility that is unable to provide the certification required (testing for non-storm water discharges), must notify the Director by [insert date 270 days after permit issuance] or, for facilities that begin to discharge storm water associated with industrial activity after [insert date 270 days after permit issuance], 180 days after submitting an NOI to be covered by this permit. If the failure to certify is caused by the inability to perform adequate tests or evaluations, such notifications shall describe: the procedure of any test conducted for the presence of non-storm water discharges; the results of such test or other relevant observations; potential sources of non-storm water discharges to the storm sewer; and why adequate tests for such storm sewers were not feasible. Non-storm water discharges to waters of the United States that are not authorized by an NPDES permit are unlawful and must be terminated.

(h) Sediment and Erosion Control—The plan shall identify areas which, due to topography, activities, or other factors, have a high potential for significant soil erosion, and identify structural, vegetative, and/or stabilization measures to be used to limit erosion.

(i) Management of Runoff—The plan shall contain a narrative consideration of the appropriateness of traditional storm water management practices (practices other than those which control the generation or source(s) of pollutants) used to divert, infiltrate, reuse, or otherwise manage storm water runoff in a manner that reduces pollutants in storm water discharges from the site. The plan shall provide that measures that the permittee determines to be reasonable and appropriate shall be implemented and maintained. The potential of various sources at the facility to contribute pollutants to storm water discharges associated with industrial activity [see Part XI.T.3.a.(2) (Description of Potential Pollutant Sources) of this permit] shall be considered when determining reasonable and appropriate measures. Appropriate measures or other equivalent measures may include: vegetative swales and practices, reuse of collected storm water (such as for a process or as an irrigation source), inlet controls (such as oil/water separators), snow management activities, infiltration devices, and wet detention/retention devices.

(4) Comprehensive Site Compliance Evaluation. Qualified personnel shall conduct site compliance evaluations at appropriate intervals specified in the plan, but in no case less than once a year. Such evaluations shall provide:

(a) Areas contributing to a storm water discharge associated with industrial activity shall be visually inspected for evidence of, or the potential for, pollutants entering the drainage system. Measures to reduce pollutant loadings shall be evaluated to determine whether they are adequate and properly implemented in accordance with the terms of the permit or whether additional control measures are needed. Structural storm water management measures, sediment and erosion control measures, and other structural pollution prevention measures identified in the plan shall be observed to ensure that they are operating correctly. A visual inspection of equipment needed to implement the plan, such as spill response equipment, shall be made.

(b) Based on the results of the evaluation, the description of potential pollutant sources identified in the plan in accordance with Part XI.T.3.a.(2) (Description of Potential Pollutant Sources) of this permit and pollution prevention measures and controls identified in the plan in accordance with paragraph XI.T.3.a.(3) (Measures and Controls) of this permit shall be revised as appropriate within 2 weeks of such evaluation and shall provide for implementation of any changes to the plan in a timely manner, but in no case more than 12 weeks after the evaluation.

(c) A report summarizing the scope of the evaluation, personnel making the evaluation, the date(s) of the evaluation, major observations relating to the implementation of the storm water pollution prevention plan, and actions taken in accordance with paragraph XI.T.3.a.(4)(b) of the permit shall be made and retained as part of the storm water pollution prevention plan for at least 3 years after the date of the evaluation. The report shall identify any incidents of noncompliance. Where a report does not identify any incidents of noncompliance, the report shall contain a certification that the facility is in compliance with the storm water pollution prevention plan and this permit. The report shall be signed in accordance with Part VII.G. (Signatory Requirements) of this permit.

(d) Where compliance evaluation schedules overlap with inspections required under 3.a.(3)(d), the compliance evaluation may be conducted in place of one such inspection.

4. Numeric Effluent Limitations

There are no numeric effluent limitations beyond those in Part V.B.

5. Monitoring and Reporting Requirements

a. Quarterly Visual Examination of Storm Water Quality. Facilities shall perform and document a visual examination of a storm water discharge associated with industrial activity from each outfall, except discharges exempted below. The examination must be made at least once in each of the following designated periods during daylight hours unless there is insufficient rainfall or snow melt to produce a runoff event: January through March; April through June; July through September; and October through December.

(1) Examinations shall be made of samples collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 1 hour) of when the runoff or snowmelt begins discharging. The examinations shall document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on the samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. Where practicable, the same individual should carry out the collection and examination of discharges for entire permit term.

(2) Visual examination reports must be maintained onsite in the pollution prevention plan. The report shall include the examination date and time, examination personnel, the nature of the discharge (i.e., runoff or snow melt), visual quality of the storm water discharge (including observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution), and probable sources of any observed storm water contamination.

(3) When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may collect a sample of effluent of one of such outfalls and report that the observation data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

(4) When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the results of the visual examination. Adverse weather conditions which may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(5) When a discharger is unable to conduct visual storm water examinations at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirement as long as the facility remains inactive and unstaffed. The facility must maintain a certification with the pollution prevention plan stating that the site is inactive and unstaffed so that performing visual examinations during a qualifying event is not feasible.

U. Storm Water Discharges Associated With Industrial Activity From Food and Kindred Products Facilities

1. Discharges Covered Under This Section

This section covers all storm water discharges from food and kindred products processing facilities (commonly identified by Standard Industrial Classification (SIC) code 20), including: meat products; dairy products; canned, frozen and preserved fruits, vegetables, and food specialties; grain mill products; bakery products; sugar and confectionery products; fats and oils; beverages; and miscellaneous food preparations and kindred products and tobacco products manufacturing (SIC Code 21), except for storm water discharges identified under paragraph I.B.3. where industrial plant yards; material handling sites; refuse sites; sites used for application or disposal of process wastewaters; sites used for storage and maintenance of material handling equipment; sites used for residential treatment, storage, or disposal; shipping and receiving areas; manufacturing buildings; and storage areas for raw material and intermediate and finished products are exposed to storm water and areas where industrial activity has taken place in the past and significant materials remain. For the purposes of this paragraph, material handling activities include the storage, loading, and unloading, transportation, or conveyance of any raw material, intermediate product, finished product, by-product, or waste product.

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

2. Special Conditions

a. Prohibition of Non-storm Water Discharges.

(1) Discharges of non-storm water, including boiler blowdown, cooling tower overflow and blowdown, ammonia refrigeration purging, and vehicle washing/clean-out operations, to waters of the United States, or through municipal separate storm sewer systems, are not authorized by this permit (except those discharges identified in part III.A.2 in the permit). The operators of such discharges must obtain coverage under a separate NPDES wastewater discharge permit.

3. Storm Water Pollution Prevention Plan Requirements

a. Contents of Plan. The plan shall include, at a minimum, the following items:

(1) Pollution Prevention Team. Each plan shall identify a specific individual or individuals within the facility organization as members of a storm water Pollution Prevention Team that are responsible for developing the storm water pollution prevention plan and assisting the facility or plant manager in its implementation, maintenance, and revision. The plan shall clearly identify the responsibilities of each team member. The activities and responsibilities of the team shall address all aspects of the facility's storm water pollution prevention plan.

(2) Description of Potential Pollutant Sources. Each plan shall provide a description of potential sources which may reasonably be expected to add significant amounts of pollutants to storm water discharges or which may result in the discharge of pollutants during dry weather from separate storm sewers draining the facility. Each plan shall identify all activities and significant materials which may potentially be significant pollutant sources. Each plan shall include, at a minimum:

(a) Drainage—A site map indicating the pattern of storm water drainage, existing structural control measures to reduce pollutants in storm water runoff, surface water bodies, locations where significant materials are exposed to precipitation, and locations where major spills or leaks identified under Part XI.U.3.a.(2)(c) (Spills and Leaks) of this permit have occurred since 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit. The map must also indicate the locations of all industrial activities that are exposed to precipitation, including, but not limited to: loading/unloading areas; vehicle fueling; vehicle and equipment maintenance and/or cleaning areas; waste treatment, storage and disposal locations; liquid storage tanks; vents and stacks from cooking, drying, and similar operations, dry product vacuum transfer lines; animal holding pens; spoiled product and broken product container storage areas; significant dust or particulate generating areas; and any other processing and storage areas exposed to storm water. Flows with a significant potential for causing erosion shall also be identified. In addition, the site map must identify monitoring locations. In addition, the map must indicate the outfall locations and the types of discharges contained in the drainage areas of the outfalls.

(b) Inventory of Exposed Materials—An inventory of the types of materials handled at the site that potentially may be exposed to precipitation. Such inventory shall include a narrative description of significant materials that have been handled, treated, stored or disposed in a manner to allow exposure to storm water between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; method and location of onsite storage or disposal; materials management practices employed to minimize contact of materials with storm water runoff between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; the location and a description of existing structural and nonstructural control measures to reduce pollutants in storm water runoff; and a description of any treatment the storm water receives.

(c) Spills and Leaks—A list of significant spills and significant leaks of toxic or hazardous pollutants that occurred at areas that are exposed to precipitation or that otherwise drain to a storm water conveyance at the facility after the date of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit. Such list shall be updated as appropriate during the term of the permit.

(d) Sampling Data—A summary of existing discharge sampling data describing pollutants in storm water discharges from the facility, including a summary of sampling data collected during the term of this permit.

(e) Summary of Potential Pollutant Sources—The description of potential pollutant sources culminates in a narrative assessment of the risk potential that the industrial activities, materials, and physical features of the site, as identified in XI.U.3.a.(2)(a) (drainage), pose to storm water quality. The description shall specifically list any significant potential source of pollutants at the site and for each potential source, any pollutant or pollutant parameter (e.g., biochemical oxygen demand, oil and grease, etc.) of concern shall be identified.

In addition to food and kindred products processing-related industrial activities, the plan must also describe application/storage of pest control chemicals (e.g., rodenticides, insecticides, fungicides, and others) used on plant grounds, including a description of pest control application and chemical storage practices.

(3) Measures and Controls. Each facility covered by this permit shall develop a description of storm water management controls appropriate for the facility, and implement such controls. The appropriateness and priorities of controls in a plan shall reflect identified potential sources of pollutants at the facility. The description of storm water management controls shall address the following

minimum components, including a schedule for implementing such controls:

(a) Good Housekeeping—Good housekeeping requires the maintenance of areas which may contribute pollutants to storm waters discharges in a clean, orderly manner.

(b) Preventive Maintenance—A preventive maintenance program shall involve timely inspection and maintenance of storm water management devices (e.g., cleaning oil/water separators, catch basins) as well as inspecting and testing facility equipment and systems to uncover conditions that could cause breakdowns or failures resulting in discharges of pollutants to surface waters, and ensuring appropriate maintenance of such equipment and systems.

(c) Spill Prevention and Response Procedures—Areas where potential spills which can contribute pollutants to storm water discharges can occur, and their accompanying drainage points shall be identified clearly in the storm water pollution prevention plan. Areas that must be identified should include loading/unloading stations, outdoor storage areas, and waste management areas exposed to storm water. Where appropriate, specifying material handling procedures, storage requirements, and use of equipment such as diversion valves in the plan should be considered. Procedures for cleaning up spills shall be identified in the plan and made available to the appropriate personnel. The necessary equipment to implement a clean up should be available to personnel.

(d) Inspections—In addition to the comprehensive site evaluation required under Part XI.U.3.a.(4) of this section, qualified facility personnel shall be identified to inspect designated equipment and areas of the facility. At a minimum, the following areas, where the potential for exposure to storm water exists, must be inspected on a regularly scheduled basis: loading and unloading areas for all significant materials; storage areas, including associated containment areas; waste management units; vents and stacks emanating from industrial activities; spoiled product and broken product container holding areas; animal holding pens; staging areas; and air pollution control equipment. A set of tracking or follow-up procedures shall be used to ensure that appropriate actions are taken in response to the inspections. Records of inspections shall be maintained. Based on the results of the inspection, the description of potential pollutant sources and pollution prevention measures and controls identified in the plan shall be revised as appropriate within 2 weeks of such inspection and shall provide for implementation of any changes to the plan in a timely manner, but in no case more than 12 weeks after the inspection.

(e) Employee Training—Employee training programs shall inform personnel responsible for implementing activities identified in the storm water pollution prevention plan or otherwise responsible for storm water management at all levels of responsibility of the components and goals of the storm water pollution prevention plan. Training should address topics such as spill response, good housekeeping, material management practices, unloading/loading practices, outdoor storage areas, waste management practices, pest control, and improper connections to the storm sewer. At a minimum, this training must be provided annually. The pollution prevention plan shall identify frequencies and approximate dates for such training.

(f) Recordkeeping and Internal Reporting Procedures—A description of incidents (such as spills, or other discharges), along with other information describing the quality and quantity of storm water discharges shall be included in the plan required under this part. Inspections and maintenance activities shall be documented and records of such activities shall be incorporated into the plan. Ineffective BMPs must be recorded and the date of their corrective actions noted in the plan.

(g) Non-storm Water Discharges

(i) The plan shall include a certification that the discharge has been tested or evaluated for the presence of non-storm water discharges. The certification shall include the identification of potential significant sources of non-storm water at the site, a description of the results of any test and/or evaluation for the presence of non-storm water discharges, the evaluation criteria or testing method used, the date of any testing and/or evaluation, and the onsite drainage points that were directly observed during the test. Certifications shall be signed in accordance with Part VII.G. of this permit. Such certification may not be feasible if the facility operating the storm water discharge associated with industrial activity does not have access to an outfall, manhole, or other point of access to the ultimate conduit which receives the discharge. In such cases, the source identification section of the storm water pollution prevention plan shall indicate why the certification required by this part was not feasible, along with the identification of potential significant sources of non-storm water at the site. A discharger that is unable to provide the certification required by this paragraph must notify the Director in accordance with Part XI.U.3.a.(3)(g)(iv) (Failure to Certify) of this permit.

(ii) Except for flows from fire fighting activities, sources of non-storm water listed in Part III.A.2 (Prohibition of Non-storm Water Discharges) of this permit that are combined with storm water discharges associated with industrial activity must be identified in the plan. The plan shall identify and ensure the implementation of appropriate pollution prevention measures for the non-storm water component(s) of the discharge.

(iii) If the facility discharges wastewater, other than storm water via an existing NPDES permit, a copy of the NPDES permit authorizing the discharge must be attached to the plan. Similarly, if the facility submitted an application for an NPDES permit for non-storm water discharges, but has not yet received that permit, a copy of the permit application must be attached. Upon issuance or reissuance of an NPDES permit, the facility must modify its plan to include a copy of that permit.

(iv) Failure To Certify—Any facility that is unable to provide the certification required (testing for non-storm water discharges), must notify the Director by [Insert date 270 days after permit issuance] or, for facilities which begin to discharge storm water associated with industrial activity after [Insert date 270 days after permit issuance], 180 days after submitting an NOI to be covered by this permit. If the failure to certify is caused by the inability to perform adequate tests or evaluations, such notification shall describe: the procedure of any test conducted for the presence of non-storm water discharges; the results of such test or other relevant observations; potential sources of non-storm water discharges to the storm sewer; and why adequate tests for such storm sewers were not feasible. Non-storm water discharges to waters of the United States which are not authorized by an NPDES permit are unlawful and must be terminated.

(h) Sediment and Erosion Control—The plan shall identify areas which, due to topography, activities, or other factors, have a high potential for significant soil erosion, and identify structural, vegetative, and/or stabilization measures to be used to limit erosion.

(i) Management of Runoff—The plan shall contain a narrative consideration of the appropriateness of traditional storm water management practices (practices other than those which

control the generation or source(s) of pollutants) used to divert, infiltrate, reuse, or otherwise manage storm water runoff in a manner that reduces pollutants in storm water discharges from the site. The plan shall provide that measures that the permittee determines to be reasonable and appropriate shall be implemented and maintained. The potential of various sources at the facility to contribute pollutants to storm water discharges associated with industrial activity [see Part XI.U.3.a.(2) (Description of Potential Pollutant Sources) of this permit] shall be considered when determining reasonable and appropriate measures. Appropriate measures or equivalent measures may include: vegetative swales and practices, reuse of collected storm water (such as for a process or as an irrigation source), inlet controls (such as oil/water separators), snow management activities, infiltration devices, and wet detention/retention devices.

(4) Comprehensive Site Compliance Evaluation. Qualified personnel shall conduct site compliance evaluations at appropriate intervals specified in the plan, but in no case less than once a year. Where compliance evaluation schedules overlap with inspections required under XI.U.3.a.(3)(d) of this section, the compliance evaluation may be conducted in place of one such inspection. Such evaluations shall provide:

(a) Areas contributing to a storm water discharge associated with industrial activity shall be visually inspected for evidence of, or the potential for, pollutants entering the drainage system. Measures to reduce pollutant loadings shall be evaluated to determine whether they are adequate and properly implemented in accordance with the terms of the permit or whether additional control measures are needed. Structural storm water management measures, sediment and erosion control measures, and other structural pollution prevention measures identified in the plan shall be observed to ensure that they are operating correctly. A visual inspection of equipment needed to implement the plan, such as spill response equipment, shall be made.

(b) Based on the results of the evaluation, the description of potential pollutant sources identified in the plan in accordance with Part XI.U.3.a.(2) (Description of Potential Pollutant Sources) of this permit and pollution prevention measures and controls identified in the plan in accordance with paragraph XI.U.3.a.(3) (Measures and Controls) of this permit shall be revised as appropriate within 2 weeks of such inspection and shall provide for implementation of any changes to the plan in a timely manner, but in no case more than 12 weeks after the inspection.

(c) A report summarizing the scope of the evaluation, personnel making the evaluation, the date(s) of the evaluation, major observations relating to the implementation of the storm water pollution prevention plan, and actions taken in accordance with paragraph XI.U.3.a.(4)(d) (above) of the permit shall be made and retained as part of the storm water pollution prevention plan for at least 3 years from the date of the evaluation. The report shall identify any incidents of noncompliance. Where a report does not identify any incidents of noncompliance, the report shall contain a certification that the facility is in compliance with the storm water pollution prevention plan and this permit. The report shall be signed in accordance with Part VII.G. (Signatory Requirements) of this permit.

(d) The storm water pollution prevention plan must describe the scope and content of the comprehensive site evaluations that qualified personnel will conduct to (1) confirm the accuracy of the description of potential sources contained in the plan, (2) determine the effectiveness of the plan, and (3) assess compliance with the terms and conditions of the permit. The individual or individuals who will conduct the evaluations must be identified in the plan and should be members of the pollution prevention team, as identified in Part XI.U.3.a.(1) (Pollution Prevention Team).

4. Numeric Effluent Limitations

There are no additional numeric effluent limitations beyond those described in Part V.B of this permit.

5. Monitoring and Reporting Requirements

a. *Analytical Monitoring Requirements.* During the period beginning [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] and the period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance], permittees with grain mill and fats and oils products facilities must monitor their storm water discharges associated with industrial activity at least quarterly (4 times per year) during years 2 and 4 except as provided in paragraphs 5.a.(3) (Sampling Waiver), 5.a.(4) (Representative Discharge), and 5.a.(5) (Alternative Certification). Grain mill and fats and oils products facilities are required to monitor their storm water discharges for the pollutants of concern listed in Table U–1 or U–2 below. Facilities must report in accordance with 5.b. (Reporting). In addition to the parameters listed in Table U–1 or U–2 below, the permittee shall provide the date and duration (in hours) of the storm event(s) sampled; rainfall measurements or estimates (in inches) of the storm event that generated the sampled runoff; the duration between the storm event sampled and the end of the previous measurable (greater than 0.1 inch rainfall) storm event; and an estimate of the total volume (in gallons) of the discharge sampled.

TABLE U–1.—GRAIN MILL PRODUCTS

Pollutant of concern	Cut-off concentration (mg/L)
Total Suspended Solids	100

TABLE U–2.—FATS AND OILS PRODUCTS MONITORING REQUIREMENTS

Pollutant of concern	Cut-off concentration (mg/L)
Biochemical Oxygen Demand (BOD_5)	30
Chemical Oxygen Demand (COD)	120
Nitrate Plus Nitrite Nitrogen	0.68
Total Suspended Solids	100

(1) Monitoring Periods. Grain mill and fats and oils products facilities shall monitor samples collected during the sampling periods of: January to March, April to June, July to September, and October to December for the years specified in paragraph a. (above).

(2) Sample Type. A minimum of one grab sample shall be taken. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The required 72-hour storm event interval is waived where the preceding measurable storm event did not result in a measurable discharge from the facility. The required 72-hour storm event interval may also be waived where the permittee documents that less than a 72-hour interval is representative for local storm events during the season when sampling is being conducted. The grab sample shall be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first

hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable. If storm water discharges associated with industrial activity commingle with process or non-process water, then where practicable permittees must attempt to sample the storm water discharge before it mixes with the non-storm water discharge.

(3) Sampling Waiver.

(a) Adverse Conditions—When a discharger is unable to collect samples within a specified sampling period due to adverse climatic conditions, the discharger shall collect a substitute sample from a separate qualifying event in the next period and submit the data along with data for the routine sample in that period. Adverse weather conditions that may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(b) Low Concentration Waiver—When the average concentration for a pollutant calculated from all monitoring data collected from an outfall during the monitoring period [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] is less than the corresponding value for that pollutant listed in Table U–1 under the column Monitoring Cut-off Concentration, a facility may waive monitoring and reporting requirements in the monitoring period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance]. The facility must submit to the Director, in lieu of the monitoring data, a certification that there has not been a significant change in industrial activity or the pollution prevention measures in area of the facility which drains to the outfall for which sampling was waived.

(c) When a discharger is unable to conduct quarterly chemical storm water sampling at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirements as long as the facility remains inactive and unstaffed. The facility must submit to the Director, in lieu of monitoring data, a certification statement on the DMR stating that the site is inactive and unstaffed so that collecting a sample during a qualifying event is not possible.

(4) Representative Discharge. When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may test the effluent of one of such outfalls and report that the quantitative data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan. The permittee shall include the description of the location of the outfalls, explanation of why outfalls are expected to discharge substantially identical effluents, and estimate of the size of the drainage area and runoff coefficient with the Discharge Monitoring Report.

(5) Alternative Certification. A discharger is not subject to the monitoring requirements of this section provided the discharger makes a certification for a given outfall, or on a pollutant-by-pollutant basis in lieu of monitoring reports required under paragraph *b* below, under penalty of law, signed in accordance with Part VII.G. (Signatory Requirements), that material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, industrial machinery or operations, or significant materials from past industrial activity, that are located in areas of the facility within the drainage area of the outfall are not presently exposed to storm water and are not expected to be exposed to storm water for the certification period. Such certification must be retained in the storm water pollution prevention plan, and submitted to EPA in accordance with Part VI.C. of this permit. In the case of certifying that a pollutant is not present, the permittee must submit the certification along with the monitoring reports required under paragraph *(b)* below. If the permittee cannot certify for an entire period, they must submit the date exposure was eliminated and any monitoring required up until that date. This certification option is not applicable to compliance monitoring requirements associated with effluent limitations.

b. Reporting. Permittees with grain mill and fats and oils products facilities shall submit monitoring results for each outfall associated with industrial activity [or a certification in accordance with Sections (3), (4), or (5) above] obtained during the reporting period beginning [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] on Discharge Monitoring Report Form(s) postmarked no later than the 31st day of the following March [insert the date 2 years after permit issuance]. Monitoring results (or a certification in accordance with Sections (3), (4), or (5) above] obtained during the period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance] shall be submitted on Discharge Monitoring Report Form(s) postmarked no later than the 31st day of the following March. For each outfall, one signed Discharge Monitoring Report form must be submitted to the Director per storm event sampled. Signed copies of Discharge Monitoring Reports, or said certifications, shall be submitted to the Director of the NPDES program at the address of the appropriate Regional Office listed in Part VI.G. of the fact sheet to this permit.

(1) Additional Notification. In addition to filing copies of discharge monitoring reports in accordance with paragraph b (above) food and kindred products, facilities with at least one storm water discharge associated with industrial activity through a large or medium municipal separate storm sewer system (systems serving a population of 100,000 or more) must submit signed copies of discharge monitoring reports to the operator of the municipal separate storm sewer system in accordance with the dates provided in paragraph b (above).

a. Quarterly Visual Examination of Storm Water Quality. Facilities shall perform and document a visual examination of a storm water discharge associated with industrial activity from each outfall, except discharges exempted below. The examination(s) must be made at least once in each of the following 3-month periods: January through March, April through June, July through September, and October through December. The examination shall be made during daylight hours unless there is insufficient rainfall or snow melt to produce a runoff event.

(1) Examinations shall be made of a grab sample collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 1 hour) of

when the runoff or snowmelt begins discharging. The examinations shall document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on the samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. Where practicable, the same individual should carry out the collection and examination of discharges for entire permit term.

(2) Visual examination reports must be maintained onsite in the pollution prevention plan. The report shall include the examination date and time, examination personnel, the nature of the discharge (i.e., runoff or snow melt), visual quality of the storm water discharge (including observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution), and probable sources of any observed storm water contamination.

(3) When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may collect a sample of effluent of one of such outfalls and report that the examination data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area (e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)) shall be provided in the plan.

(4) When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the records of the visual examinations. Adverse weather conditions which may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(5) When a discharger is unable to conduct visual storm water examinations at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirement as long as the facility remains inactive and unstaffed. The facility must maintain a certification with the pollution prevention plan stating that the site is inactive and unstaffed so that performing visual examinations during a qualifying event is not feasible.

V. Storm Water Discharges Associated With Industrial Activity From Textile Mills, Apparel, and Other Fabric Product Manufacturing Facilities

1. Discharges Covered Under This Section

The requirements listed under this section shall apply to storm water discharges from the following activities: Textile Mill Products, of and regarding facilities and establishments engaged in the preparation of fiber and subsequent manufacturing of yarn, thread, braids, twine, and cordage, the manufacturing of broadwoven fabrics, narrow woven fabrics, knit fabrics, and carpets and rugs from yarn; processes involved in the dyeing and finishing of fibers, yarn fabrics, and knit apparel; the integrated manufacturing of knit apparel and other finished articles of yarn; the manufacturing of felt goods (wool), lace goods, nonwoven fabrics, miscellaneous textiles, and other apparel products (generally described by SIC codes 22 and 23).

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

2. Special Conditions

a. Prohibition of Non-storm Water Discharges.

(1) In addition to the general prohibition of non-storm waster discharges at Part III A.2 of this permit to discharges of wastewater, such as wastewater as a result of wet processing, wastewaters resulting from any processes relating to the production process, reused or recycled water, and waters used in cooling towers are prohibited under this permit. Operators of such discharges to waters of the United States, must obtain coverage under a separate NPDES permit.

3. Storm Water Pollution Prevention Plan Requirements

a. Contents of Plan. The plan shall include, at a minimum, the following items:

(1) Pollution Prevention Team. Each plan shall identify a specific individual or individuals within the facility organization as members of a storm water Pollution Prevention Team who are responsible for developing the storm water pollution prevention plan and assisting the facility or plant manager in its implementation, maintenance, and revision. The plan shall clearly identify the responsibilities of each team member. The activities and responsibilities of the team shall address all aspects of the facility's storm water pollution prevention plan.

(2) Description of Potential Pollutant Sources. Each plan shall provide a description of potential sources which may reasonably be expected to add significant amounts of pollutants to storm water discharges or which may result in the discharge of pollutants during dry weather from separate storm sewers draining the facility. Each plan shall identify all activities and significant materials which may potentially be significant pollutant sources. Each plan shall include, at a minimum:

(a) Drainage.

(i) A site map indicating an outline of the portions of the drainage area of each storm water outfall that are within the facility boundaries, each existing structural control measure to reduce pollutants in storm water runoff, surface water bodies, locations where significant materials are exposed to precipitation, locations where major spills or leaks identified under Part XI.V.3.a.(2)(c) (Spills and Leaks) of this permit have occurred, and the locations of the following activities where such activities are exposed to precipitation:

loading/unloading areas, locations used for the treatment, storage or disposal of wastes, liquid storage tanks or silos, bulk storage areas that may exist, processing areas and storage areas, fueling stations, vehicle and equipment maintenance and/or cleaning areas. The map must indicate the outfall locations and the types of discharges contained in the drainage areas of the outfalls.

(ii) For each area of the facility that generates storm water discharges associated with industrial activity with a reasonable potential for containing significant amounts of pollutants, a prediction of the direction of flow, and an identification of the types of pollutants which are likely to be present in storm water discharges associated with industrial activity. Factors to consider include the toxicity of chemical; quantity of chemicals used, produced or discharged; the likelihood of contact with storm water; and history of significant leaks or spills of toxic or hazardous pollutants. Flows with a significant potential for causing erosion shall be identified.

(b) Inventory of Exposed Materials—An inventory of the types of materials handled at the site that potentially may be exposed to precipitation. Such inventory shall include a narrative description of significant materials that have been handled, treated, stored or disposed in a manner to allow exposure to storm water between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; method and location of onsite storage or disposal; materials management practices employed to minimize contact of materials with storm water runoff between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; the location and a description of existing structural and nonstructural control measures to reduce pollutants in storm water runoff; and a description of any treatment the storm water receives.

(c) Spills and Leaks—A list of significant spills and significant leaks of toxic or hazardous pollutants that occurred at areas that are exposed to precipitation or that otherwise drain to a storm water conveyance at the facility after the date of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit. Such list shall be updated as appropriate during the term of the permit.

(d) Sampling Data—A summary of existing discharge sampling data describing pollutants in storm water discharges from the facility, including a summary of sampling data collected during the term of this permit.

(e) Risk Identification and Summary of Potential Pollutant Sources—A narrative description of the potential pollutant sources from the following activities: loading and unloading operations; outdoor storage activities; outdoor manufacturing or processing activities; significant dust or particulate generating processes; onsite waste disposal practices; industry-specific significant materials and industrial activities (e.g., backwinding, beaming, bleaching, backing, bonding carbonizing, carding, cut and sew operations, desizing, drawing, dyeing flocking, fulling, knitting, mercerizing, opening, packing, plying, scouring, slashing, spinning, synthetic-felt processing, textile waste processing, tufting, turning, weaving, web forming, winging, yarn spinning, and yarn texturing). The description shall specifically list any significant potential source of pollutants at the site and for each potential source, any pollutant or pollutant parameter (e.g., biochemical oxygen demand, etc.) of concern shall be identified.

(3) Measures and Controls. Each facility covered by this permit shall develop a description of storm water management controls appropriate for the facility, and implement such controls. The appropriateness and priorities of controls in a plan shall reflect identified potential sources of pollutants at the facility. The description of storm water management controls shall address the following minimum components, including a schedule for implementing such controls:

(a) Good Housekeeping—Good housekeeping requires the maintenance of areas which may contribute pollutants to storm water discharges in a clean, orderly manner. The following areas must be specifically addressed, when applicable at the facility:

(i) Material Storage Areas—All stored and containerized materials (fuels, petroleum products, solvents, dyes, etc.) must be stored in a protected area, away from drains and clearly labeled. The plan must describe measures that prevent or minimize contamination of storm water runoff from such storage areas. The facility should specify which materials are stored indoors and must provide a description of the containment area or enclosure for those materials which are stored outdoors. Above ground storage tanks, drums, and barrels permanently stored outside must be delineated on the site map with a description of the appropriated containment measures in place to prevent leaks and spills. The facility may consider an inventory control plan to prevent excessive purchasing, storage, and handling of potentially hazardous substances. In the case of storage of empty chemical drums and containers, facilities should employ practices which ensure that barrels are clean and residuals are not subject to contact with storm water, such practices may include triple-rinsing containers. The discharge waters from such washings must be collected and disposed of properly.

(ii) Material Handling Area—The plan must describe measures that prevent or minimize contamination of the storm water runoff from materials handling operations and areas. The facility may consider the use of spill and overflow protection; covering fueling areas; covering and enclosing areas where the transfer of materials may occur. Where applicable, the plan must address the replacement or repair of leaking connections, valves, transfer lines and pipes that may carry chemicals, dyes, or wastewater.

(iii) Fueling Areas—The plan must describe measures that prevent or minimize contamination of the storm water runoff from fueling areas. The facility may consider covering the fueling area, using spill and overflow protection, minimizing runon of storm water to the fueling area, using dry cleanup methods, and/or collecting the storm water runoff and providing treatment or recycling.

(iv) Above Ground Storage Tank Areas—The plan must describe measures that prevent or minimize contamination of the storm water runoff from above ground storage tank areas. The facility must consider storage tanks and their associated piping and valves. The facility may consider regular cleanup of these areas, preparation of a spill prevention control and countermeasure program, provide spill and overflow protection, minimizing runon of storm water from adjacent areas, restrict access to the area, insertion of filters in adjacent catch basins, provide absorbent booms in unbermed fueling areas, use of dry cleanup methods, and permanently sealing drains within critical areas that may discharge to a storm drain.

(b) Preventive Maintenance—A preventive maintenance program shall involve timely inspection and maintenance of storm water management devices (e.g., cleaning oil/water separators, sediment traps, catch basins, infiltration devices, ponds) as well as inspecting and testing facility equipment and systems to uncover conditions that could cause breakdowns

or failures resulting in discharges of pollutants to surface waters, and ensuring appropriate maintenance of such equipment and systems.

(c) Spill Prevention and Response Procedures—Areas where potential spills which can contribute pollutants to storm water discharges can occur, and their accompanying drainage points shall be identified clearly in the storm water pollution prevention plan. Where appropriate, specifying material handling procedures, storage requirements, and use of equipment such as diversion valves in the plan should be considered. Procedures for cleaning up spills shall be identified in the plan and made available to the appropriate personnel. The necessary equipment to implement a clean up should be available to personnel.

(d) Inspections—Qualified facility personnel shall be identified to inspect designated equipment and areas of the facility at appropriate intervals specified in the plan. Inspection intervals are to occur on a monthly basis. Inspections of this nature shall include, but not be limited to, the following areas: all containment and storage areas, transfer and transmission lines, spill prevention, good housekeeping practices, management of process waste products, all structural and nonstructural management practices. A set of tracking or follow-up procedures shall be used to ensure that appropriate actions are taken in response to the inspections. Records of inspections shall be maintained.

(e) Employee Training—Employee training programs shall inform personnel responsible for implementing activities identified in the storm water pollution prevention plan or otherwise responsible for storm water management at all levels of responsibility of the components and goals of the storm water pollution prevention plan. Training should address topics such as spill response, good housekeeping and material management practices. The pollution prevention plan shall identify dates for such training to take place at least annually (once per calendar year). Employee training must, at a minimum address the following areas when applicable to a facility: use of reused/recycled waters; solvents management; proper disposal of dyes; proper disposal of petroleum products and spent lubricants; spill prevention and control; fueling procedures; and general good housekeeping practices. Employees, independent contractors, and customers must be informed about BMPs and be required to perform in accordance with these practices. Copies of BMPs and any specific management plans, including emergency phone numbers, shall be posted in the work areas.

(f) Recordkeeping and Internal Reporting Procedures—A description of incidents (such as spills, or other discharges), along with other information describing the quality and quantity of storm water discharges shall be included in the plan required under this part. Inspections and maintenance activities shall be documented and records of such activities shall be incorporated into the plan.

(g) Non-storm Water Discharges.

(i) The plan shall include a certification that the discharge has been tested or evaluated for the presence of non-storm water discharges. The certification shall include the identification of potential significant sources of non-storm water at the site, a description of the results of any test and/or evaluation for the presence of non-storm water discharges, the evaluation criteria or testing method used, the date of any testing and/or evaluation, and the onsite drainage points that were directly observed during the test. Certifications shall be signed in accordance with Part VII.G. of this permit. Such certification may not be feasible if the facility operating the storm water discharge associated with industrial activity does not have access to an outfall, manhole, or other point of access to the ultimate conduit which receives the discharge. In such cases, the source identification section of the storm water pollution prevention plan shall indicate why the certification required by this part was not feasible, along with the identification of potential significant sources of non-storm water at the site. A discharger that is unable to provide the certification required by this paragraph must notify the Director in accordance with paragraph XI.V.3.a.(3)(g)(iii) (below).

(ii) Except for flows from fire fighting activities, sources of non-storm water listed in Part III.A.2. of this permit that are combined with storm water discharges associated with industrial activity must be identified in the plan. The plan shall identify and ensure the implementation of appropriate pollution prevention measures for the non-storm water component(s) of the discharge.

(iii) Failure to Certify—Any facility that is unable to provide the certification required (testing for non-storm water discharges), must notify the Director by [Insert date 270 days after permit issuance] or, for facilities which begin to discharge storm water associated with industrial activity after [Insert date 270 days after permit issuance], 180 days after submitting an NOI to be covered by this permit. If the failure to certify is caused by the inability to perform adequate tests or evaluations, such notification shall describe: the procedure of any test conducted for the presence of non-storm water discharges; the results of such test or other relevant observations; potential sources of non-storm water discharges to the storm sewer; and why adequate tests for such storm sewers were not feasible. Non-storm water discharges to waters of the United States which are not authorized by an NPDES permit are unlawful, and must be terminated.

(h) Sediment and Erosion Control—The plan shall identify areas which, due to topography, activities, or other factors, have a high potential for significant soil erosion, and identify structural, vegetative, and/or stabilization measures to be used to limit erosion.

(i) Management of Runoff—The plan shall contain a narrative consideration of the appropriateness of traditional storm water management practices (practices other than those which control the generation or source(s) of pollutants) used to divert, infiltrate, reuse, or otherwise manage storm water runoff in a manner that reduces pollutants in storm water discharges from the site. The plan shall provide that measures that the permittee determines to be reasonable and appropriate shall be implemented and maintained. The potential of various sources at the facility to contribute pollutants to storm water discharges associated with industrial activity [see paragraph XI.V.3.a.(2) of this section (Description of Potential Pollutant Sources)] shall be considered when determining reasonable and appropriate measures. Appropriate measures or other equivalent measures may include: vegetative swales and practices, reuse of collected storm water (such as for a process or as an irrigation source), inlet controls (such as oil/water separators), snow management activities, infiltration devices, and wet detention/retention devices.

(4) Comprehensive Site Compliance Evaluation. Qualified personnel shall conduct site compliance evaluations at appropriate intervals specified in the plan, but in no case less than once a year. Such evaluations shall provide:

(a) Areas contributing to a storm water discharge associated with industrial activity (storage tank areas, waste disposal and storage areas, dumpsters and open containers stored outside, materials storage areas, engine maintenance and repair areas, material handling areas, and loading dock areas) shall be visually inspected for evidence of, or the potential for, pollutants

entering the drainage system. Measures to reduce pollutant loadings shall be evaluated to determine whether they are adequate and properly implemented in accordance with the terms of the permit or whether additional control measures are needed. Structural storm water management measures, sediment and erosion control measures, and other structural pollution prevention measures identified in the plan shall be observed to ensure that they are operating correctly. A visual inspection of equipment needed to implement the plan, such as spill response equipment, shall be made.

(b) Based on the results of the evaluation, the description of potential pollutant sources identified in the plan in accordance with paragraph XI.V.3.a.(2) of this section (Description of Potential Pollutant Sources) and pollution prevention measures and controls identified in the plan in accordance with paragraph XI.V.3.a.(3) of this section (Measures and Controls) shall be revised as appropriate within 2 weeks of such evaluation and shall provide for implementation of any changes to the plan in a timely manner, but in no case more than 12 weeks after the evaluation.

(c) A report summarizing the scope of the evaluation, personnel making the evaluation, the date(s) of the evaluation, major observations relating to the implementation of the storm water pollution prevention plan, and actions taken in accordance with paragraph XI.V.3.a.(4)(b) (above) of the permit shall be made and retained as part of the storm water pollution prevention plan for at least 3 years from the date of the evaluation. The report shall identify any incidents of noncompliance. Where a report does not identify any incidents of noncompliance, the report shall contain a certification that the facility is in compliance with the storm water pollution prevention plan and this permit. The report shall be signed in accordance with Part VII.G. (Signatory Requirements) of this permit.

(d) Where compliance evaluation schedules overlap with inspections required under 3.a.(3)(d), the compliance evaluation may be conducted in place of one such inspection.

4. Numeric Effluent Limitations

There are no additional numeric effluent limitations beyond those described in Part V.B of this permit.

5. Monitoring and Reporting Requirements

a. Quarterly Visual Examination of Storm Water Quality. Facilities shall perform and document a visual examination of a representative storm water discharge associated with industrial activity from each outfall, except discharges exempted below. The examination must be made at least once in each designated period [described in *(1)*, below] during daylight hours unless there is insufficient rainfall or snow melt to produce a runoff event.

(1) Examinations shall be conducted in each of the following periods for the purposes of visually inspecting storm water quality associated with storm water runoff or snow melt: January through March; April through June; July through September; and October through December.

(2) Examinations shall be made of samples collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed one hour) of when the runoff or snowmelt begins discharging. The examinations shall document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on the samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. Whenever practicable the same individual will carry out the collection and examination of discharges for the life of the permit.

When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the records of the visual examination. Adverse weather conditions which may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(3) Visual examination reports must be maintained in the pollution prevention plan. The report shall include the examination date and time, examination personnel, the nature of the discharge (i.e., runoff or snow melt), visual quality of the storm water discharge (including observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution), and probable sources of any observed storm water contamination.

(4) When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may collect a sample of effluent of one of such outfalls and report that the examination data also applies to the substantially identical outfalls provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and an explanation in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

(5) When a discharger is unable to conduct visual storm water examinations at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirement as long as the facility remains inactive and unstaffed. The facility must maintain a certification with the pollution prevention plan stating that the site is inactive and unstaffed so that performing visual examinations during a qualifying event is not feasible.

W. Storm Water Discharges Associated With Industrial Activity From Wood and Metal Furniture and Fixture Manufacturing Facilities

1. Discharges Covered Under This Section.

The requirements listed under this section shall apply to storm water discharges associated with industrial activities from facilities involved in the manufacturing of: wood kitchen cabinets (generally described by SIC code 2434); household furniture (generally described by SIC code 251); office furniture (generally described by SIC code 252); public buildings and related furniture (generally described by SIC code 253); partitions, shelving, lockers, and office and store fixtures (generally described by SIC code 254); and miscellaneous furniture and fixtures (generally described by SIC code 259).

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

2. Special Conditions

a. Prohibition of Non-storm Water Discharges. This section does not cover any discharge subject to process wastewater effluent limitation guidelines, including storm water that combines with process wastewater.

3. Storm Water Pollution Prevention Plan Requirements

a. Contents of Plan. The plan shall include, at a minimum, the following items:

(1) Pollution Prevention Team. Each plan shall identify a specific individual or individuals within the facility organization as members of a storm water Pollution Prevention Team that are responsible for developing the storm water pollution prevention plan and assisting the facility or plant manager in its implementation, maintenance, and revision. The plan shall clearly identify the responsibilities of each team member. The activities and responsibilities of the team shall address all aspects of the facility's storm water pollution prevention plan.

(2) Description of Potential Pollutant Sources. Each plan shall provide a description of potential sources which may reasonably be expected to add significant amounts of pollutants to storm water discharges or which may result in the discharge of pollutants during dry weather from separate storm sewers draining the facility. Each plan shall identify all activities and significant materials which may potentially be significant pollutant sources. Each plan shall include, at a minimum:

(a) Drainage.

(i) A site map indicating an outline of the portions of the drainage area of each storm water outfall that are within the facility boundaries, each existing structural control measure to reduce pollutants in storm water runoff, surface water bodies, locations where significant materials are exposed to precipitation, locations where major spills or leaks identified under Part XI.W.3.a.(2)(c) (Spills and Leaks) of this permit have occurred, and the locations of the following activities where such activities are exposed to precipitation: fueling stations; vehicle and equipment maintenance and/or cleaning areas; loading and unloading areas; material storage (including tanks or other vessels used for liquid or waste storage) areas; outdoor material processing areas; areas where wastes are treated, stored, or disposed; access roads; and rail spurs. The map must indicate the outfall locations and the types of discharges contained in the drainage areas of the outfalls.

(ii) For each area of the facility that generates storm water discharges associated with industrial activity with a reasonable potential for containing significant amounts of pollutants, a prediction of the direction of flow, and an identification of the types of pollutants which are likely to be present in storm water discharges associated with industrial activity. Factors to consider include the toxicity of the chemical; quantity of chemicals used, produced or discharged; the likelihood of contact with storm water; and history of significant leaks or spills of toxic or hazardous pollutants. Flows with a significant potential for causing erosion shall be identified.

(b) Inventory of Exposed Materials—An inventory of the types of materials handled at the site that potentially may be exposed to precipitation. Such inventory shall include a narrative description of significant materials that have been handled, treated, stored or disposed in a manner to allow exposure to storm water between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; method and location of onsite storage or disposal; materials management practices employed to minimize contact of materials with storm water runoff between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; the location and a description of existing structural and nonstructural control measures to reduce pollutants in storm water runoff; and a description of any treatment the storm water receives.

(c) Spills and Leaks—A list of significant spills and significant leaks of toxic or hazardous pollutants that occurred at areas that are exposed to precipitation or that otherwise drain to a storm water conveyance at the facility after the date of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit. Such list shall be updated as appropriate during the term of the permit.

(d) Sampling Data—A summary of existing discharge sampling data describing pollutants in storm water discharges from the facility, including a summary of sampling data collected during the term of this permit.

(e) Risk Identification and Summary of Potential Pollutant Sources—A narrative description of the potential pollutant sources from the following activities: loading and unloading operations; outdoor storage activities; outdoor manufacturing or processing activities; significant dust or particulate generating processes; and onsite waste treatment, storage, or disposal practices. The description shall specifically list any significant potential source of pollutants at the site and for each potential source, any pollutant or pollutant parameter (e.g., biochemical oxygen demand, etc.) of concern shall be identified.

(3) Measures and Controls. Each facility covered by this permit shall develop a description of storm water management controls appropriate for the facility, and implement such controls. The appropriateness and priorities of controls in a plan shall reflect identified potential sources of pollutants at the facility. The description of storm water management controls shall address the following minimum components, including a schedule for implementing such controls:

(a) Good Housekeeping—Good housekeeping requires the maintenance of areas which may contribute pollutants to storm water discharges in a clean, orderly manner.

(b) Preventive Maintenance—A preventive maintenance program shall involve timely inspection and maintenance of storm water management devices (e.g., cleaning oil/water separators, catch basins) as well as inspecting and testing facility equipment and systems to uncover conditions that could cause breakdowns or failures resulting in discharges of pollutants to surface waters, and ensuring appropriate maintenance of such equipment and systems.

(c) Spill Prevention and Response Procedures—Areas where potential spills which can contribute pollutants to storm water discharges can occur, and their accompanying drainage points shall be identified clearly in the storm

water pollution prevention plan. Where appropriate, specifying material handling procedures, storage requirements, and use of equipment such as diversion valves in the plan should be considered. Procedures for cleaning up spills shall be identified in the plan and made available to the appropriate personnel. The necessary equipment to implement a clean up should be available to personnel.

(d) Inspections—In addition to the comprehensive site compliance evaluation required under Part XI.W.3.a.(4), of this permit, qualified facility personnel shall be identified to inspect the following on a quarterly basis: the integrity of storm water discharge diversions, conveyance systems, sediment control and collection systems, and containment structures; vegetative BMPs to determine if soil erosion has occurred; and material handling and storage areas and other potential sources of pollution for evidence of actual or potential pollutant discharges of contaminated storm water. Information must be maintained onsite and include the inspection date and time and the name of personnel conducting the visual inspection. The pollution prevention plan must be updated based on the results of each inspection. A set of tracking or follow-up procedures shall be used to ensure that appropriate actions are taken in response to the inspections. Records of inspections shall be maintained. The use of a checklist developed by the facility is encouraged.

(e) Employee Training—Employee training programs shall inform personnel responsible for implementing activities identified in the storm water pollution prevention plan or otherwise responsible for storm water management at all levels of responsibility of the components and goals of the storm water pollution prevention plan. Training should address topics such as spill response, good housekeeping and material management practices. The pollution prevention plan shall identify periodic dates for such training.

(f) Recordkeeping and Internal Reporting Procedures—A description of incidents (such as spills, or other discharges), BMP inspection and maintenance activities, along with other information describing the quality and quantity of storm water discharges shall be included in the plan required under this part. Inspections and maintenance activities shall be documented and records of such activities shall be incorporated into the plan. Ineffective BMPs must be reported and the date of their corrective action noted.

(g) Non-storm Water Discharges.

(i) The plan shall include a certification that the discharge has been tested or evaluated for the presence of non-storm water discharges. The certification shall include the identification of potential significant sources of non-storm water at the site, a description of the results of any test and/or evaluation for the presence of non-storm water discharges, the evaluation criteria or testing method used, the date of any testing and/or evaluation, and the onsite drainage points that were directly observed during the test. Certifications shall be signed in accordance with Part VII.G. of this permit. Such certification may not be feasible if the facility operating the storm water discharge associated with industrial activity does not have access to an outfall, manhole, or other point of access to the ultimate conduit which receives the discharge. In such cases, the source identification section of the storm water pollution prevention plan shall indicate why the certification required by this part was not feasible, along with the identification of potential significant sources of non-storm water at the site. A discharger that is unable to provide the certification required by this paragraph must notify the Director in accordance with paragraph XI.W.3.a.(3)(g)(iii) (below).

(ii) Except for flows from fire fighting activities, sources of non-storm water listed in Part III.A.2. (Prohibition of Non-storm Water Discharges) of this permit that are combined with storm water discharges associated with industrial activity must be identified in the plan. The plan shall identify and ensure the implementation of appropriate pollution prevention measures for the non-storm water component(s) of the discharge.

(iii) Failure to Certify—Any facility that is unable to provide the certification required (testing for non-storm water discharges), must notify the Director by [Insert date 270 days after permit issuance] or, for facilities which begin to discharge storm water associated with industrial activity after [Insert date 270 days after permit issuance], 180 days after submitting an NOI to be covered by this permit. If the failure to certify is caused by the inability to perform adequate tests or evaluations, such notification shall describe: the procedure of any test conducted for the presence of non-storm water discharges; the results of such test or other relevant observations; potential sources of non-storm water discharges to the storm sewer; and why adequate tests for such storm sewers were not feasible. Non-storm water discharges to waters of the United States which are not authorized by an NPDES permit are unlawful, and must be terminated.

(h) Sediment and Erosion Control—The plan shall identify areas which, due to topography, activities, or other factors, have a high potential for significant soil erosion, and identify structural, vegetative, and/or stabilization measures to be used to limit erosion.

(i) Management of Runoff—The plan shall contain a narrative consideration of the appropriateness of traditional storm water management practices (practices other than those which control the generation or source(s) of pollutants) used to divert, infiltrate, reuse, or otherwise manage storm water runoff in a manner that reduces pollutants in storm water discharges from the site. The plan shall provide that measures that the permittee determines to be reasonable and appropriate shall be implemented and maintained. The potential of various sources at the facility to contribute pollutants to storm water discharges associated with industrial activity [see paragraph XI.W.3.a.(2) of this section (Description of Potential Pollutant Sources)] shall be considered when determining reasonable and appropriate measures. Appropriate measures or other equivalent measures may include: vegetative swales and practices, reuse of collected storm water (such as for a process or as an irrigation source), inlet controls (such as oil/water separators), snow management activities, infiltration devices, and wet detention/retention devices.

(4) Comprehensive Site Compliance Evaluation. Qualified personnel shall conduct site compliance evaluations at appropriate intervals specified in the plan, but, in no case less than once a year. Such evaluations shall provide:

(a) Areas contributing to a storm water discharge associated with industrial activity including, but not limited to, coal piles, ash disposal areas, loading/unloading operations, and waste treatment, storage, or disposal locations shall be visually inspected for evidence of, or the potential for, pollutants entering the drainage system. Measures to reduce pollutant loadings shall be evaluated to determine whether they are adequate and properly implemented in accordance with the terms of the permit or whether additional control measures are needed. Structural storm water management measures, sediment and erosion control measures, and other structural pollution prevention measures identified in the plan shall be observed to ensure that they are operating correctly. A visual

inspection of equipment needed to implement the plan, such as spill response equipment, shall be made.

(b) Based on the results of the evaluation, the description of potential pollutant sources identified in the plan in accordance with paragraph XI.W.3.a.(2) of this section (Description of Potential Pollutant Sources) and pollution prevention measures and controls identified in the plan in accordance with paragraph XI.W.3.a.(3) of this section (Measures and Controls) shall be revised as appropriate within 2 weeks of such evaluation and shall provide for implementation of any changes to the plan in a timely manner, but in no case more than 12 weeks after the evaluation.

(c) A report summarizing the scope of the evaluation, personnel making the evaluation, the date(s) of the evaluation, major observations relating to the implementation of the storm water pollution prevention plan, and actions taken in accordance with paragraph XI.W.a.(4)(b) (above) of the permit shall be made and retained as part of the storm water pollution prevention plan for at least 3 years from the date of the evaluation. The report shall identify any incidents of noncompliance. Where a report does not identify any incidents of noncompliance, the report shall contain a certification that the facility is in compliance with the storm water pollution prevention plan and this permit. The report shall be signed in accordance with Part VII.G. (Signatory Requirements) of this permit.

(d) Where compliance evaluation schedules overlap with inspections required under XI.W.3.a.(3)(d), the compliance evaluation may be conducted in place of one such inspection.

4. Numeric Effluent Limitations

There are no additional numeric effluent limitations beyond those described in Part V.B of this permit.

5. Monitoring and Reporting Requirements

a. Monitoring Requirements.

(1) Quarterly Visual Examination of Storm Water Quality. Facilities shall perform and document a visual examination of a storm water discharge associated with industrial activity from each outfall, except discharges exempted below. The examination must be made at least once in each designated period (described in (a), below) during daylight hours unless there is insufficient rainfall or snow melt to produce a runoff event.

(a) Examinations shall be conducted in each of the following periods for the purposes of visually inspecting storm water quality associated with storm water runoff or snow melt: January through March; April through June; July through September; and October through December.

(b) Examinations shall be made of samples collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed one hour) of when the runoff or snowmelt begins discharging. The examinations shall document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on the samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. Whenever practicable the same individual will carry out the collection and examination of discharges for the life of the permit.

(c) When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the records of the visual examination. Adverse weather conditions which may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricanes, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(d) When a discharger is unable to conduct visual storm water examinations at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirement as long as the facility remains inactive and unstaffed. The facility must maintain a certification with the pollution prevention plan stating that the site is inactive and unstaffed so that performing visual examinations during a qualifying event is not feasible.

(e) Visual examination reports must be maintained onsite in the pollution prevention plan. The report shall include the examination date and time, examination personnel, the nature of the discharge (i.e., runoff or snow melt), visual quality of the storm water discharge (including observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution), and probable sources of any observed storm water contamination.

(f) When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may collect a sample of effluent of one of such outfalls and report that the observation data also applies to the substantially identical outfalls provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explaining in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area (e.g., low (under 40 percent), medium (40 to 65 percent) or high (above 65 percent)) shall be provided in the plan.

(g) When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination. Adverse weather conditions which may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

X. Storm Water Discharges Associated With Industrial Activity From Printing and Publishing Facilities

1. Discharges Covered Under This Section

The requirements listed under this section shall apply to storm water discharges associated with industrial activity from the following types of facilities: book printing (SIC Code 2732); commercial printing, lithographic (SIC Code 2752); commercial printing, gravure (SIC Code 2754); commercial printing, not elsewhere classified (SIC Code 2759); and platemaking and related services (SIC Code 2796).

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

2. Special Conditions

There are no additional special conditions beyond those found in Part III. of today's permit.

3. Storm Water Pollution Prevention Plan Requirements

a. Contents of Plan. The plan shall include, at a minimum, the following items:

(1) Pollution Prevention Team. Each plan shall identify a specific individual or individuals within the facility organization as members of a storm water Pollution Prevention Team that are responsible for developing the storm water pollution prevention plan and assisting the facility or plant manager in its implementation, maintenance, and revision. The plan shall clearly identify the responsibilities of each team member. The activities and responsibilities of the team shall address all aspects of the facility's storm water pollution prevention plan.

(2) Description of Potential Pollutant Sources. Each plan shall provide a description of potential sources which may reasonably be expected to add significant amounts of pollutants to storm water discharges or which may result in the discharge of pollutants during dry weather from separate storm sewers draining the facility. Each plan shall identify all activities and significant materials which may potentially be significant pollutant sources. Each plan shall include, at a minimum:

(a) Drainage.

(i) A site map indicating an outline of the portions of the drainage area of each storm water outfall that are within the facility boundaries, each existing structural control measure to reduce pollutants in storm water runoff, surface water bodies, locations where significant materials are exposed to precipitation, locations where major spills or leaks identified under Part XI.X.3.a.(2)(c) (Spills and Leaks) of this section have occurred, and the locations of the following activities where such activities are exposed to precipitation: fueling stations, vehicle and equipment maintenance and/or cleaning areas, loading/unloading areas, locations used for the treatment, storage or disposal of wastes, liquid storage tanks, processing areas and storage areas. Above ground storage tanks, drums, and barrels permanently stored outside must be delineated on the site map. The map must indicate the outfall locations and the types of discharges contained in the drainage areas of the outfalls.

(ii) For each area of the facility that generates storm water discharges associated with industrial activity with a reasonable potential for containing significant amounts of pollutants, a prediction of the direction of flow, and an identification of the types of pollutants which are likely to be present in storm water discharges associated with industrial activity. Factors to consider include the toxicity of the chemical; quantity of chemicals used, produced or discharged; the likelihood of contact with storm water; and history of significant leaks or spills of toxic or hazardous pollutants. Flows with a significant potential for causing erosion shall be identified.

(b) Inventory of Exposed Materials—An inventory of the types of materials handled at the site that potentially may be exposed to precipitation. Such inventory shall include a narrative description of significant materials that have been handled, treated, stored or disposed in a manner to allow exposure to storm water between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; method and location of onsite storage or disposal; materials management practices employed to minimize contact of materials with storm water runoff between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; the location and a description of existing structural and nonstructural control measures to reduce pollutants in storm water runoff; and a description of any treatment the storm water receives.

(c) Spills and Leaks—A list of significant spills and significant leaks of toxic or hazardous pollutants that occurred at areas that are exposed to precipitation or that otherwise drain to a storm water conveyance at the facility after the date of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit. Such list shall be updated as appropriate during the term of the permit.

(d) Sampling Data—A summary of existing discharge sampling data describing pollutants in storm water discharges from the facility, including a summary of sampling data collected during the term of this permit.

(e) Risk Identification and Summary of Potential Pollutant Sources—A narrative description of the potential pollutant sources from the following activities associated with printing, publishing and allied facilities: loading and unloading operations; outdoor storage activities; significant dust or particulate generating processes; and onsite waste disposal practices (i.e., blanket wash). The description shall specifically list any significant potential source of pollutants at the site and for each potential source, any pollutant or pollutant parameter (e.g., oil and grease, scrap metal, etc.) of concern shall be identified.

(3) Measures and Controls. Each facility covered by this permit shall develop a description of storm water management controls appropriate for the facility, and implement such controls. The appropriateness and priorities of controls in a plan shall reflect identified potential sources of pollutants at the facility. The description of storm water management controls shall address the following minimum components, including a schedule for implementing such controls:

(a) Good Housekeeping—Good housekeeping requires the maintenance of areas which may contribute pollutants to storm water discharges in a clean, orderly manner. Areas where good housekeeping should be implemented include:

(i) Material Storage Areas—All stored and containerized materials (skids, pallets, solvents, bulk inks, and hazardous waste, empty drums, portable/mobile containers of plant debris, wood crates, steel racks, fuel oil, etc.) should be stored in a protected area, away from drains and properly labeled. The plan should describe measures that prevent or minimize contamination of the storm water runoff from such storage areas. The facility should specify which materials are stored indoors and must provide a description of the containment area or enclosure for those materials which are stored outdoors. The facility may consider an inventory control plan to prevent excessive purchasing, storage, and handling of potentially hazardous substances. The facility may consider indoor storage of the materials and/or

installation of berming and diking of the area.

(ii) Material Handling Areas—The plan must describe measures that prevent or minimize contamination of the storm water runoff from materials handling operations and areas (i.e., blanket wash, mixing solvents, loading/ unloading materials). The facility may consider the use of spill and overflow protection; covering fuel areas; covering and enclosing areas where the transfer of materials may occur. Where applicable, the plan must address the replacement or repair of leaking connections, valves, transfer lines and pipes that may carry chemicals, or wastewater.

(iii) Fueling Areas—The plan must describe measures that prevent or minimize contamination of the storm water runoff from fueling areas. The facility may consider covering the fueling area, using spill and overflow protection, minimizing runon of storm water to the fueling area, using dry cleanup methods, and/or collecting the storm water runoff and providing treatment or recycling.

(iv) Above Ground Storage Tank Areas—The plan must describe measures that prevent or minimize contamination of the storm water runoff from above ground storage tanks and their associated piping and valves. The facility may consider regular cleanup of these areas, preparation of a spill prevention control and countermeasure program, provide spill and overflow protection, minimizing runon of storm water from adjacent facilities and properties, restrict access to the area, insertion of filters in adjacent catch basins, provide absorbent booms in unbermed fueling areas, use of dry cleanup methods, and permanently sealing drains within critical areas that may discharge to a storm drain.

(b) Preventive Maintenance—A preventive maintenance program shall involve timely inspection and maintenance of storm water management devices (e.g., cleaning oil/ water separators, vegetative swales, secondary containment, catch basins) as well as inspecting and testing facility equipment and systems to uncover conditions that could cause breakdowns or failures resulting in discharges of pollutants to surface waters, and ensuring appropriate maintenance of such equipment and systems.

(c) Spill Prevention and Response Procedures—Areas where potential spills which can contribute pollutants to storm water discharges can occur, and their accompanying drainage points shall be identified clearly in the storm water pollution prevention plan. Where appropriate, specifying material handling procedures, storage requirements, and use of equipment such as diversion valves in the plan should be considered. Procedures for cleaning up spills shall be identified in the plan and made available to the appropriate personnel. The necessary equipment to implement a clean up should be available to personnel.

(d) Inspections—Qualified facility personnel shall be identified to inspect designated equipment and areas of the facility on an annual basis. The following areas shall be included in, but not limited to, all inspections: all containment and material storage areas, fueling areas, loading and unloading areas, equipment cleaning areas. A set of tracking or follow-up procedures shall be used to ensure that appropriate actions are taken in response to the inspections. Records of inspections shall be maintained.

(e) Employee Training—Employee training programs shall inform personnel responsible for implementing activities identified in the storm water pollution prevention plan or otherwise responsible for storm water management at all levels of responsibility of the components and goals of the storm water pollution prevention plan. The pollution prevention plan shall identify how often training will take place, but training should be provided annually. Employee training must, at a minimum, address the following areas when applicable to a facility: spent solvent management; spill prevention and control; used oil management; fueling procedures; and general good housekeeping practices. The pollution prevention plan shall identify periodic dates for such training.

(f) Recordkeeping and Internal Reporting Procedures—A description of incidents (such as spills, or other discharges), along with other information describing the quality and quantity of storm water discharges shall be included in the plan required under this part. Inspections and maintenance activities shall be documented and records of such activities shall be incorporated into the plan.

(g) Non-storm Water Discharges.

(i) The plan shall include a certification that the discharge has been tested or evaluated for the presence of non-storm water discharges. The certification shall include the identification of potential significant sources of non-storm water at the site, a description of the results of any test and/or evaluation for the presence of non-storm water discharges, the evaluation criteria or testing method used, the date of any testing and/or evaluation, and the onsite drainage points that were directly observed during the test. Certifications shall be signed in accordance with Part VII.G. of this permit. Such certification may not be feasible if the facility operating the storm water discharge associated with industrial activity does not have access to an outfall, manhole, or other point of access to the ultimate conduit which receives the discharge. In such cases, the source identification section of the storm water pollution prevention plan shall indicate why the certification required by this part was not feasible, along with the identification of potential significant sources of non-storm water at the site. A discharger that is unable to provide the certification required by this paragraph must notify the Director in accordance with paragraph XI.X.3.a.(3)(g)(iii) (below).

(ii) Except for flows from fire fighting activities, sources of non-storm water listed in Part III.A.2 (Non-storm Water Discharges) of this permit that are combined with storm water discharges associated with industrial activity must be identified in the plan. The plan shall identify and ensure the implementation of appropriate pollution prevention measures for the non-storm water component(s) of the discharge.

(iii) Failure to Certify—Any facility that is unable to provide the certification required (testing for non-storm water discharges), must notify the Director by [Insert date 270 days after permit issuance] or, for facilities which begin to discharge storm water associated with industrial activity after [Insert date 270 days after permit issuance], 180 days after submitting an NOI to be covered by this permit. If the failure to certify is caused by the inability to perform adequate tests or evaluations, such notification shall describe: the procedure of any test conducted for the presence of non-storm water discharges; the results of such test or other relevant observations; potential sources of non-storm water discharges to the storm sewer; and why adequate tests for such storm sewers were not feasible. Non-storm water discharges to waters of the United States which are not authorized by an NPDES permit are unlawful, and must be terminated.

(h) Sediment and Erosion Control—The plan shall identify areas which, due to topography, activities, or other factors, have a high potential for significant soil erosion, and identify structural, vegetative, and/or stabilization measures to be used to limit erosion.

(i) Management of Runoff—The plan shall contain a narrative consideration of the appropriateness of traditional

storm water management practices (practices other than those which control the generation or source(s) of pollutants) used to divert, infiltrate, reuse, or otherwise manage storm water runoff in a manner that reduces pollutants in storm water discharges from the site. The plan shall provide that measures that the permittee determines to be reasonable and appropriate shall be implemented and maintained. The potential of various sources at the facility to contribute pollutants to storm water discharges associated with industrial activity [see paragraph XI.X.3.a.(2) of this section (Description of Potential Pollutant Sources)] shall be considered when determining reasonable and appropriate measures. Appropriate measures or other equivalent measures may include: vegetative swales and practices, reuse of collected storm water (such as for a process or as an irrigation source), inlet controls (such as oil/water separators), snow management activities, infiltration devices, and wet detention/retention devices.

(4) Comprehensive Site Compliance Evaluation. Qualified personnel shall conduct site compliance evaluations at appropriate intervals specified in the plan, but in no case less than once a year. Such evaluations shall provide:

(a) Areas contributing to a storm water discharge associated with industrial activity (including, but not limited to, material handling areas, material storage areas, waste disposal and storage areas, loading/unloading areas) shall be visually inspected for evidence of, or the potential for, pollutants entering the drainage system. Measures to reduce pollutant loadings shall be evaluated to determine whether they are adequate and properly implemented in accordance with the terms of the permit or whether additional control measures are needed. Structural storm water management measures, sediment and erosion control measures, and other structural pollution prevention measures identified in the plan shall be observed to ensure that they are operating correctly. A visual inspection of equipment needed to implement the plan, such as spill response equipment, shall be made.

(b) Based on the results of the evaluation, the description of potential pollutant sources identified in the plan in accordance with paragraph XI.X.3.a.(2) of this section (Description of Potential Pollutant Sources) and pollution prevention measures and controls identified in the plan in accordance with paragraph XI.X.3.a.(3) of this section (Measures and Controls) shall be revised as appropriate within 2 weeks of such evaluation and shall provide for implementation of any changes to the plan in a timely manner, but in no case more than 12 weeks after the evaluation.

(c) A report summarizing the scope of the evaluation, personnel making the evaluation, the date(s) of the evaluation, major observations relating to the implementation of the storm water pollution prevention plan, and actions taken in accordance with paragraph XI.X.3.a.(4)(b) (above) of the permit shall be made and retained as part of the storm water pollution prevention plan for at least 3 years from the date of the evaluation. The report shall identify any incidents of noncompliance. Where a report does not identify any incidents of noncompliance, the report shall contain a certification that the facility is in compliance with the storm water pollution prevention plan and this permit. The report shall be signed in accordance with Part VII.G. (Signatory Requirements) of this permit.

(d) Where compliance evaluation schedules overlap with inspections required under 3.a.(3)(d), the compliance evaluation may be conducted in place of one such inspection.

4. Numeric Effluent Limitations

There are no additional numeric effluent limitations beyond those described in Part V.B. of this permit.

5. Monitoring and Reporting Requirements

a. Monitoring Requirements.

(1) Quarterly Visual Examination of Storm Water Quality. Facilities shall perform and document a visual examination of a storm water discharge associated with industrial activity for each outfall except discharges exempted below. The examination must be made at least once in each designated period [described in *(a)*, below] during daylight hours unless there is insufficient rainfall or snow melt to produce a runoff event.

(a) Examinations shall be conducted in each of the following periods for the purposes of visually inspecting storm water quality associated with storm water runoff or snow melt: January through March; April through June; July through September; and October through December.

(b) Examinations shall be made of a grab sample collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed one hour) of when the runoff or snowmelt begins discharging. The examinations shall document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on the samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. Whenever practicable the same individual will carry out the collection and examination of discharges for the life of the permit.

When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the records of the visual examination. Adverse weather conditions which may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(c) Visual examination reports must be maintained in the pollution prevention plan. The report shall include the examination date and time, examination personnel, the nature of the discharge (i.e., runoff or snow melt), visual quality of the storm water discharge (including observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution), and probable sources of any observed storm water contamination.

(d) When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may collect a sample of effluent of one of such outfalls and report that the examination data also applies to the substantially identical outfalls provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explaining in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the

drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

(e) When a discharger is unable to conduct visual storm water examinations at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirement as long as the facility remains inactive and unstaffed. The facility must maintain a certification with the pollution prevention plan stating that the site is inactive and unstaffed so that performing visual examinations during a qualifying event is not feasible.

Y. Storm Water Discharges Associated With Industrial Activity From Rubber, Miscellaneous Plastic Products, and Miscellaneous Manufacturing Industries

1. Discharges Covered Under This Section

The requirements listed under this section shall apply to all storm water discharges associated with industrial activity from rubber and miscellaneous plastic products manufacturing facilities (SIC major group 30) and miscellaneous manufacturing industries, except jewelry, silverware, and plated ware (SIC major group 39, except 391).

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

2. Special Conditions

Prohibition of Non-storm Water Discharges. Other than as provided in Part III.A. of this permit, non-storm water discharges are not authorized by this section.

3. Storm Water Pollution Prevention Plan Requirements

a. Contents of Plan. The plan shall include, at a minimum, the following items:

(1) Pollution Prevention Team. Each plan shall identify a specific individual or individuals within the facility organization as members of a storm water Pollution Prevention Team that are responsible for developing the storm water pollution prevention plan and assisting the facility or plant manager in its implementation, maintenance, and revision. The plan shall clearly identify the responsibilities of each team member. The activities and responsibilities of the team shall address all aspects of the facility's storm water pollution prevention plan.

(2) Description of Potential Pollutant Sources. Each plan shall provide a description of potential sources which may reasonably be expected to add significant amounts of pollutants to storm water discharges or which may result in the discharge of pollutants during dry weather from separate storm sewers draining the facility. Each plan shall identify all activities and significant materials which may potentially be significant pollutant sources. All rubber manufacturers shall in particular review the use of zinc at their facilities and the possible pathways through which zinc may be discharged in storm water runoff. Each plan shall include, at a minimum:

Drainage.

(i) A site map indicating an outline of the portions of the drainage area of each storm water outfall that are within the facility boundaries, each existing structural control measure to reduce pollutants in storm water runoff, surface water bodies, locations where significant materials are exposed to precipitation, locations where major spills or leaks identified under Part XI.Y.3.a.(2)(c) (Spills and Leaks) of this permit have occurred, and the locations of the following activities where such activities are exposed to precipitation: fueling stations, vehicle and equipment maintenance and/or cleaning areas, loading/unloading areas, locations used for the treatment, storage or disposal of wastes, liquid storage tanks, processing areas and storage areas. The map must indicate the outfall locations and the types of discharges contained in the drainage areas of the outfalls.

(ii) For each area of the facility that generates storm water discharges associated with industrial activity with a reasonable potential for containing significant amounts of pollutants, a prediction of the direction of flow, and an identification of the types of pollutants which are likely to be present in storm water discharges associated with industrial activity. Factors to consider include the toxicity of a chemical; quantity of chemicals used, produced or discharged; the likelihood of contact with storm water; and history of significant leaks or spills of toxic or hazardous pollutants. Flows with a significant potential for causing erosion shall be identified.

(b) Inventory of Exposed Materials—An inventory of the types of materials handled at the site that potentially may be exposed to precipitation. Such inventory shall include a narrative description of significant materials that have been handled, treated, stored or disposed in a manner to allow exposure to storm water between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; method and location of onsite storage or disposal; materials management practices employed to minimize contact of materials with storm water runoff between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; the location and a description of existing structural and nonstructural control measures to reduce pollutants in storm water runoff; and a description of any treatment the storm water receives.

(c) Spills and Leaks—A list of significant spills and significant leaks of toxic or hazardous pollutants that occurred at areas that are exposed to precipitation or that otherwise drain to a storm water conveyance at the facility after the date of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit. Such list shall be updated as appropriate during the term of the permit.

(d) Sampling Data—A summary of existing discharge sampling data describing pollutants in storm water discharges from the facility, including a summary of sampling data collected during the term of this permit.

(e) Risk Identification and Summary of Potential Pollutant Sources—A narrative description of the potential pollutant sources from the following activities: loading and unloading operations; outdoor storage activities; outdoor manufacturing or processing activities; significant dust or particulate generating processes; and onsite waste disposal practices. The description shall specifically list any significant potential source of pollutants at the site and for each potential source, any pollutant or pollutant parameter (e.g., biochemical oxygen demand, etc.) of concern shall be identified.

Measures and Controls. Each facility covered by this permit shall develop a description of storm water management controls appropriate for the facility, and implement such controls. The appropriateness and priorities of controls in a plan shall reflect identified potential sources of pollutants at the facility. Facilities subject to EPCRA Section 313 should note that the special requirements of Part IV.E. of this permit also apply to their facilities. The description of storm water management controls shall address the following minimum components, including a schedule for implementing such controls:

(a) Good Housekeeping—Good housekeeping requires the maintenance of areas which may contribute pollutants to storm water discharges in a clean, orderly manner.

(b) Preventive Maintenance—A preventive maintenance program shall involve timely inspection and maintenance of storm water management devices (e.g., cleaning oil/water separators, catch basins) as well as inspecting and testing facility equipment and systems to uncover conditions that could cause breakdowns or failures resulting in discharges of pollutants to surface waters, and ensuring appropriate maintenance of such equipment and systems.

(c) Spill Prevention and Response Procedures—Areas where potential spills which can contribute pollutants to storm water discharges can occur, and their accompanying drainage points shall be identified clearly in the storm water pollution prevention plan. Where appropriate, specifying material handling procedures, storage requirements, and use of equipment such as diversion valves in the plan should be considered. Procedures for cleaning up spills shall be identified in the plan and made available to the appropriate personnel. The necessary equipment to implement a cleanup should be available to personnel.

(d) Inspections—In addition to or as part of the comprehensive site evaluation required under paragraph XI.Y.3.a.(4) of this section, qualified facility personnel shall be identified to inspect designated equipment and areas of the facility at appropriate intervals specified in the plan. A set of tracking or follow-up procedures shall be used to ensure that appropriate actions are taken in response to the inspections. Records of inspections shall be maintained.

(e) Employee Training—Employee training programs shall inform personnel responsible for implementing activities identified in the storm water pollution prevention plan or otherwise responsible for storm water management at all levels of responsibility of the components and goals of the storm water pollution prevention plan. Training should address topics such as spill response, good housekeeping and material management practices. The pollution prevention plan shall identify periodic dates for such training.

(f) Recordkeeping and Internal Reporting Procedures—A description of incidents (such as spills, or other discharges), along with other information describing the quality and quantity of storm water discharges shall be included in the plan required under this part. Inspections and maintenance activities shall be documented and records of such activities shall be incorporated into the plan.

Non-storm Water Discharges.

(i) The plan shall include a certification that the discharge has been tested or evaluated for the presence of non-storm water discharges. The certification shall include the identification of potential significant sources of non-storm water at the site, a description of the results of any test and/or evaluation for the presence of non-storm water discharges, the evaluation criteria or testing method used, the date of any testing and/or evaluation, and the onsite drainage points that were directly observed during the test. Certifications shall be signed in accordance with Part VII.G. of this permit. Such certification may not be feasible if the facility operating the storm water discharge associated with industrial activity does not have access to an outfall, manhole, or other point of access to the ultimate conduit which receives the discharge. In such cases, the source identification section of the storm water pollution prevention plan shall indicate why the certification required by this part was not feasible, along with the identification of potential significant sources of non-storm water at the site. A discharger that is unable to provide the certification required by this paragraph must notify the Director in accordance with paragraph XI.Y.3.a.(3)(g)(iii) (below).

(ii) Except for flows from fire fighting activities, sources of non-storm water listed in Part III.A.2 (Prohibition of Non-storm Water Discharges) of this permit that are combined with storm water discharges associated with industrial activity must be identified in the plan. The plan shall identify and ensure the implementation of appropriate pollution prevention measures for the non-storm water component(s) of the discharge.

(iii) Failure to Certify—Any facility that is unable to provide the certification required (testing for non-storm water discharges), must notify the Director by [Insert date 270 days after permit issuance] or, for facilities which begin to discharge storm water associated with industrial activity after [Insert date 270 days after permit issuance], 180 days after submitting an NOI to be covered by this permit. If the failure to certify is caused by the inability to perform adequate tests or evaluations, such notification shall describe: the procedure of any test conducted for the presence of non-storm water discharges; the results of such test or other relevant observations; potential sources of non-storm water discharges to the storm sewer; and why adequate tests for such storm sewers were not feasible. Non-storm water discharges to waters of the United States which are not authorized by an NPDES permit are unlawful, and must be terminated.

(h) Sediment and Erosion Control—The plan shall identify areas which, due to topography, activities, or other factors, have a high potential for significant soil erosion, and identify structural, vegetative, and/or stabilization measures to be used to limit erosion.

(i) Management of Runoff—The plan shall contain a narrative consideration of the appropriateness of traditional storm water management practices (practices other than those which control the generation or source(s) of pollutants) used to divert, infiltrate, reuse, or otherwise manage storm water runoff in a manner that reduces pollutants in storm water discharges from the site. The plan shall provide that measures that the permittee determines to be reasonable and appropriate shall be implemented and maintained. The potential of various sources at the facility to contribute pollutants to storm water discharges associated with industrial activity [see paragraph XI.Y.3.a.(2) of this section (Description of Potential Pollutant Sources)] shall be considered when determining reasonable and appropriate measures. Appropriate measures or other equivalent measures may include: vegetative swales and practices, reuse of collected storm water (such as for a process or as an irrigation source), inlet controls (such as oil/water separators), snow management activities, infiltration devices, and wet detention/retention devices.

(j) Special Requirements for All Rubber Products Manufacturers—All rubber products manufacturing facilities shall include specific measures and controls to minimize the discharge of zinc in their storm water discharges. The following possible sources of zinc shall be reviewed and the accompanying BMPs shall be included as appropriate in the storm water pollution prevention plan:

(i) Inadequate Housekeeping—All permittees shall review the handling

and storage of zinc bags at their facilities and consider the following BMPs for the pollution prevention plan: employee training regarding the handling and storage of zinc bags, indoor storage of zinc bags, thorough cleanup of zinc spills without washing the zinc into the storm drain, and the use of 2,500-pound sacks of zinc rather than 50- to 100-pound sacks.

(ii) Zinc in Dumpsters—The following BMPs or equivalent measures shall be considered to reduce discharges of zinc from dumpsters: providing a cover for the dumpster; move the dumpster to an indoors location; or provide a lining for the dumpster.

(iii) Malfunctioning Dust Collectors or Baghouses—Permittees shall review dust collectors and baghouses as possible sources in zinc in storm water runoff. Improperly operating dust collectors or baghouses shall be replaced or repaired as appropriate. The pollution prevention plan shall also provide for regular maintenance of these facilities.

(iv) Grinding Operations—Permittees shall review dust generation from rubber grinding operations at their facility and, as appropriate, install a dust collection system.

(v) Zinc Stearate Coating Operations—Permittees shall include in the pollution prevention plan appropriate measures to prevent and/or clean up drips or spills of zinc stearate slurry which may be released to the storm drain. Alternate compounds to zinc stearate shall also be considered.

(4) Comprehensive Site Compliance Evaluation. Qualified personnel shall conduct site compliance evaluations once a year. Such evaluations shall provide:

(a) Areas contributing to a storm water discharge associated with industrial activity shall be visually inspected for evidence of, or the potential for, pollutants entering the drainage system. Measures to reduce pollutant loadings shall be evaluated to determine whether they are adequate and properly implemented in accordance with the terms of the permit or whether additional control measures are needed. Structural storm water management measures, sediment and erosion control measures, and other structural pollution prevention measures identified in the plan shall be observed to ensure that they are operating correctly. A visual inspection of equipment needed to implement the plan, such as spill response equipment, shall be made.

(b) Based on the results of the evaluation, the description of potential pollutant sources identified in the plan in accordance with paragraph XI.Y.3.a.(2) of this section (Description of Potential Pollutant Sources) and pollution prevention measures and controls identified in the plan in accordance with paragraph XI.Y.3.a.(3) of this section (Measures and Controls) shall be revised as appropriate within 2 weeks of such evaluation and shall provide for implementation of any changes to the plan in a timely manner, but in no case more than 12 weeks after the evaluation.

(c) A report summarizing the scope of the evaluation, personnel making the evaluation, the date(s) of the evaluation, major observations relating to the implementation of the storm water pollution prevention plan, and actions taken in accordance with paragraph XI.Y.3.a.(4)(b) (above) of the permit shall be made and retained as part of the storm water pollution prevention plan for at least 3 years from the date of the evaluation. The report shall identify any incidents of noncompliance. Where a report does not identify any incidents of noncompliance, the report shall contain a certification that the facility is in compliance with the storm water pollution prevention plan and this permit. The report shall be signed in accordance with Part VII.G. (Signatory Requirements) of this permit.

(d) Where compliance evaluation schedules overlap with inspections required under 3.a.(3)(d), the compliance evaluation may be conducted in place of one such inspection.

4. Numeric Effluent Limitations

There are no additional numeric effluent limitations beyond those described in Part V.B of this permit.

5. Monitoring and Reporting Requirements

a. Analytical Monitoring Requirements.
During the period beginning [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] and the period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance], permittees with rubber product manufacturing facilities must monitor their storm water discharges associated with industrial activity at least quarterly (4 times per year) during years 2 and 4 except as provided in paragraphs 6.a.(3) (Sampling Waiver), 6.a.(4) (Representative Discharge), and 6.a.(5) (Alternative Certification). Rubber product manufacturing facilities are required to monitor their storm water discharges for the pollutants of concern listed in Table Y–1 below. Facilities must report in accordance with 6.b. (Reporting). In addition to the parameters listed in Table Y–1 below, the permittee shall provide the date and duration (in hours) of the storm event(s) sampled; rainfall measurements or estimates (in inches) of the storm event that generated the sampled runoff; the duration between the storm event sampled and the end of the previous measurable (greater than 0.1 inch rainfall) storm event; and an estimate of the total volume (in gallons) of the discharge sampled.

TABLE Y–1—MONITORING REQUIREMENTS

Pollutants of concern	Cut-off concentration
Total Recoverable Zinc ...	0.117 mg/L

(1) Monitoring Periods. Rubber product manufacturing facilities shall monitor samples collected during the sampling periods of: January through March, April through June, July through September, and October through December for the years specified in paragraph a. (above).

(2) Sample Type. A minimum of one grab sample shall be taken. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The required 72-hour storm event interval is waived where the preceding measurable storm event did not result in a measurable discharge from the facility. The required 72-hour storm event may also be waived where the permittee documents that less than a 72-hour interval is representative for local storm events during the season when sampling is being conducted. The grab sample shall be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable. If storm water discharges associated with industrial activity commingle with process or nonprocess water, then where practicable permittees must attempt to sample the storm water discharge before it mixes with the non-storm water discharge.

(3) Sampling Water.

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(a) Adverse Conditions—When a discharger is unable to collect samples within a specified sampling period due to adverse climatic conditions, the discharger shall collect a substitute sample from a separate qualifying event in the next period and submit the data along with data for the routine sample in that period. Adverse weather conditions that may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricanes, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(b) Low Concentration Waiver—When the average concentration for a pollutant calculated from all monitoring data collected from an outfall during the monitoring period [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] is less than the corresponding value for that pollutant listed in Table Y–1 under the column Monitoring Cut-Off Concentration, a facility may waive monitoring and reporting requirements in the monitoring period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance]. The facility must submit to the Director, in lieu of the monitoring data, a certification that there has not been a significant change in industrial activity or the pollution prevention measures in area of the facility that drains to the outfall for which sampling was waived.

(c) When a discharger is unable to conduct quarterly chemical storm water sampling at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirements as long as the facility remains inactive and unstaffed. The facility must submit to the Director, in lieu of monitoring data, a certification statement on the DMR stating that the site is inactive and unstaffed so that collecting a sample during a qualifying event is not possible.

(4) Representative Discharge. When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may test the effluent of one of such outfalls and report that the quantitative data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent, or high (above 65 percent)] shall be provided in the plan. The permittee shall include the description of the location of the outfalls, explanation of why outfalls are expected to discharge substantially identical effluents, and estimate of the size of the drainage area and runoff coefficient with the Discharge Monitoring Report.

(5) Alternative Certification. A discharger is not subject to the monitoring requirements of this section provided the discharger makes a certification for a given outfall or on a pollutant-by-pollutant basis, in lieu of monitoring reports required under paragraph b below, under penalty of law, signed in accordance with Part VII.G. (Signatory Requirements), that material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, industrial machinery or operations, or significant materials, by-products, industrial machinery or operations, or significant materials from past industrial activity that are located in areas of the facility within the drainage area of the outfall are not presently exposed to storm water and are not expected to be exposed to storm water for the certification period. Such certification must be retained in the storm water pollution prevention plan, and submitted to EPA in accordance with Part VI.C. of this permit. In the case of certifying that a pollutant is not present, the permittee must submit the certification along with the monitoring reports required under paragraph b below. If the permittee cannot certify for an entire period, they must submit the date exposure was eliminated and any monitoring required up until that date. This certification option is not applicable to compliance monitoring requirements associated with effluent limitations.

(b) Reporting. Permittees with rubber product manufacturing facilities shall submit monitoring results for each outfall associated with industrial activity [or a certification in accordance with Sections (3), (4), or (5) above] obtained during the reporting period beginning [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] on Discharge Monitoring Report Form(s) postmarked no later than the 31st day of the following March [insert the date 2 years after permit issuance]. Monitoring results [or a certification in accordance with Sections (3), (4), or (5) above] obtained during the period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance] shall be submitted on Discharge Monitoring Form(s) postmarked no later than the 31st day of the following March. For each outfall, one signed Discharge Monitoring Report form must be submitted to the Director per storm event sampled. Signed copies of Discharge Monitoring Reports, or said certifications,shall be submitted to the Director of the NPDES program at the address of the appropriate Regional Office listed in Part VI.G. of the fact sheet.

(1) Additional Notification. In addition to filing copies of discharge monitoring reports in accordance with paragraph (b) (above), rubber product manufacturing facilities with at least one storm water discharge associated with industrial activity through a large or medium municipal separate storm sewer system (systems serving a population of 100,000 or more) must submit signed copies of discharge monitoring reports to the operator of the municipal separate storm sewer system in accordance with the dates provided in paragraph (b) (above).

(c) Quarterly Visual Examination of Storm Water Quality. Facilities shall perform and document a visual examination of a representative storm water discharge associated with industrial from each outfall, except discharges exempted below. The examination must be made at least once in each designated period [described in *(1)*, below] during daylight hours unless there is insufficient rainfall or snow melt to produce a runoff event.

(1) Examinations shall be conducted in each of the following periods for the purposes of visually inspecting storm water quality associated with storm water runoff or snow melt: January through March; April through June; July through September; and October through December.

(2) Examinations shall be made of samples collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed one hour) of when the runoff or snowmelt begins discharging. The examinations shall document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No

analytical tests are required to be performed on the samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. Whenever practicable the same individual will carry out the collection and examination of discharges for the life of the permit.

(3) Visual examination reports must be maintained onsite in the pollution prevention plan. The report shall include the examination date and time, examination personnel, the nature of the discharge (i.e., runoff or snow melt), visual quality of the storm water discharge (including observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution), and probable sources of any observed storm water contamination.

(4) When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may collect a sample of effluent of one of such outfalls and report that the observation data also applies to the substantially identical outfalls provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explaining in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

(5) When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the records of the visual examination. Adverse weather conditions which may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(6) When a discharger is unable to conduct visual storm water examinations at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirement as long as the facility remains inactive and unstaffed. The facility must maintain a certification with the pollution prevention plan stating that the site is inactive and unstaffed so that performing visual examinations during a qualifying event is not feasible.

Z. Storm Water Discharges Associated With Industrial Activity From Leather Tanning and Finishing Facilities

1. Discharges Covered Under This Section.

The requirements listed under this section shall apply to storm water discharges from the following activities: leather tanning, currying and finishing (commonly identified by Standard Industrial Classification (SIC) code 3111). Discharges from facilities that make fertilizer solely from leather scraps and leather dust are also covered under this section. When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

2. Special Conditions

There are no special conditions for this section beyond those in Part III. of this permit.

3. Storm Water Pollution Prevention Plan Requirements

a. Contents of Plan. The plan shall include, at a minimum, the following items:

(1) Pollution Prevention Team. Each plan shall identify a specific individual or individuals within the facility organization as members of a storm water Pollution Prevention Team that are responsible for developing the storm water pollution prevention plan and assisting the facility or plant manager in its implementation, maintenance, and revision. The plan shall clearly identify the responsibilities of each team member. The activities and responsibilities of the team shall address all aspects of the facility's storm water pollution prevention plan.

(2) Description of Potential Pollutant Sources. Each plan shall provide a description of potential sources which may reasonably be expected to add significant amounts of pollutants to storm water discharges or which may result in the discharge of pollutants during dry weather from separate storm sewers draining the facility. Each plan shall identify all activities and significant materials which may potentially be significant pollutant sources or, during periods of dry weather, result in dry weather flows. Each plan shall include, at a minimum:

(a) Drainage.

(i) A site map indicating an outline of the portions of the drainage area of each storm water outfall that are within the facility boundaries, each existing structural control measure to reduce pollutants in storm water runoff, surface water bodies (including wetlands), locations where significant materials are exposed to precipitation, locations where major spills or leaks identified under Part XI.Z.3.a.(2)(c) (Spills and Leaks) of this permit have occurred, and the locations of the following activities where such activities are exposed to precipitation: fueling stations, vehicle and equipment maintenance and/or cleaning areas, loading/unloading areas, locations used for the treatment, storage or disposal of wastes, material storage (including tanks or other vessels used for liquid or waste storage), processing and storage areas for activities associated with beamhouse, tanyard, retan-wet finishing and dry finishing operations, and haul roads, access roads and rail spurs. The site map must also identify the location of all outfalls covered by this permit and include an inventory of the types of discharges contained in each outfall.

(ii) For each area of the facility that generates storm water discharges associated with industrial activity with a reasonable potential for containing significant amounts of pollutants, a prediction of the direction of flow, and an identification of the types of pollutants which are likely to be present in storm water discharges associated with industrial activity. Factors to consider include the toxicity of a chemical; quantity of chemicals used, produced or discharged; the likelihood of contact with storm water; and history

of significant leaks or spills of toxic or hazardous pollutants. Flows with a significant potential for causing erosion shall be identified.

(b) Inventory of Exposed Materials—An inventory of the types of materials handled at the site that potentially may be exposed to precipitation. Such inventory shall include a narrative description of significant materials that have been handled, treated, stored or disposed in a manner to allow exposure to storm water between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; method and location of onsite storage or disposal; materials management practices employed to minimize contact of materials with storm water runoff between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; the location and a description of existing structural and nonstructural control measures to reduce pollutants in storm water runoff; and a description of any treatment the storm water receives. The description must be updated whenever there is a significant change in the types or amounts of materials, or material management practices, that may affect the exposure of materials to storm water.

(c) Spills and Leaks—A list of significant spills and significant leaks of toxic or hazardous pollutants that occurred at areas that are exposed to precipitation or that otherwise drain to a storm water conveyance at the facility after the date of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit. Significant spills include but are not limited to, releases of oil or hazardous substances in excess of quantities that are reportable under Section 311 of the Clean Water Act (CWA) (see 40 CFR 110.10 and 40 CFR 117.21) or Section 102 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (see 40 CFR 302.4). Significant spills may also include releases of oil or hazardous substances that are not in excess of reporting requirements and releases of materials that are not classified as oil or a hazardous substance. Such list shall be updated as appropriate during the term of the permit.

(d) Sampling Data—A summary of existing discharge sampling data describing pollutants in storm water discharges from the facility, including a summary of sampling data collected during the term of this permit.

(e) Risk Identification and Summary of Potential Pollutant Sources—A narrative description of potential pollutant sources including but not limited to the following activities: loading and unloading operations; outdoor storage activities, including but not limited to: temporary or permanent storage of fresh and brine cured hides, chemical drums, bags, containers and above ground tanks, leather dust, scraps, trimmings and shavings, spent solvents, extraneous hide substances and hair, and empty chemical containers and bags; floor sweepings and washings; refuse and waste piles and sludge; outdoor manufacturing or processing activities; significant dust or particulate generating processes including buffing; vehicle maintenance, washing and fueling and onsite waste disposal practices. The description shall specifically list any significant potential source of pollutants at the site and for each potential source, any pollutant or pollutant parameter (e.g., biochemical oxygen demand, total suspended solids, chromium, etc.) of concern shall be identified.

(3) Measures and Controls. Each facility covered by this permit shall develop a description of storm water management controls appropriate for the facility, and implement such controls. The appropriateness and priorities of controls in a plan shall reflect identified potential sources of pollutants at the facility. The description of storm water management controls shall address the following minimum components, including a schedule for implementing such controls:

(a) Good Housekeeping—Good housekeeping requires the maintenance of areas which may contribute pollutants to storm water discharges in a clean, orderly manner. The following areas must be specifically addressed:

(i) Storage Areas for Raw, Semiprocessed, or Finished Tannery By-products—Pallets and/or bales of raw, semiprocessed or finished tannery by-products (e.g., splits, trimmings, shavings, etc.) should be stored indoors or protected by polyethylene wrapping, tarpaulins, roofed storage area or other suitable means. Materials should be placed on an impermeable surface, the area should be enclosed or bermed or other equivalent measures should be employed to prevent runon and runoff of storm water.

(ii) Material Storage Areas—Label storage units of all materials (e.g., specific chemicals, hazardous materials, spent solvents, waste materials). Maintain such containers and units in good condition. Describe measures that prevent or minimize contact with storm water. The facility must consider indoor storage, installation of berming and diking around the area, and/or other equivalent measures to prevent runon and runoff of storm water.

(iii) Buffing/Shaving Areas—The plan must describe measures that prevent or minimize contamination of the storm water runoff with leather dust from buffing/shaving areas. The facility may consider dust collection enclosures, preventive inspection/maintenance programs or other appropriate preventive measures.

(iv) Receiving, Unloading, and Storage Areas—The plan must describe measures that prevent or minimize contamination of the storm water runoff from receiving, unloading, and storage areas. Exposed receiving, unloading and storage areas for hides and chemical supplies should be protected by a suitable cover, diversion of drainage to the process sewer, grade berming or curbing area to prevent runon of storm water or other appropriate preventive measures. Materials must be plainly labelled and maintained in good condition.

(v) Outdoor Storage of Contaminated Equipment—The plan must describe measures that minimize contact of storm water with contaminated equipment. Equipment should be protected by suitable cover, diversion of drainage to the process sewer, thorough cleaning prior to storage or other appropriate preventive measures.

(vi) Waste Management—The plan must describe measures that prevent contamination of the storm water runoff from waste storage areas. The facility may consider inspection/maintenance programs or other equivalent measures for leaking containers or spills, covering dumpsters, moving waste management activities indoors, covering waste piles with temporary covering material such as tarpaulins or polyethylene, and minimizing storm water runon by enclosing the area or building berms around the area.

(b) Preventive Maintenance—A preventive maintenance program shall involve timely inspection and maintenance of storm water management devices (e.g., cleaning oil/water separators, catch basins) as well as inspecting and testing facility equipment and systems to uncover conditions that could cause breakdowns or failures resulting in discharges of pollutants to surface waters, and ensuring appropriate maintenance of such equipment and systems.

(c) Spill Prevention and Response Procedures—Areas where potential spills which can contribute pollutants to storm water discharges can occur, and their accompanying drainage points

shall be identified clearly in the storm water pollution prevention plan. Where appropriate, specifying material handling procedures, storage requirements, and use of equipment such as diversion valves in the plan should be considered. Procedures for cleaning up spills shall be identified in the plan and made available to the appropriate personnel. The necessary equipment to implement a clean up should be available to personnel.

(d) Inspections—Qualified facility personnel shall be identified to inspect designated equipment and areas of the facility at least on a quarterly basis. The following areas shall be included in all inspections: leather processing areas, storage areas for chemicals, including but not limited to above ground tanks, fueling areas, vehicle and equipment maintenance areas, material storage areas, loading and unloading areas, waste management areas and other potential sources of pollution for evidence of actual or potential discharges of contaminated storm water. A set of tracking or follow-up procedures shall be used to ensure that appropriate actions are taken in response to the inspections and that the pollution prevention plan is appropriately modified. Records of inspections shall be maintained as part of the pollution prevention plan.

Qualified personnel are required to conduct quarterly inspections of all Best Management Practices (BMPs). The inspections shall include an assessment of the effectiveness and need for maintenance of storm water roofing and covers, dikes and curbs, discharge diversions, sediment control and collection systems and all other BMPs.

Quarterly inspections must be made at least once in each of the following designated periods during daylight hours: January through March (storm water runoff or snow melt), April through June (storm water runoff), July through September (storm water runoff), and October through December (snow melt runoff). Records shall be maintained as part of the pollution prevention plan.

(e) Employee Training—Employee training programs shall inform personnel responsible for implementing activities identified in the storm water pollution prevention plan or otherwise responsible for storm water management at all levels of responsibility of the components and goals of the storm water pollution prevention plan. The pollution prevention plan shall identify how often training will take place, but in all cases, training must be held at least annually. Employee training must, at a minimum, address the following areas when applicable to a facility: general good housekeeping practices, spill prevention and control, waste management, inspections, preventive maintenance, detection of non-storm water discharges and other areas.

(f) Recordkeeping and Internal Reporting Procedures—A description of incidents (such as leaks, spills, or other discharges), along with other information describing the quality and quantity of storm water discharges shall be included in the plan required under this part. Inspections and maintenance activities shall be documented and records of such activities shall be incorporated into the plan. The plan must address spills, monitoring, and BMP inspection and maintenance activities. BMPs which were ineffective must be reported and the date of their corrective action recorded. Employees must report incidents of leaking fluids to facility management and these reports must be incorporated into the plan.

(g) Non-storm Water Discharges.

(i) The plan shall include a certification that the discharge has been tested or evaluated for the presence of non-storm water discharges. The certification shall include the identification of potential significant sources of non-storm water at the site, a description of the results of any test and/or evaluation for the presence of non-storm water discharges, the evaluation criteria or testing method used, the date of any testing and/or evaluation, and the onsite drainage points that were directly observed during the test. Certifications shall be signed in accordance with Part VII.G. of this permit. Such certification may not be feasible if the facility operating the storm water discharge associated with industrial activity does not have access to an outfall, manhole, or other point of access to the ultimate conduit which receives the discharge. In such cases, the source identification section of the storm water pollution prevention plan shall indicate why the certification required by this part was not feasible, along with the identification of potential significant sources of non-storm water at the site. A discharger that is unable to provide the certification required by this paragraph must notify the Director in accordance with paragraph XI.Z.3.a.(3)(g)(iii) (below).

(ii) Except for flows from fire fighting activities, sources of non-storm water listed in Part III.A.2 (Prohibition of Non-storm Water Discharges) of this permit that are combined with storm water discharges associated with industrial activity must be identified in the plan. The plan shall identify and ensure the implementation of appropriate pollution prevention measures for the non-storm water component(s) of the discharge.

(iii) Failure to Certify—Any facility that is unable to provide the certification required (testing for non-storm water discharges), must notify the Director by [Insert date 270 days after permit issuance] or, for facilities which begin to discharge storm water associated with industrial activity after [Insert date 270 days after permit issuance], 180 days after submitting an NOI to be covered by this permit. If the failure to certify is caused by the inability to perform adequate tests or evaluations, such notification shall describe: the procedure of any test conducted for the presence of non-storm water discharges; the results of such test or other relevant observations; potential sources of non-storm water discharges to the storm sewer; and why adequate tests for such storm sewers were not feasible. Non-storm water discharges to waters of the United States which are not authorized by an NPDES permit are unlawful, and must be terminated.

(h) Sediment and Erosion Control—The plan shall identify areas which, due to topography, activities, or other factors, have a high potential for significant soil erosion, and identify structural, vegetative, and/or stabilization measures to be used to limit erosion.

(i) Management of Runoff—The plan shall contain a narrative consideration of the appropriateness of traditional storm water management practices (practices other than those which control the generation or source(s) of pollutants) used to divert, infiltrate, reuse, or otherwise manage storm water runoff in a manner that reduces pollutants in storm water discharges from the site. The plan shall provide that measures that the permittee determines to be reasonable and appropriate shall be implemented and maintained. The potential of various sources at the facility to contribute pollutants to storm water discharges associated with industrial activity [see paragraph XI.Z.3.a.(2) of this section (Description of Potential Pollutant Sources)] shall be considered when determining reasonable and appropriate measures. Appropriate measures or equivalent measures may include: vegetative swales and practices, reuse of collected storm water (such as for a process or as an irrigation source), inlet controls (such as oil/water separators), snow management activities, infiltration devices, and wet detention/retention devices. In addition, the permittee must describe the storm water pollutant source area or activity (e.g., storage areas, loading and unloading areas,

above ground storage of chemicals) to be controlled by each storm water management practice.

The plan must consider management practices, such as berms for uncovered storage areas, uncovered loading and unloading areas, above ground liquid storage and waste management areas. The installation of detention ponds must also be considered.

(4) Comprehensive Site Compliance Evaluation. Qualified personnel shall conduct site compliance evaluations at appropriate intervals specified in the plan, but in no case less than once a year. Such evaluations shall provide:

(a) Areas contributing to a storm water discharge associated with industrial activity shall be visually inspected for evidence of, or the potential for, pollutants entering the drainage system. Measures to reduce pollutant loadings shall be evaluated to determine whether they are adequate and properly implemented in accordance with the terms of the permit or whether additional control measures are needed. Structural storm water management measures, sediment and erosion control measures, and other structural pollution prevention measures identified in the plan shall be observed to ensure that they are operating correctly. A visual inspection of equipment needed to implement the plan, such as spill response equipment, shall be made.

(b) Based on the results of the evaluation, the description of potential pollutant sources identified in the plan in accordance with paragraph XI.Z.3.a.(2) of this section (Description of Potential Pollutant Sources) and pollution prevention measures and controls identified in the plan in accordance with paragraph XI.Z.3.a.(3) of this section (Measures and Controls) shall be revised as appropriate within 2 weeks of such evaluation and shall provide for implementation of any changes to the plan in a timely manner, but in no case more than 12 weeks after the evaluation.

(c) A report summarizing the scope of the evaluation, personnel making the evaluation, the date(s) of the evaluation, major observations relating to the implementation of the storm water pollution prevention plan, and actions taken in accordance with paragraph XI.Z.3.a.(4)(b) (above) of the permit shall be made and retained as part of the storm water pollution prevention plan for at least 3 years from the date of the evaluation. The report shall identify any incidents of noncompliance. Where a report does not identify any incidents of noncompliance, the report shall contain a certification that the facility is in compliance with the storm water pollution prevention plan and this permit. The report shall be signed in accordance with Part VII.G. (Signatory Requirements) of this permit.

(d) The storm water pollution prevention plan must describe the scope and content of comprehensive site inspections that qualified personnel will conduct to (1) Confirm the accuracy of the description of potential pollution sources contained in the plan, (2) determine the effectiveness of the plan, and (3) assess compliance with the terms and conditions of the permit. Comprehensive site compliance evaluations must be conducted at least once a year. The individual or individuals who will conduct the inspections must be identified in the plan and should be members of the pollution prevention team. Evaluation reports must be retained for at least 3 years from the date of the evaluation.

(e) Where compliance evaluation schedules overlap with inspections required under XI.Z.3.a.(3)(d), the compliance evaluation may be conducted in place of one such inspection.

4. Numeric Effluent Limitations. There are no additional numeric effluent limitations beyond those described in Part V.B of this permit.

5. Monitoring and Reporting Requirements.

(a) Quarterly Visual Examination of Storm Water Quality. Facilities shall perform and document a visual examination of a storm water discharge associated with industrial activity from each outfall, except discharges exempted below. The examination must be made at least once in each designated period [described in *(1)* below] during daylight hours unless there is insufficient rainfall or snow melt to produce a runoff event.

(1) Examinations shall be conducted in each of the following periods for the purposes of visually inspecting storm water quality associated with storm water runoff or snow melt: January through March; April through June; July through September; and October through December.

(2) Examinations shall be made of samples collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 1 hour) of when the runoff or snowmelt begins discharging. The examinations shall document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on the samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. Where practicable, the same individual should carry out the collection and examination of discharges for entire permit term.

(3) Visual examination reports must be maintained onsite in the pollution prevention plan. The report shall include the examination date and time, examination personnel, the nature of the discharge (i.e., runoff or snow melt), visual quality of the storm water discharge (including observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution), and probable sources of any observed storm water contamination.

(4) When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may collect a sample of effluent of one of such outfalls and report that the observation data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

(5) When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the records of the visual examination. Adverse weather conditions which may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricanes, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(6) When a discharger is unable to conduct visual storm water examinations at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirement as long as the facility remains inactive and unstaffed. The facility must maintain a certification with the pollution prevention plan stating that the site is inactive and unstaffed so that performing visual examinations during a qualifying event is not feasible.

AA. Storm Water Discharges Associated With Industrial Activity From Fabricated Metal Products Industry

1. Discharges Covered Under This Section. The requirements listed under this section shall apply to storm water discharges associated with industrial activity from the fabricated metals industry listed below, except for electrical related industries: fabricated metal products, except machinery & transportation equipment, SIC 34 (3429, 3441, 3442, 3443, 3444, 3451, 3452, 3462, 3471, 3479, 3494, 3496, 3499); and jewelry, silverware, and plated ware (SIC Code 391).

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

2. Special Conditions.

a. Prohibition of Non-storm Water Discharges.

(1) This permit does not authorize the discharge of process wastewater. Certain non-storm discharges identified in Part III.A.2. are authorized under this permit.

3. Storm Water Pollution Prevention Plan Requirements.

a. Contents of Plan. The plan shall include, at a minimum, the following items:

(1) Pollution Prevention Team. Each plan shall identify a specific individual or individuals within the facility organization as members of a storm water Pollution Prevention Team that are responsible for developing the storm water pollution prevention plan and assisting the facility or plant manager in its implementation, maintenance, and revision. The plan shall clearly identify the responsibilities of each team member. The activities and responsibilities of the team shall address all aspects of the facility's storm water pollution prevention plan.

(2) Description of Potential Pollutant Sources. Each plan shall provide a description of potential sources which may reasonably be expected to add significant amounts of pollutants to storm water discharges or which may result in the discharge of pollutants during dry weather from separate storm sewers draining the facility. Each plan shall identify all industrial activities and significant materials which may potentially be significant pollutant sources. Each plan shall specifically identify the physical features of the facility that may contribute to storm water runoff. Each plan shall include, at a minimum:

(a) Drainage

(i) A site map indicating the outfall locations and types of discharges contained in the drainage areas of the outfalls, an outline of the portions of the drainage area of each storm water outfall that are within the facility boundaries, each existing structural control measure to reduce pollutants in storm water runoff, surface water bodies, locations where significant materials are exposed to precipitation, locations where major spills or leaks identified under Part IX.AA.3.a.(2)(c) (Spills and Leaks) of this permit have occurred, and the locations of the following activities where such activities are exposed to precipitation: raw metal storage areas, finished metal storage areas, scrap disposal collection sites, equipment storage areas, retention and detention basins, temporary diversion dikes or berms, permanent diversion dikes or berms, right-of-way or perimeter diversion devices, any sediment traps or barriers, vehicle and equipment maintenance and/or cleaning areas,loading/unloading areas, locations used for the treatment, storage or disposal of wastes, liquid storage tanks, processing areas including outside painting areas, wood preparation, recycling and raw material storage.

(ii) For each area of the facilities that generates storm water discharges associated with industrial activity with a reasonable potential for containing significant amounts of pollutants, a prediction of the direction of flow, and an identification of the types of pollutants which are likely to be present in storm water discharges associated with industrial activity. Factors to consider include the toxicity of chemical; quantity of chemicals used, produced or discharged; the likelihood of contact with storm water; and history of significant leaks or spills of toxic or hazardous pollutants. In addition, flows with a significant potential for causing erosion shall be identified such as heavy equipment use areas, drainage from roofs, parking lots, etc.

(b) Inventory of Exposed Materials—An inventory of the types of materials handled at the site that potentially may be exposed to precipitation. Such inventory shall include a narrative description of significant materials that have been handled, treated, stored or disposed in a manner to allow exposure to storm water between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present: method and location of onsite storage or disposal; materials management practices employed to minimize contact of materials with storm water runoff between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; the location and a description of existing structural and nonstructural control measures to reduce pollutants in storm water runoff; and a description of any treatment the storm water receives.

(c) Spills and Leaks—A list of significant spills and significant leaks of toxic or hazardous pollutants that occurred at areas that are exposed to precipitation or that otherwise drain to a storm water conveyance at the facility after the date of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit. Significant spills that should be considered for the fabricated metals industry include, but are not limited to, chromium, toluene, pickle liquor, sulfuric acid, zinc and other water priority chemicals and hazardous chemicals and wastes. Such list shall be updated as appropriate during the term of the permit.

(d) Sampling Data—A summary of existing discharge sampling data describing pollutants in storm water discharges from the facility, including a summary of sampling data collected during the term of this permit.

(e) Risk Identification and Summary of Potential Pollutant Sources—A narrative description of the potential pollutant sources from the following activities: loading and unloading operations for paints, chemicals and raw materials; outdoor storage activities for raw materials, paints, empty containers, corn cob, chemicals, scrap metals; outdoor manufacturing or processing

activities such as grinding, cutting, degreasing, buffing, brazing, etc; significant dust or particulate generating processes; and onsite waste disposal practices for spent solvents, sludge, pickling baths, shavings, ingots pieces, refuse and waste piles. The description shall specifically list any significant potential source of pollutants at the site and for each potential source, any pollutant or pollutant parameter (e.g., biochemical or chemical oxygen demand, chromium, total suspended solids, oil and grease, etc.) of concern shall be identified.

(3) Measures and Controls. Each facility covered by this permit shall develop a description of storm water management controls appropriate for the facility, and implement such controls. The appropriateness and priorities of controls in a plan shall reflect identified potential sources of pollutants at the facility. The description of storm water management controls shall address the following minimum components, including a schedule for implementing such controls:

(a) Good Housekeeping—Good housekeeping requires the maintenance of areas which may contribute pollutants to storm water discharges in a clean, orderly manner. Permittees should address the following areas in the manner described.

(i) Raw Steel Handling Storage-Include measures controlling or recovering scrap metals, fines, and iron dust, including measures for containing materials within storage handling areas.

(ii) Paints and Painting Equipment-Consider control measures to prevent or minimize exposure of paint and painting equipment from exposure to storm water.

(b) Preventive Maintenance—Preventive maintenance measures shall include timely inspection and maintenance of storm water management devices (e.g., cleaning oil/water separators, catch basins) as well as inspecting and testing facility equipment and systems to uncover conditions that could cause breakdowns or failures resulting in discharges of pollutants to surface waters, and ensuring appropriate maintenance of such equipment and systems.

(c) Spill Prevention and Response Procedures—Areas where potential spills which could contribute pollutants to storm water discharges may occur, and their accompanying drainage points shall be identified clearly in the storm water pollution prevention plan. Where appropriate, specifying material handling procedures, storage requirements, and use of equipment such as diversion valves in the plan should be considered. Procedures for cleaning up spills shall be identified in the plan and made available to the appropriate personnel. The necessary equipment to implement a clean up should be available to personnel. The following areas should be addressed:

(i) Metal Fabricating Areas-Include measures for maintaining clean, dry, orderly conditions in these areas. Use of dry clean-up techniques should be considered in the plan.

(ii) Storage Areas for Raw Metal-Include measures to keep these areas free of conditions that could cause spills or leakage of materials. Storage areas should be maintained for easy access in case spill clean up is necessary. Stored materials should be able to be identified correctly and quickly.

(iii) Receiving, Unloading, and Storage Areas-Include measures to prevent spills and leaks; plan for quick remedial clean up and instruct employees on clean-up techniques and procedures.

(iv) Storage of Equipment-Include measures for preparing equipment for storage and the proper method to store equipment including protecting with covers, storing indoors. The plan should include clean-up measures for equipment that will be stored outdoors to remove potential pollutants.

(v) Metal Working Fluid Storage Areas-The plan should include measures that identify controls particularly for storage of metal working fluids.

(vi) Cleaners and Rinse Water-The plan should include measures to control and cleanup spills of solvents and other liquid cleaners; control sand buildup and disbursement from sand-blasting operations, prevent exposure of recyclable wastes; and employ substitute cleaners when possible.

(vii) Lubricating Oil and Hydraulic Fluid Operations-Consider using devices or monitoring equipment to detect and control leaks and overflows, including the installation of perimeter controls such as dikes, curbs, grass filter strips, or other equivalent measures.

(viii) Chemical Storage Areas-Identify proper storage that prevents storm water contamination and prevents accidental spillage. The plan should include a program to inspect containers, and identify proper disposal and spill controls.

(d) Inspections—Qualified facility personnel shall be identified to inspect designated equipment and areas of the facility at appropriate intervals specified in the plan. Metal fabricators shall at a minimum include the following areas for inspection: raw metal storage areas, finished product storage areas, material and chemical storage areas, recycling areas, loading and unloading areas, equipment storage areas, paint areas, fueling and maintenance areas, and waste management areas. A set of tracking or follow-up procedures shall be used to ensure that appropriate actions are taken in response to the inspections. Records of inspections shall be maintained.

(e) Employee Training—Employee training programs shall inform personnel responsible for implementing activities identified in the storm water pollution prevention plan or otherwise responsible for storm water management at all levels of responsibility of the components and goals of the storm water pollution prevention plan. Training should address topics such as spill response, good housekeeping, and material management practices. The pollution prevention plan shall identify periodic dates for such training.

(f) Recordkeeping and Internal Reporting Procedures—A description of incidents (such as spills, or other discharges), along with other information describing the quality and quantity of storm water discharges shall be included in the plan required under this part. Inspections and maintenance activities shall be documented and records of such activities shall be incorporated into the plan.

(g) Non-storm Water Discharges

(i) The plan shall include a certification that the discharge has been tested or evaluated for the presence of non-storm water discharges. The certification shall include the identification of potential significant sources of non-storm water at the site, a description of the results of any test and/or evaluation for the presence of non-storm water discharges, the evaluation criteria or testing method used, the date of any testing and/or evaluation, and the onsite drainage points that were directly observed during the test. Certifications shall be signed in accordance with Part VII.G. of this permit. Such certification may not be feasible if the facility operating the storm water discharge associated with industrial activity does not have access to an outfall, manhole, or other point of access to the ultimate conduit which receives the discharge. In such cases, the source identification section of the storm water pollution prevention plan shall indicate why the certification required by this part was not feasible, along with the identification of potential significant sources of non-storm water at the site. A discharger that is unable to provide the certification required by this paragraph must notify the Director in

accordance with paragraph XI.AA.3.a.(3)(g)(iii) (below).

(ii) Except for flows from fire fighting activities, sources of non-storm water listed in Part III.A.2. (Prohibition of Non-storm Water Discharges) of this permit that are combined with storm water discharges associated with industrial activity must be identified in the plan. The plan shall identify and ensure the implementation of appropriate pollution prevention measures for the non-storm water component(s) of the discharge.

(iii) Failure to Certify—Any facility that is unable to provide the certification required (testing for non-storm water discharges), must notify the Director by [Insert date 270 days after permit issuance] or, for facilities which begin to discharge storm water associated with industrial activity after [Insert date 270 days after permit issuance], 180 days after submitting a notice of intent to be covered by this permit. If the failure to certify is caused by the inability to perform adequate tests or evaluations, such notification shall describe: the procedure of any test conducted for the presence of non-storm water discharges; the results of such test or other relevant observations; potential sources of non-storm water discharges to the storm sewer; and why adequate tests for such storm sewers were not feasible. Non-storm water discharges to waters of the United States which are not authorized by an NPDES permit are unlawful, and must be terminated.

(h) Sediment and Erosion Control—The plan shall identify areas which, due to topography, activities, or other factors, have a high potential for significant soil erosion. The plan shall identify structural, vegetative, and/or stabilization measures to be used to limit erosion. These shall include but not be limited to grass swales, filter strips, treatment works, or other equivalent measures. Metal fabricators must include in their plan measures to minimize erosion related to the high volume of traffic from heavy equipment for delivery to and from the facility and for equipment operating at the facility on a daily basis such as forklifts, cranes, etc.

(i) Management of Runoff—The plan shall contain a narrative consideration of the appropriateness of traditional storm water management practices (practices other than those which control the generation or source(s) of pollutant(s) used to divert, infiltrate, reuse, or otherwise manage storm water runoff in a manner that reduces pollutants in storm water discharges from the site. The plan shall provide that measures that the permittee determines to be reasonable and appropriate shall be implemented and maintained. The potential of various sources at the facility to contribute pollutants to storm water discharges associated with industrial activities under the SIC codes identified under paragraph XI.AA.1. of this section shall be considered when determining reasonable and appropriate measures. Appropriate measures may include: vegetative swales and practices, reuse of collected storm water (such as for a process or as an irrigation source), inlet controls (such as oil/water separators), snow management activities, infiltration devices, and wet detention/retention devices.

(4) Comprehensive Site Compliance Evaluation. Qualified personnel shall conduct site compliance evaluations at least once a year. Such evaluations shall include:

(a) Visual inspection of areas contributing to a storm water discharge for evidence of, or the potential for, pollutants entering the drainage system. Inspection shall address areas associated with the storage of raw metals, storage of spent solvents and chemicals, outdoor paint areas, drainage from roof, unloading and loading areas, equipment storage areas, recycling areas, and retention ponds (sludge). Potential pollutants include chromium, zinc, lubricating oil, solvents, aluminum, oil and grease, methyl ethyl ketone, steel, and other related materials. Measures to reduce pollutant loadings shall be evaluated to determine whether they are adequate and properly implemented in accordance with the terms of the permit or whether additional control measures are needed. Structural storm water management measures, such as detention basins and channels, gutters or drains to direct discharge flow, oil/water separators in storm drains, containment structures, concrete pads, sediment and erosion control measures, and other structural pollution prevention measures identified in the plan shall be observed to ensure that they are operating correctly. A visual inspection of equipment needed to implement the plan, such as spill response equipment and containment drums, shall be made to determine if the equipment is functioning properly and that drums are not in a corrosive or deteriorating state.

(b) Based on the results of the evaluation, the description of potential pollutant sources identified in the plan in accordance with paragraph XI.AA.3.a.(2) of this section (Description of Potential Pollutant Sources) and pollution prevention measures and controls identified in the plan in accordance with paragraph XI.AA.3.a.(3) of this section (Measures and Controls) shall be revised as appropriate within 2 weeks of such evaluation and shall provide for implementation of any changes to the plan in a timely manner, but in no case more than 12 weeks after the evaluation.

(c) A report summarizing the scope of the evaluation, personnel making the evaluation, the date(s) of the evaluation, major observations relating to the implementation of the storm water pollution prevention plan, and actions taken in accordance with paragraph XI.AA.3.a.(4)(b) (above) of the permit shall be made and retained as part of the storm water pollution prevention plan for at least 3 years from the date of the inspection. The report shall identify any incidents of noncompliance. Where a report does not identify any incidents of noncompliance, the report shall contain a certification that the facility is in compliance with the storm water pollution prevention plan and this permit. The report shall be signed in accordance with Part VII.G. (Signatory Requirements) of this permit.

(d) Where compliance evaluation schedules overlap with inspections required under 3.a.(3)(d), the compliance evaluation may be conducted in place of one such inspection.

4. Numeric Effluent Limitations. There are no additional numeric effluent limitations beyond those described in Part V.B. of this permit.

5. Monitoring and Reporting Requirements

a. Analytical Monitoring Requirements. During the period beginning [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] and the period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance], permittees with metal fabricating facilities must monitor their storm water discharges associated with industrial activity at least quarterly (4 times per year) during years 2 and 4 except as provided in paragraphs 5.a.(3) (Sampling Waiver), 5.a.(4) (Representative Discharge), and 5.a.(5) (Alternative Certification). Metal fabricating facilities are required to monitor their storm water discharges for the pollutants of concern listed in Tables AA–1 and AA–2 below. The monitoring requirements are subdivided into two classifications to determine pollutants of concern: (1) fabricated metal products except coating and (2) fabricated metal coating and engraving. Facilities must report in accordance with 5.b. (Reporting). In addition to the

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parameters listed in Tables AA–1 and AA–2 below, the permittee shall provide the date and duration (in hours) of the storm event(s) sampled; rainfall measurements or estimates (in inches) of the storm event that generated the sampled runoff; the duration between the storm event sampled and the end of the previous measurable (greater than 0.1 inch rainfall) storm event; and an estimate of the total volume (in gallons) of the discharge sampled.

TABLE AA–1.—MONITORING REQUIREMENTS FOR FABRICATED METAL PRODUCTS EXCEPT COATING

Pollutants of concern	Monitoring cut-off concentration
Total Recoverable Aluminum.	0.75 mg/L
Total Recoverable Iron	1.0 mg/L
Total Recoverable Zinc	0.117 mg/L
Nitrate plus Nitrite Nitrogen	0.68 mg/L

TABLE AA–2.—MONITORING REQUIREMENTS FOR FABRICATED METAL COATING AND ENGRAVING

Pollutants of concern	Monitoring cut-off concentration
Total Recoverable Zinc	0.117 mg/L
Nitrate plus Nitrite Nitrogen	0.068 mg/L

(1) Monitoring Periods. Metal fabricating facilities shall monitor samples collected during the sampling periods of: January through March, April through June, July through September, and October through December for the years specified in paragraph a. (above).

(2) Sample Type. A minimum of one grab sample shall be taken. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. The required 72-hour storm event interval is waived where the preceding measurable storm event did not result in a measurable discharge from the facility. The required 72-hour storm event interval may also be waived where the permittee documents that less than a 72-hour interval is representative for local storm events during the season when sampling is being conducted. The grab sample shall be taken during the first 30 minutes of the discharge. If the collection of a grab sample during the first 30 minutes is impracticable, a grab sample can be taken during the first hour of the discharge, and the discharger shall submit with the monitoring report a description of why a grab sample during the first 30 minutes was impracticable. If storm water discharges associated with industrial activity commingle with process or nonprocess water, then where practicable permittees must attempt to sample the storm water discharge before it mixes with the non-storm water discharge.

(3) Sampling Waiver

(a) Adverse Conditions—When a discharger is unable to collect samples within a specified sampling period due to adverse climatic conditions, the discharger shall collect a substitute sample from a separate qualifying event in the next period and submit the data along with data for the routine sample in that period. Adverse weather conditions that may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(b) Low Concentration Waiver—When the average concentration for a pollutant calculated from all monitoring data collected from an outfall during the monitoring period [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] is less than the corresponding value for that pollutants listed in Tables AA–1 and AA–2 under the column Monitoring Cut-off Concentration, a facility may waive monitoring and reporting requirements in the monitoring period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance]. The facility must submit to the Director, in lieu of the monitoring data, a certification that there has not been a significant change in industrial activity or the pollution prevention measures in areas of the facility which drain to the outfall for which sampling was waived.

(c) When a discharger is unable to conduct quarterly chemical storm water sampling at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirements as long as the facility remains inactive and unstaffed. The facility must submit to the Director, in lieu of monitoring data, a certification statement on the DMR stating that the site is inactive and unstaffed so that collecting a sample during a qualifying event is not possible.

(4) Representative Discharge. When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may test the effluent of one of such outfalls and report that the quantitative data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan. The permittee shall include the description of the location of the outfalls, explanation of why outfalls are expected to discharge substantially identical effluents, and estimate of the size of the drainage area and runoff coefficient with the Discharge Monitoring Report.

(5) Alternative Certification. A discharger is not subject to the monitoring requirements of this section provided the discharger makes a certification for a given outfall or on a pollutant-by-pollutant basis in lieu of monitoring reports required under paragraph *b* below, under penalty of law, signed in accordance with Part VII.G. (Signatory Requirements), that material handling equipment or activities, raw materials, intermediate products, final products, waste materials, by-products, industrial machinery or operations, or significant materials from past industrial activity that are located in areas of the facility within the drainage area of the outfall are not presently exposed to storm water and are not expected to be exposed to storm water for the certification period. Such certification must be retained in the storm water pollution prevention plan, and submitted to EPA in accordance with Part VI.C. of this permit. In the case of certifying that a pollutant is not present, the permittee must submit the certification along with the monitoring reports required under paragraph *(b)* below. If the permittee cannot certify for an entire period, they must submit the date exposure was eliminated and any monitoring required up until that date. This certification option is not applicable to compliance

monitoring requirements associated with effluent limitations.

b. Reporting. Permittees with metal fabricating and engraving facilities shall submit monitoring results for each outfall associated with industrial activity [or a certification in accordance with Sections (3), (4), or (5) above] obtained during the reporting period beginning [insert date 1 year after permit issuance] lasting through [insert date 2 years after permit issuance] on Discharge Monitoring Report Form(s) postmarked no later than the 31st day of the following March [insert the date 2 years after permit issuance]. Monitoring results (or a certification in accordance with Sections (3), (4), or (5) above] obtained during the period beginning [insert date 3 years after permit issuance] lasting through [insert date 4 years after permit issuance] shall be submitted on Discharge Monitoring Report Form(s) postmarked no later than the 31st day of the following March. For each outfall, one signed Discharge Monitoring Report form must be submitted to the Director per storm event sampled. Signed copies of Discharge Monitoring Reports, or said certifications, shall be submitted to the Director of the NPDES program at the address of the appropriate Regional Office listed in Part VI.G. of the fact sheet.

(1) Additional Notification. In addition to filing copies of discharge monitoring reports in accordance with paragraph b (above), metal fabricating facilities with at least one storm water discharge associated with industrial activity through a large or medium municipal separate storm sewer system (systems serving a population of 100,000 or more) must submit signed copies of discharge monitoring reports to the operator of the municipal separate storm sewer system in accordance with the dates provided in paragraph b (above).

c. Quarterly Visual Examination of Storm Water Quality. Facilities shall perform and document a visual examination of a storm water discharge associated with industrial activity from each outfall, except discharges exempted below. The examination must be made at least once in each designated period [described in paragraph (*1*) below] during daylight hours unless there is insufficient rainfall or snow melt to produce a runoff event.

(1) Examinations shall be conducted in each of the following periods for the purposes of visually inspecting storm water quality associated with storm water runoff or snowmelt: January through March; April through June; July through September; and October through December.

(2) Examinations shall be made of samples collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 1 hour) of when the runoff or snowmelt begins discharging. The examinations shall document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on the samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. Where practicable, the same individual should carry out the collection and examination of discharges for the entire permit term.

(3) Visual examination reports must be maintained onsite in the pollution prevention plan. The report shall include the examination date and time, examination personnel, the nature of the discharge (i.e., runoff or snow melt), visual quality of the storm water discharge (including observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution), and probable sources of any observed storm water contamination.

(4) When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may collect a sample of effluent of one of such outfalls and report that the examination data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

(5) When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the records of the visual examinations. Adverse weather conditions which may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(6) When a discharger is unable to conduct visual storm water examinations at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirement as long as the facility remains inactive and unstaffed. The facility must maintain a certification with the pollution prevention plan stating that the site is inactive and unstaffed so that performing visual examinations during a qualifying event is not feasible.

AB. Storm Water Discharges Associated With Industrial Activity From Facilities That Manufacture Transportation Equipment, Industrial, or Commercial Machinery

1. Discharges Covered Under This Section

a. The requirements listed under this section shall apply to storm water discharges associated with transportation equipment, industrial or commercial machinery manufacturing facilities (commonly described by SIC Major Group 35 except SIC 357, and SIC Major Group 37, except SIC 373). Common activities include: industrial plant yards; material handling sites; refuse sites; sites used for application or disposal of process wastewaters; sites used for storage and maintenance of material handling equipment; sites used for residual treatment, storage, or disposal; shipping and receiving areas; manufacturing buildings; storage areas for raw material and intermediate and finished products; and areas where industrial activity has taken place in the past and significant materials remain and are exposed to storm water.

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all

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applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

2. Prohibition of Non-storm Water Discharges. There are no additional requirements other than those in Part III. of the permit.

3. Storm Water Pollution Prevention Plan Requirements

a. Contents of Plan. The plan shall include, at a minimum, the following items:

(1) Pollution Prevention Team. Each plan shall identify the specific individual or individuals within the facility organization as members of a storm water Pollution Prevention Team that are responsible for developing the storm water pollution prevention plan and assisting the facility or plant manager in its implementation, maintenance, and revision. The plan shall clearly identify the responsibilities of each team member. The activities and responsibilities of the team shall address all aspects of the facility's storm water pollution prevention plan.

(2) Description of Potential Pollutant Sources. Each plan shall provide a description of potential sources which may reasonably be expected to add significant amounts of pollutants to storm water discharges or which may result in the discharge of pollutants during dry weather from separate storm sewers draining the facility. Each plan shall identify all activities and significant materials which may potentially be significant pollutant sources. Each plan shall include, at a minimum:

(a) Drainage

(i) A site map indicating the pattern of storm water drainage, existing structural control measures to reduce pollutants in storm water runoff, surface water bodies, locations where significant materials are exposed to precipitation, and locations where major spills or leaks identified under Part XI.AB.3.a.(2)(c) (Spills and Leaks) of this permit have occurred since 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit. The map must also indicate the locations of all industrial activities that are exposed to precipitation, including, but not limited to: loading/unloading areas; waste treatment; storage and disposal locations; liquid storage tanks; vents and stacks from metal processing and similar operations; significant dust or particulate generating areas; and any other processing and storage areas exposed to storm water. The map must indicate the outfall locations and the types of discharges contained in the drainage areas of the outfalls.

(ii) For each area of the facility that generates storm water discharges associated with industrial activity with a reasonable potential for contacting significant amounts of pollutants, a prediction of the direction of flow, and an identification of the types of pollutants that are likely to present in storm water discharges associated with industrial activity must be identified. Factors to consider include the toxicity of a chemical; quantity of chemicals used, produced, or discharged; the likelihood of contract with storm water; and history of significant leaks or spills of toxic or hazardous pollutants. Flows with a significant potential for causing erosion shall be identified.

(b) Inventory of Exposed Materials—An inventory of the types of materials handled at the site that potentially may be exposed to precipitation. Such inventory shall include a narrative description of significant materials that have been handled, treated, stored or disposed in a manner to allow exposure to storm water between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; method and location of onsite storage or disposal; materials management practices employed to minimize contact of materials with storm water runoff between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; the location and a description of existing structural and nonstructural control measures to reduce pollutants in storm water runoff; and a description of any treatment the storm water receives.

(c) Spills and Leaks—A list of significant spills and significant leaks of toxic or hazardous pollutants that occurred at areas that are exposed to precipitation or that otherwise drain to a storm water conveyance at the facility after the date of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit. Significant spills include, but are not limited to, releases of oil or hazardous substances in excess of quantities that are reportable under Section 311 of CWA (see 40 CFR 110.10 and 117.21) or Section 102 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (see 40 CFR 302.4). Significant spills may also include releases of oil or hazardous substances that are not excess of reporting requirements and releases of materials that are not classified as oil or hazardous substance. Such list shall be updated as appropriate during the term of the permit.

(d) Sampling Data—A summary of existing discharge sampling data describing pollutants in storm water discharges from the facility, including a summary of sampling data collected during the term of this permit.

(e) Risk Identification and Summary of Potential Pollutant Sources—A narrative description of the potential pollutant sources from the following activities: loading and unloading operations; outdoor storage activities; significant dust or particulate generating processing activities; and onsite waste disposal. The description shall specifically list any significant potential source of pollutants at the site and for each potential source, any pollutant or pollutant parameter (e.g., oil and grease, etc.) of concern shall be identified.

(3) Measures and Controls. Each facility covered by this permit shall develop a description of storm water management controls appropriate for the facility, and implement such controls. The appropriateness and priorities of controls in a plan shall reflect identified potential sources of pollutants at the facility. The description of storm water management controls shall address the following minimum components, including a schedule for implementing such controls:

(a) Good Housekeeping—Good housekeeping requires the maintenance of areas which may contribute pollutants to storm waters discharges in a clean, orderly manner. Areas where good housekeeping practices should be implemented are storage areas for raw materials, waste materials and finished products; loading/unloading areas; and waste disposal areas for hazardous and nonhazardous wastes. Examples of good housekeeping measures include sweeping; labelling drums containing hazardous materials; and preventive monitoring practices (e.g., routine observation of manufacturing processes) or equivalent measures.

(b) Preventive Maintenance—A preventive maintenance program shall involve timely inspection and maintenance of storm water management devices (e.g., cleaning oil/ water separators, catch basins) as well as inspecting and testing facility equipment and systems to uncover conditions that could cause breakdowns or failures resulting in discharges of pollutants to surface waters, and

ensuring appropriate maintenance of such equipment and systems.

(c) Spill Prevention and Response Procedures—Areas where potential spills which can contribute pollutants to storm water discharges can occur, and their accompanying drainage points shall be identified clearly in the storm water pollution prevention plan. Areas to be identified should include loading/unloading areas, outdoor storage areas, and waste management areas exposed to storm water. Where appropriate, specifying material handling procedures, storage requirements, and use of equipment such as diversion valves in the plan should be considered. Procedures for cleaning up spills shall be identified in the plan and made available to the appropriate personnel. The necessary equipment to implement a clean up should be available to personnel.

(d) Inspections—Qualified facility personnel shall be identified to inspect designated equipment and areas of the facility on a periodic basis. At a minimum, the following areas, where the potential for exposure to storm water exists, must be inspected on a regularly scheduled basis: loading and unloading areas for all significant materials; storage areas, including associated containment areas; waste management units; and vents and stacks from industrial activities. For any problems identified during inspections, the plan shall be revised to include measures to address these problems. A set of tracking or follow-up procedures shall be used to ensure that appropriate actions are taken in response to the inspections. Records of inspections shall be maintained.

(e) Employee Training—Employee training programs shall inform personnel responsible for implementing activities identified in the storm water pollution prevention plan or otherwise responsible for storm water management at all levels of responsibility of the components and goals of the storm water pollution prevention plan. Training should address topics such as spill response, good housekeeping, material management practices, unloading/loading practices, outdoor storage areas, waste management practices, proper handling procedures of hazardous waste, and improper connections to the storm sewer. At a minimum, this training should be provided annually. The pollution prevention plan shall identify frequencies and approximate dates for such training.

(f) Recordkeeping and Internal Reporting Procedures—A description of incidents (such as spills, or other discharges), along with other information describing the quality and quantity of storm water discharges shall be included in the plan required under this part. Inspections and maintenance activities shall be documented and records of such activities shall be incorporated into the plan. Ineffective BMPs should be reported and the date of their corrective actions noted.

(g) Non-storm Water Discharges

(i) The plan shall include a certification that the discharge has been tested or evaluated for the presence of non-storm water discharges as identified in Part III.A.2. of this permit. The certification shall include the identification of potential significant sources of non-storm water at the site, a description of the results of any test and/or evaluation for the presence of non-storm water discharges, the evaluation criteria or testing method used, the date of any testing and/or evaluation, and the onsite drainage points that were directly observed during the test. Certifications shall be signed in accordance with Part VII.G. of this permit. Such certification may not be feasible if the facility operating the storm water discharge associated with industrial activity does not have access to an outfall, manhole, or other point of access to the ultimate conduit which receives the discharge. In such cases, the source identification section of the storm water pollution prevention plan shall indicate why the certification required by this part was not feasible, along with the identification of potential significant sources of non-storm water at the site. A discharger that is unable to provide the certification required by this paragraph must notify the Director in accordance with Part XI.AB.3.a.(3)(g)(iv) (Failure to Certify) of this permit.

(ii) Except for flows from fire fighting activities, sources of non-storm water listed in Part III.A. (Prohibition of Non-storm Water Discharges) of this permit that are combined with storm water discharges associated with industrial activity must be identified in the plan. The plan shall identify and ensure the implementation of appropriate pollution prevention measures for the non-storm water component(s) of the discharge.

(iii) If the facility discharges wastewater, other than storm water via an existing NPDES permit, a copy of the NPDES permit authorizing the discharge must be attached to the plan. Similarly, if the facility submitted an application for an NPDES permit for non-storm water discharges, but has not yet received that permit, a copy of the permit application must be attached. Upon issuance or reissuance of an NPDES permit, the facility must modify its plan to include a copy of that permit. For facilities that discharge wastewater, other than solely domestic wastewater, to a Publicly Owned Treatment Works (POTW), the facility must notify the POTW of its discharge. Proof of this notification should be attached to the plan in the form of either (1) a copy of the permit issued by the treatment plant to the facility or (2) a copy of a notification letter to the POTW. Notification should identify, in general, the types of wastewater discharged to the POTW, including any storm water discharges. In any of these cases, specific permit conditions must be considered in the plan.

(iv) Failure to Certify—Any facility that is unable to provide the certification required (testing for non-storm water discharges), must notify the Director by [Insert date 270 days after permit issuance] or, for facilities which begin to discharge storm water associated with industrial activity after [Insert date 270 days after permit issuance], 180 days after submitting an NOI to be covered by this permit. If the failure to certify is caused by the inability to perform adequate tests or evaluations, such notification shall describe: the procedure of any test conducted for the presence of non-storm water discharges; the results of such test or other relevant observations; potential sources of non-storm water discharges to the storm sewer; and why adequate tests for such storm sewers were not feasible. Non-storm water discharges to waters of the United States which are not authorized by an NPDES permit are unlawful, and must be terminated.

(h) Sediment and Erosion Control—The plan shall identify areas which, due to topography, activities, or other factors, have a high potential for significant soil erosion, and identify structural, vegetative, and/or stabilization measures to be used to limit erosion.

(i) Management of Runoff—The plan shall contain a narrative consideration of the appropriateness of traditional storm water management practices (practices other than those which control the generation or source(s) of pollutants) used to divert, infiltrate, reuse, or otherwise manage storm water runoff in a manner that reduces pollutants in storm water discharges from the site. The plan shall provide that measures that the permittee determines to be reasonable and appropriate shall be implemented and maintained. The potential of various sources at the facility to contribute pollutants to storm water discharges associated with industrial activity (see paragraph XI.AB.3.a.(2) (Description of

Potential Pollutant Sources) of this permit) shall be considered when determining reasonable and appropriate measures. Appropriate measures or other equivalent measures may include: vegetative swales and practices, reuse of collected storm water (such as for a process or as an irrigation source), inlet controls (such as oil/water separators), snow management activities, infiltration devices, and wet detention/retention devices. In addition, the permittee must describe the storm water pollutant source area or activity (storage areas, loading/unloading) to be controlled by each storm water management practice.

(4) Comprehensive Site Compliance Evaluation. Qualified personnel shall conduct site compliance evaluations at appropriate intervals specified in the plan, but in no case less than once a year. Such evaluations shall provide:

(a) Areas contributing to a storm water discharge associated with industrial activity shall be visually inspected for evidence of, or the potential for, pollutants entering the drainage system. Measures to reduce pollutant loadings shall be evaluated to determine whether they are adequate and properly implemented in accordance with the terms of the permit or whether additional control measures are needed. Structural storm water management measures, sediment and erosion control measures, and other structural pollution prevention measures identified in the plan shall be observed to ensure that they are operating correctly. A visual inspection of equipment needed to implement the plan, such as spill response equipment, shall be made.

(b) Based on the results of the evaluation, the description of potential pollutant sources identified in the plan in accordance with Part XI.AB.3.a.(2) (Description of Potential Pollutant Sources) of this permit and pollution prevention measures and controls identified in the plan in accordance with paragraph XI.AB.3.a.(3) (Measures and Controls) of this permit shall be revised as appropriate within 2 weeks of such evaluation and shall provide for implementation of any changes to the plan in a timely manner, but in no case more than 12 weeks after the evaluation.

(c) A report summarizing the scope of the evaluation, personnel making the inspection, the date(s) of the inspection, major observations relating to the implementation of the storm water pollution prevention plan, and actions taken in accordance with paragraph XI.AB.3.a.(4)(b) (above) of the permit shall be made and retained as part of the storm water pollution prevention plan for at least 3 years after the date of the evaluation. The report shall identify any incidents of noncompliance. Where a report does not identify any incidents of noncompliance, the report shall contain a certification that the facility is in compliance with the storm water pollution prevention plan and this permit. The report shall be signed in accordance with Part VII.G. (Signatory Requirements) of this permit.

(d) Where compliance evaluation schedules overlap with inspections required under 3.a.(3)(d), the compliance evaluation may be conducted in place of one such inspection.

4. Numeric Effluent Limitations. There are no additional numeric limitations beyond those described in Part V.B of this permit.

5. Monitoring and Reporting Requirements.

a. Monitoring Requirements.

(1) Quarterly Visual Examination of Storm Water Quality. Facilities shall perform and document a visual examination of a storm water discharge associated with industrial activity from each outfall, except discharges exempted below. The examination must be made at least once in each designated period [described in *(a)*, below] during daylight hours unless there is insufficient rainfall or snow melt to produce a runoff event.

(a) Examinations shall be conducted in each of the following periods for the purposes of visually inspecting storm water quality associated with storm water runoff or snow melt: January through March; April through June; July through September; and October through December.

(b) Examinations shall be made of samples collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed one hour) of when the runoff or snowmelt begins discharging. The examinations shall document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on the samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. Where practicable the same individual will carry out the collection and examination of discharges for the life of the permit.

(c) When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the records of the visual examination. Adverse weather conditions which may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(d) When a discharger is unable to conduct visual storm water examinations at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirement as long as the facility remains inactive and unstaffed. The facility must maintain a certification with the pollution prevention plan stating that the site is inactive and unstaffed so that performing visual examinations during a qualifying event is not feasible.

(e) Visual examination reports must be maintained onsite in the pollution prevention plan. The report shall include the examination date and time, examination personnel, the nature of the discharge (i.e., runoff or snow melt), visual quality of the storm water discharge (including observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution), and probable sources of any observed storm water contamination.

(f) When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may collect a sample of effluent of one of such outfalls and report that the examination data also applies to the substantially identical outfalls provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explaining in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

AC. Storm Water Discharges Associated With Industrial Activity From Facilities That Manufacture Electronic and Electrical Equipment and Components, Photographic and Optical Goods

1. Discharges Covered Under This Section. The requirements listed under this section shall apply to all storm water discharges associated with industrial activity from facilities that manufacture: electronic and other electrical equipment and components, except computer equipment (SIC major group 36); measuring, analyzing, and controlling instruments; photographic, medical and optical goods; watches and clocks (SIC major group 38) and computer and office equipment (SIC code 357).

When an industrial facility, described by the above coverage provisions of this section, has industrial activities being conducted onsite that meet the description(s) of industrial activities in another section(s), that industrial facility shall comply with any and all applicable monitoring and pollution prevention plan requirements of the other section(s) in addition to all applicable requirements in this section. The monitoring and pollution prevention plan terms and conditions of this multi-sector permit are additive for industrial activities being conducted at the same industrial facility (co-located industrial activities). The operator of the facility shall determine which other monitoring and pollution prevention plan section(s) of this permit (if any) are applicable to the facility.

2. Special Conditions.

a. Prohibition of Non-storm Water Discharges. Other than as provided in use this Section III.A. of this permit, non-storm water discharges are not authorized by this permit.

3. Storm Water Pollution Prevention Plan Requirements.

a. Contents of Plan. The plan shall include, at a minimum, the following items:

(1) Pollution Prevention Team. Each plan shall identify a specific individual or individuals within the facility organization as members of a storm water Pollution Prevention Team that are responsible for developing the storm water pollution prevention plan and assisting the facility or plant manager in its implementation, maintenance, and revision. The plan shall clearly identify the responsibilities of each team member. The activities and responsibilities of the team shall address all aspects of the facility's storm water pollution prevention plan.

(2) Description of Potential Pollutant Sources. Each plan shall provide a description of potential sources which may reasonably be expected to add significant amounts of pollutants to storm water discharges or which may result in the discharge of pollutants during dry weather from separate storm sewers draining the facility. Each plan shall identify all activities and significant materials which may potentially be significant pollutant sources. Each plan shall include, at a minimum:

(a) Drainage

(i) A site map indicating an outline of the portions of the drainage area of each storm water outfall that are within the facility boundaries, each existing structural control measure to reduce pollutants in storm water runoff, surface water bodies, locations where significant materials are exposed to precipitation, locations where major spills or leaks identified under Part XI.AC.3.a.(2)(c) (Spills and Leaks) of this permit have occurred, and the locations of the following activities where such activities are exposed to precipitation: fueling stations, vehicle and equipment maintenance and/or cleaning areas, loading/unloading areas, locations used for the treatment, storage or disposal of wastes, liquid storage tanks, processing areas and storage areas. The map must indicate the outfall locations and the types of discharges contained in the drainage areas of the outfalls.

(ii) For each area of the facility that generates storm water discharges associated with industrial activity with a reasonable potential for containing significant amounts of pollutants, a prediction of the direction of flow, and an identification of the types of pollutants which are likely to be present in storm water discharges associated with industrial activity. Factors to consider include the toxicity of chemical; quantity of chemicals used, produced or discharged; the likelihood of contact with storm water; and history of significant leaks or spills of toxic or hazardous pollutants. Flows with a significant potential for causing erosion shall be identified.

(b) Inventory of Exposed Materials—An inventory of the types of materials handled at the site that potentially may be exposed to precipitation. Such inventory shall include a narrative description of significant materials that have been handled, treated, stored or disposed in a manner to allow exposure to storm water between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; method and location of onsite storage or disposal; materials management practices employed to minimize contact of materials with storm water runoff between the time of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit and the present; the location and a description of existing structural and nonstructural control measures to reduce pollutants in storm water runoff; and a description of any treatment the storm water receives.

(c) Spills and Leaks—A list of significant spills and significant leaks of toxic or hazardous pollutants that occurred at areas that are exposed to precipitation or that otherwise drain to a storm water conveyance at the facility after the date of 3 years prior to the date of the submission of a Notice of Intent (NOI) to be covered under this permit. Such list shall be updated as appropriate during the term of the permit.

(d) Sampling Data—A summary of existing discharge sampling data describing pollutants in storm water discharges from the facility, including a summary of sampling data collected during the term of this permit.

(e) Risk Identification and Summary of Potential Pollutant Sources—A narrative description of the potential pollutant sources from the following activities: loading and unloading operations; outdoor storage activities; outdoor manufacturing or processing activities; significant dust or particulate generating processes; and onsite waste disposal practices. The description shall specifically list any significant potential source of pollutants at the site and for each potential source, any pollutant or pollutant parameter (e.g., biochemical oxygen demand, etc.) of concern shall be identified.

(3) Measures and Controls. Each facility covered by this permit shall develop a description of storm water management controls appropriate for the facility, and implement such controls. The appropriateness and priorities of controls in a plan shall reflect identified potential sources of pollutants at the facility. The description of storm water management controls shall address the following minimum components, including a schedule for implementing such controls:

(a) Good Housekeeping—Good housekeeping requires the maintenance of areas which may contribute pollutants to storm water discharges in a clean, orderly manner.

(b) Preventive Maintenance—A preventive maintenance program shall involve timely inspection and maintenance of storm water management devices (e.g., cleaning oil/

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water separators, catch basins) as well as inspecting and testing facility equipment and systems to uncover conditions that could cause breakdowns or failures resulting in discharges of pollutants to surface waters, and ensuring appropriate maintenance of such equipment and systems.

(c) Spill Prevention and Response Procedures—Areas where potential spills which can contribute pollutants to storm water discharges can occur, and their accompanying drainage points shall be identified clearly in the storm water pollution prevention plan. Where appropriate, specifying material handling procedures, storage requirements, and use of equipment such as diversion valves in the plan should be considered. Procedures for cleaning up spills shall be identified in the plan and made available to the appropriate personnel. The necessary equipment to implement a clean up should be available to personnel.

(d) Inspections—In addition to or as part of the comprehensive site evaluation required under paragraph XI.AC.3.a.(4) of this section, qualified facility personnel shall be identified to inspect designated equipment and areas of the facility at appropriate intervals specified in the plan. A set of tracking or follow-up procedures shall be used to ensure that appropriate actions are taken in response to the inspections. Records of inspections shall be maintained.

(e) Employee Training—Employee training programs shall inform personnel responsible for implementing activities identified in the storm water pollution prevention plan or otherwise responsible for storm water management at all levels of responsibility of the components and goals of the storm water pollution prevention plan. Training should address topics such as spill response, good housekeeping and material management practices. The pollution prevention plan shall identify periodic dates for such training.

(f) Recordkeeping and Internal Reporting Procedures—A description of incidents (such as spills, or other discharges), along with other information describing the quality and quantity of storm water discharges shall be included in the plan required under this part. Inspections and maintenance activities shall be documented and records of such activities shall be incorporated into the plan.

(g) Non-storm Water Discharges

(i) The plan shall include a certification that the discharge has been tested or evaluated for the presence of non-storm water discharges. The certification shall include the identification of potential significant sources of non-storm water at the site, a description of the results of any test and/or evaluation for the presence of non-storm water discharges, the evaluation criteria or testing method used, the date of any testing and/or evaluation, and the onsite drainage points that were directly observed during the test. Certifications shall be signed in accordance with Part VII.G. of this permit. Such certification may not be feasible if the facility operating the storm water discharge associated with industrial activity does not have access to an outfall, manhole, or other point of access to the ultimate conduit which receives the discharge. In such cases, the source identification section of the storm water pollution prevention plan shall indicate why the certification required by this part was not feasible, along with the identification of potential significant sources of non-storm water at the site. A discharger that is unable to provide the certification required by this paragraph must notify the Director in accordance with paragraph XI.AC.3.a.(3)(g)(iii) (below).

(ii) Except for flows from fire fighting activities, sources of non-storm water listed in Part III.A.2 (Prohibition of Non-storm Water Discharges) of this permit that are combined with storm water discharges associated with industrial activity must be identified in the plan. The plan shall identify and ensure the implementation of appropriate pollution prevention measures for the non-storm water component(s) of the discharge.

(iii) Failure to Certify—Any facility that is unable to provide the certification required (testing for non-storm water discharges), must notify the Director by [Insert date 270 days after permit issuance] or, for facilities which begin to discharge storm water associated with industrial activity after [Insert date 270 days after permit issuance], 180 days after submitting an NOI to be covered by this permit. If the failure to certify is caused by the inability to perform adequate tests or evaluations, such notification shall describe: the procedure of any test conducted for the presence of non-storm water discharges; the results of such test or other relevant observations; potential sources of non-storm water discharges to the storm sewer; and why adequate tests for such storm sewers were not feasible. Non-storm water discharges to waters of the United States which are not authorized by an NPDES permit are unlawful, and must be terminated.

(h) Sediment and Erosion Control—The plan shall identify areas which, due to topography, activities, or other factors, have a high potential for significant soil erosion, and identify structural, vegetative, and/or stabilization measures to be used to limit erosion.

(i) Management of Runoff—The plan shall contain a narrative consideration of the appropriateness of traditional storm water management practices (practices other than those which control the generation or source(s) of pollutants) used to divert, infiltrate, reuse, or otherwise manage storm water runoff in a manner that reduces pollutants in storm water discharges from the site. The plan shall provide that measures that the permittee determines to be reasonable and appropriate shall be implemented and maintained. The potential of various sources at the facility to contribute pollutants to storm water discharges associated with industrial activity [see paragraph XI.AC.3.a.(2) of this section (Description of Potential Pollutant Sources)] shall be considered when determining reasonable and appropriate measures. Appropriate measures or equivalent measures may include: vegetative swales and practices, reuse of collected storm water (such as for a process or as an irrigation source), inlet controls (such as oil/water separators), snow management activities, infiltration devices, and wet detention/retention devices.

(4) Comprehensive Site Compliance Evaluation. Qualified personnel shall conduct site compliance evaluations once a year. Such evaluations shall provide:

(a) Areas contributing to a storm water discharge associated with industrial activity shall be visually inspected for evidence of, or the potential for, pollutants entering the drainage system. Measures to reduce pollutant loadings shall be evaluated to determine whether they are adequate and properly implemented in accordance with the terms of the permit or whether additional control measures are needed. Structural storm water management measures, sediment and erosion control measures, and other structural pollution prevention measures identified in the plan shall be observed to ensure that they are operating correctly. A visual inspection of equipment needed to implement the plan, such as spill response equipment, shall be made.

(b) Based on the results of the evaluation, the description of potential pollutant sources identified in the plan in accordance with paragraph XI.AC.3.a.(2) of this section (Description of Potential Pollutant Sources) and pollution prevention measures and controls identified in the plan in

accordance with paragraph XI.AC.3.a.(3) of this section (Measures and Controls) shall be revised as appropriate within 2 weeks of such evaluation and shall provide for implementation of any changes to the plan in a timely manner, but in no case more than 12 weeks after the evaluation.

(c) A report summarizing the scope of the inspection, personnel making the evaluation, the date(s) of the evaluation, major observations relating to the implementation of the storm water pollution prevention plan, and actions taken in accordance with paragraph XI.AC.3.a.(4)(b) (above) of the permit shall be made and retained as part of the storm water pollution prevention plan for at least 3 years from the date of the evaluation. The report shall identify any incidents of noncompliance. Where a report does not identify any incidents of noncompliance, the report shall contain a certification that the facility is in compliance with the storm water pollution prevention plan and this permit. The report shall be signed in accordance with Part VII.G. (Signatory Requirements) of this permit.

(d) Where compliance evaluation schedules overlap with inspections required under 3.a.(3)(d), the compliance evaluation may be conducted in place of one such inspection.

4. Numeric Effluent Limitations. There are no additional numeric effluent limitations beyond those described in Part V.B of this permit.

5. Monitoring and Reporting Requirements

a. Monitoring Requirements

(1) Quarterly Visual Examination of Storm Water Quality. Facilities shall perform and document a visual examination of a storm water discharge associated with industrial activity from each outfall, except discharges exempted below. The examination must be made at least once in each designated period [described in (*a*), below] during daylight hours unless there is insufficient rainfall or snow melt to produce a runoff event.

(a) Examinations shall be conducted in each of the following periods for the purposes of visually inspecting storm water quality associated with storm water runoff or snow melt: January through March; April through June; July through September; and October through December.

(b) Examinations shall be made of samples collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed one hour) of when the runoff or snowmelt begins discharging. The examinations shall document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on the samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. Whenever practicable the same individual will carry out the collection and examination of discharges for the life of the permit.

(c) Visual examination reports must be maintained onsite in the pollution prevention plan. The report shall include the examination date and time, examination personnel, the nature of the discharge (i.e., runoff or snow melt), visual quality of the storm water discharge (including observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution), and probable sources of any observed storm water contamination.

(d) When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may collect a sample of effluent of one of such outfalls and report that the observation data also applies to the substantially identical outfalls provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explaining in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

(e) When a discharger is unable to collect samples over the course of the monitoring period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the records of the visual examination. Adverse weather conditions which may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(f) When a discharger is unable to conduct visual storm water examinations at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirement as long as the facility remains inactive and unstaffed. The facility must maintain a certification with the pollution prevention plan stating that the site is inactive and unstaffed so that performing visual examinations during a qualifying event is not feasible.

XII. Coverage Under This Permit

Region III

A. Federal Facilities in the District of Columbia (DCR05##F)*

District of Columbia 401 certification special permit conditions revise the permit as follows:

1. Part IV section B is amended by the addition of the following:

Part IV. Storm Water Pollution Prevention Plans

* * * * *

B. Signature and Plan Review

* * * * *

4. Review and Approval by Department of Consumer and Regulatory Affairs

A copy of all storm water pollution prevention plans required under the permit shall be submitted to the District of Columbia's Department of Consumer and Regulatory Affairs, Environmental Regulation Administration, for review and approval.

2. Part IV section E is amended by the addition of the following:

Part IV. Storm Water Pollution Prevention Plans

* * * * *

E. Special Pollution Prevention Plan Requirements

* * * * *

5. Nitrogen, Phosphorus, Fertilizer, Pesticides and Urea Loadings and Usages

Permittees shall include in the storm water pollution prevention plan current nitrogen and phosphorus loads, current fertilizer usage, current exterior pesticide usage, and current urea for deicing usage.

6. Storm Water and Ground Water Diversions to Sanitary Sewers

Permittees shall include in the storm water pollution prevention plan the volume of any storm water diverted to the sanitary sewer from roof leaders or other connections and the volume any ground water diverted to the sanitary sewer.

7. Proposed Reductions in Nutrient and Pesticide Loads

Permittees shall include in the storm water pollution prevention plan the proposed reductions in nutrient and pesticides loads in accordance with the Chesapeake Bay Restoration goals.

8. Animal Waste Management Plans

Any permittee that manages significant quantities of animals or animal wastes, shall provide in the storm water pollution prevention plan an accounting of these animal wastes, and nutrient control measures for avoiding, reducing, or eliminating runoff of these animal wastes.

B. District of Columbia (DCR05###)*

District of Columbia 401 certification special permit conditions revise the permit as follows:

1. Part IV section B is amended by the addition of the following:

Part IV. Storm Water Pollution Prevention Plans

* * * * *

B. Signature and Plan Review

* * * * *

4. Review and Approval by Department of Consumer and Regulatory Affairs

A copy of all storm water management plans required under the permit shall be submitted to the District of Columbia's Department of Consumer and Regulatory Affairs, Environmental Regulation Administration, for review and approval.

Region VI

C. Louisiana (LAR05###)*

Louisiana 401 certification and Coastal Zone special permit conditions revise the permit as follows:

1. Part I section B. is amended by the addition of the following:

Part I. Coverage Under This Permit

B. Eligibility

* * * * *

8. Discharges Subject to Louisiana Coastal Zone Management Program

Facilities whose activities occur in, or have an effect on, the designated coastal zone of Louisiana, shall have obtained an individual coastal zone consistency concurrence, permit, or waiver from the Coastal Management Division of the Louisiana Department of Natural Resources (in accordance with the Louisiana Coastal Zone Management Program LRS 49:214). Facilities wishing to obtain a description of the areas designated by the State of Louisiana as the "coastal zone" should request that information by writing to: State of Louisiana, Department of Natural Resources, Coastal Zone Management Division, P.O. Box 44487, Baton Rouge, Louisiana 70804-4487.

2. The following section is added to Part V of the Permit:

Part V. Numeric Effluent Limitations

* * * * *

c. *Limitations for all discharges of storm water associated with industrial activity.*

(1) General Limitations: Effective [insert effective date of permit].

Parameter	Daily maximum
Total Organic Carbon (TOC)	50 mg/l
Oil & Grease	15 mg/l

(2) Oil & Gas Exploration and Production Facilities: Effective on effective date of permit.

Parameter	Daily maximum
Chemical Oxygen Demand (COD)	100 mg/l
Total Organic Carbon (TOC)	50 mg/l
Oil & Grease	15 mg/l

Chlorides:

(a) Maximum chloride concentration of the discharge shall not exceed two times the ambient concentration of the receiving water in brackish marsh areas.

(b) Maximum chloride concentration of the discharge shall not exceed 500 mg/l in freshwater or intermediate marsh areas and upland areas.

Facilities without monitoring requirements must insure the pollution prevention plan developed in accordance with Part IV will insure compliance with these effluent limitations.

* * * * *

3. The following definitions are added to Part X of the permit:

Part X. Definitions

"Brackish Marshes"—those areas that are inundated or saturated by surface water or groundwater of moderate salinity at a frequency and duration sufficient to support, and that under normal circumstances do support, emergent vegetation characterized by a prevalence of species typically adapted for life in these soil and contiguous surface water conditions. Typical vegetation includes wiregrass (*Spartina patens*), three-cornered grass (*Scirpus olneyi*), coco (*Scirpus robustus*), and widgeongrass (*Ruppia maritima*). Interstitial water salinity normally ranges between 7 and 15 parts per thousand. (LAC 33:IX.708)

"Freshwater Swamps and Marshes"—those areas that are inundated or saturated by surface water or groundwater of negligible to very low salinity at a frequency and duration sufficient to support, and that under normal circumstances do support, emergent vegetation characterized by a prevalence of species typically adapted for life in these soil and contiguous surface water conditions. Typical vegetation includes maiden cane (*Panicum hemitomon*), *Hydrocotyl sp.*, water hyacinth (*Eichhornia crassipes*), pickerelweed (*Pontederia cordata*), alligatorweed (*Alternanthera philoxeroides*), and bulltongue (*Sagittaria sp.*). Interstitial water salinity is normally less than 2 parts per thousand. (LAC 33:IX.708)

"Intermediate Marshes"—those areas that are inundated or saturated by surface water or groundwater of salinity at a frequency and duration sufficient to support, and that under normal circumstances do support, emergent vegetation characterized by a prevalence of species typically adapted for life in these soil and contiguous surface water conditions. Typical vegetation includes wiregrass (*Spartina patens*), deer pea (*Vigna repens*), bulltongue (*Sagittaria sp.*), wild millet (*Echinochloa walteri*), bullwhip (*Scirpus californicus*), and sawgrass (*Cladium jamaicense*). Interstitial water salinity normally ranges between 3 and 6 parts per thousand. (LAC 33:IX.708)

"Saline Marshes"—those wetland areas that are inundated or saturated by surface water or groundwater of salinity characteristic of near Gulf of Mexico ambient water at a frequency and duration sufficient to support, and that under normal circumstances do support, emergent vegetation characterized by a prevalence of species typically adapted for life in these soil and contiguous surface water conditions. Typical vegetation includes oystergrass (*Spartina alterniflora*), glasswort (*Salicornia sp.*), black rush (*Juncus roemericanus*), *Batis maritima*, black mangrove (*Avicennia nitida*), and saltgrass (*Distichlis spicata*). Interstitial water salinity normally exceeds 16 parts per thousand. (LAC 33:IX.708)

"Upland"—any land area that is not normally inundated with water and that would not, under normal circumstances, be characterized as swamp or fresh, intermediate, brackish, or saline marsh. The term shall have both a regional and site-specific connotation; for example, naturally occurring and man-made topographic highs that are partially or totally surrounded by swamp, marsh, or open water will be considered upland on a local basis, but will not necessitate characterization of the surrounding area as upland. The land and water bottoms of all parishes north of the nine parishes contiguous with the Gulf of Mexico shall be determined on a case-by-case basis with reference to the presences of a regional expanse of emergent aquatic vegetation or open water. (LAC 33:IX.708)

D. New Mexico (NMR05###)*

New Mexico 401 certification special permit conditions revise the permit as follows:

1. Part VI.B of the permit is revised to read:

Part VI. Monitoring and Reporting Requirements

* * * * *

B. *Reporting: Where to Submit.*

* * * * *

3. *Location.* Signed copies of discharge monitoring reports required under Parts XI. and VI.C., individual permit applications, and all other reports required herein, shall be submitted to the appropriate state office address:

New Mexico

Program Manager, Point Source Regulation Section, Surface Water Quality Bureau, New Mexico Environment Department, 1190 St. Francis Drive, Santa Fe, New Mexico 87504-0968

2. Part XI of the permit is revised to include the following additional monitoring for the industrial sectors indicated:

Part XI.

A. Storm Water Discharges Associated With Industrial Activity From Timber Products Facilities

* * * * *

5. Monitoring and Reporting Requirements

(a) * * * In addition to the parameters listed in Tables A–1,2,3,4 the following facilities shall conduct monitoring of the additional parameters indicated and the data reported to the New Mexico State Program Manager at the address above (Part VI.B). A copy of the data shall be kept with the Pollution Prevention Plan. Monitoring for the additional parameters indicated shall be conducted at least quarterly (4 times per year) in the second and fourth year of the permit. The first period of monitoring to begin on the date one year following the date of issuance of this permit. Each year of monitoring (four quarters) shall be reported no later than the following March. The report to NMED shall be postmarked no later that the 31st day of the following March.

(1) Sawmill & planing facilities: shall monitor Biochemical Oxygen Demand (BOD), Nitrate + Nitrite (NO_3+NO_2), Ammonia (NH_3) and Total Kjeldahl Nitrogen (TKN);
(2) Wood preserving facilities: shall monitor Total Suspended Solids (TSS), NO_3+NO_2, NH_3 and TKN;
(3) Log storage & handling facilities: shall monitor Chemical Oxygen Demand (COD), NO_3+NO_2, NH_3 and TKN;
(4) Other wood products: shall monitor BOD, NO_3+NO_2, TKN, NH_3 and oil & grease.

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B. Storm Water Discharges Associated With Industrial Activity From Paper And Allied Products Manufacturing Facilities

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5. Monitoring and Reporting Requirements

(a) * * * In addition to the parameters listed in Table B–1 the following facilities shall conduct monitoring of the additional parameters indicated and the data reported to the New Mexico State Program Manager at the address above (Part VI.B). A copy of the data shall be kept with the Pollution Prevention Plan. Monitoring for the additional parameters indicated shall be conducted at least quarterly (4 times per year) in the second and fourth year of the permit. The first period of monitoring to begin on the date one year following the date of issuance of this permit. Each year of monitoring (four quarters) shall be reported no later than the following March. The report to NMED shall be postmarked no later that the 31st day of the following March.

(1) Paperboard mills: shall monitor TSS, BOD, NO_3+NO_2, and TKN;
(2) Paperboard containers & boxes: shall monitor COD, NO_3+NO_2, NH_3, and TKN;
(3) Converted paper & paperboard products: shall monitor COD, NO_3+NO_2, NH_3, and TKN.

* * * * *

C. Storm Water Discharges Associated With Industrial Activity From Chemical and Allied Products Manufacturing Facilities

* * * * *

6. Monitoring and Reporting Requirements

(a) * * * In addition to the parameters listed in Tables C–2,3,4,5 the following facilities shall conduct monitoring of the additional parameters indicated and the data reported to the New Mexico State Program Manager at the address above (Part VI.B). A copy of the data shall be kept with the Pollution Prevention Plan. Monitoring for the additional parameters indicated shall be conducted at least quarterly (4 times per year) in the second and fourth year of the permit. The first period of monitoring to begin on the date one year following the date of issuance of this permit. Each year of monitoring (four quarters) shall be reported no later than the following March. The report to NMED shall be postmarked no later that the 31st day of the following March.

(1) Agricultural chemical: shall monitor total mercury (Hg), TSS, NH_3, and TKN;
(2) Inorganic chemical: shall monitor total Hg, NH_3, and TKN;
(3) Detergents, cosmetics & perfumes: shall monitor COD, TKN, NH_3, and TSS;
(4) Paints, varnishes, enamels & allied products: shall monitor TSS, NH_3, NO_3+NO_2, and TKN.
(5) Plastics, synthetics, and resins: shall monitor total Hg, NO_3+NO_2, NH_3, and TKN.

* * * * *

D. Storm Water Discharges Associated With Industrial Activity From Asphalt Paving and Roofing Materials and Lubricant Manufacturers

* * * * *

5. Monitoring and Reporting Requirements.

(a) * * * In addition to the parameters listed in Table D–1 the following facilities shall conduct monitoring of the additional parameters indicated and the data reported to the New Mexico State Program Manager at the address above (Part VI.B). A copy of the data shall be kept with the Pollution Prevention Plan. Monitoring for the additional parameters indicated shall be conducted at least quarterly (4 times per year) in the second and fourth year of the permit. The first period of monitoring to begin on the date one year following the date of issuance of this permit. Each year of monitoring (four quarters) shall be reported no later than the following March. The report to NMED shall be postmarked no later that the 31st day of the following March.

Asphalt paving & roofing materials: shall monitor COD, NO_3+NO_2, NH_3, and TKN.

E. Storm Water Discharges Associated With Industrial Activity From Glass, Clay, Cement, Concrete, Gypsum Product Manufacturing Facilities

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5. Monitoring and Reporting Requirements

(a) * * * In addition to the parameters listed in Tables E–1,2 the following facilities shall conduct monitoring of the additional parameters indicated and the data reported to the New Mexico State Program Manager at the address above (Part VI.B). A copy of the data shall be kept with the Pollution Prevention Plan. Monitoring for the additional parameters indicated shall be conducted at least quarterly (4 times per year) in the second and fourth year of the permit. The first period of monitoring to begin on the date one year following the date of issuance of this permit. Each year of monitoring (four quarters) shall be reported no later than the following March. The report to NMED shall be postmarked no later that the 31st day of the following March.

(1) Clay product manufactures: shall monitor TSS;
(2) Concrete & gypsum product manufactures: shall monitor TKN, NH_3, and NO_3+NO_2;
(3) Flat glass, glass & glassware, pressed or blown glass products: shall monitor TKN, NH_3, and NO_3+NO_2.

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F. Storm Water Discharges Associated With Industrial Activity From Primary Metals Facilities.

* * * * *

5. Monitoring and Reporting Requirements

(a) * * * In addition to the parameters listed in Tables F–1, 2, 3, 4 the following facilities shall conduct monitoring of the additional parameters indicated and the data reported to the New Mexico State Program Manager at the address above (Part VI.B). A copy of the data shall be kept with the Pollution Prevention Plan. Monitoring for the additional parameters indicated shall be conducted at least quarterly (4 times per year) in the second and fourth year of the permit. The first period of monitoring to begin on the date one year following the date of issuance of this permit. Each year of monitoring (four quarters) shall be reported no later than the following March. The report to NMED shall be postmarked no later that the 31st day of the following March.

(1) Steel works: shall monitor total Hg, TKN, NO_3+NO_2, NH_3, and TSS;
(2) Iron & steel foundries: shall monitor total Hg, COD, NO_3+NO_2, NH_3, and TKN;
(3) Rolling, drawing & extruding—non-ferrous: shall monitor total Hg, NO_3+NO_2, NH_3, and TKN;
(4) Non-ferrous foundries: shall monitor total Hg, TSS, NO_3+NO_2, NH_3, and TKN.

* * * * *

G. Storm Water Discharges Associated With Industrial Activity From Metal Mining (Ore Mining and Dressing) Facilities

* * * * *

5. Monitoring and Reporting Requirements

(a) * * * In addition to the parameters listed in Table G–1 the following facilities shall conduct monitoring of the additional parameters indicated and the data reported to the New Mexico State Program Manager at the address above (Part VI.B). A copy of the data shall be kept with the Pollution Prevention Plan. Monitoring for the additional parameters indicated shall be conducted at least quarterly (4 times per year) in the second and fourth year of the permit. The first period of monitoring to begin on the date one year following the date of issuance of this permit. Each year of monitoring (four quarters) shall be reported no later than the following March. The report to NMED shall be postmarked no later that the 31st day of the following March.

All metal mining facilities shall monitor for COD, TSS, NO_3+NO_2, TKN, NH_3, total Hg; in addition, all permittees in the SIC code for metals mining shall monitor for any heavy metal which the permittee has reason to believe may be present in storm water runoff from the mining facility.

* * * * *

I. Storm Water Discharges Associated With Industrial Activity From Oil and Gas Extraction Facilities

* * * * *

5. Monitoring and Reporting Requirements

(a) All facilities in this sector shall conduct analytical monitoring for oil and grease: total phosphorus; and total suspended solids (TSS). The data shall be reported to the New Mexico State Program Manager at the address above (Part VI.B). A copy of the data shall be kept with the Pollution Prevention Plan. Monitoring for the additional parameters indicated shall be conducted at least quarterly (4 times per year) in the second and fourth year of the permit. The first period of monitoring to begin on the date one year following the date of issuance of this permit. Each year of monitoring (four quarters) shall be reported no later than the following March. The report to NMED shall be postmarked no later that the 31st day of the following March.

* * * * *

J. Storm Water Discharges Associated With Industrial Activity From Mineral Mining and Processing Facilities

* * * * *

5. Monitoring and Reporting Requirements

(a) * * * In addition to the parameters listed in Table J–1 the following facilities shall conduct monitoring of the additional parameters indicated and the data reported to the New Mexico State Program Manager at the address above (Part VI.B). A copy of the data shall be kept with the Pollution Prevention Plan. Monitoring for the additional parameters indicated shall be conducted at least quarterly (4 times per year) in the second and fourth year of the permit. The first period of monitoring to begin on the date one year following the date of issuance of this permit. Each year of monitoring (four quarters) shall be reported no later than the following March. The report to NMED shall be postmarked no later that the 31st day of the following March.

Sand & gravel mining facilities: shall monitor TKN and NH_3.

* * * * *

K. Storm Water Discharges Associated With Industrial Activity From Hazardous Waste Treatment, Storage, or Disposal Facilities

* * * * *

5. Monitoring and Reporting Requirements

(a) * * * In addition to the parameters listed in Table K–1 all facilities shall monitor TKN, NO_3+NO_2, and TSS and the data reported to the New Mexico State Program Manager at the address above (Part VI.B). A copy of the data shall be kept with the Pollution Prevention Plan. Monitoring for the additional parameters indicated shall be conducted at least quarterly (4 times per year) in the second and fourth year of the permit. The first period of monitoring to begin on the date one year following the date of issuance of this permit. Each year of monitoring (four quarters) shall be reported no later than the following March. The report to NMED shall be postmarked no later that the 31st day of the following March.

* * * * *

L. Storm Water Discharges Associated With Industrial Activity From LandFills and Land Application Sites

5. Monitoring and Reporting Requirements.

(a) * * * In addition to the parameters listed in Table L–1 all facilities shall monitor TKN, NH_3, and NO_3+NO_2 and the data reported to the New Mexico State Program Manager at the address above (Part VI.B). A copy of the data shall be kept with the Pollution Prevention Plan. Monitoring for the additional parameters indicated shall be conducted at least quarterly (4 times per year) in the second and fourth year of the permit. The first period of monitoring to begin on the date one year following the date of issuance of this permit. Each year of monitoring (four quarters) shall be reported no later than the following March. The report to NMED shall be postmarked no later that the 31st day of the following March.

* * * * *

M. Storm Water Discharges Associated With Industrial Activity From Automobile Salvage Yards

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4. Monitoring and Reporting Requirements.

(a) * * * In addition to the parameters listed in Table M–1 all facilities shall monitor oil & grease, NO_3+NO_2, NH_3, and TKN and the data reported to the New Mexico State Program Manager at the address above (Part VI.B). A copy of the data shall be kept with the Pollution Prevention Plan. Monitoring for the additional parameters indicated shall be conducted at least quarterly (4 times per year) in the second and fourth year of the permit. The first period of monitoring to begin on the date one year following the date of issuance of this permit. Each year of monitoring (four quarters) shall be reported no later than the following March. The report to NMED shall be postmarked no later that the 31st day of the following March.

* * * * *

N. Storm Water Discharges Associated With Industrial Activity From Scrap Recycling and Waste Recycling Facilities

* * * * *

5. Monitoring and Reporting Requirements

(a) * * * In addition to the parameters listed in Table N–1 all facilities shall monitor oil & grease, NO_3+NO_2, NH_3, and TKN and the data reported to the New Mexico State Program Manager at the address above (Part VI.B). A copy of the data shall be kept with the Pollution Prevention Plan. Monitoring for the additional parameters indicated shall be conducted at least quarterly (4 times per year) in the second and fourth year of the permit. The first period of monitoring to begin on the date one year following the date of issuance of this permit. Each year of monitoring (four quarters) shall be reported no later than the following March. The report to NMED shall be postmarked no later that the 31st day of the following March.

* * * * *

O. Storm Water Discharges Associated With Industrial Activity From Steam Electric Power Generating Facilities, Including Coal Handling Areas

* * * * *

5. Monitoring and Reporting Requirements

(a) * * * In addition to the parameters listed in Table O–1 all facilities shall monitor TSS, NO_3+NO_2, TKN, NH_3, and total Zinc (Zn) and the data reported to the New Mexico State Program Manager at the address above (Part VI.B). A copy of the data shall be kept with the Pollution Prevention Plan. Monitoring for the additional parameters indicated shall be conducted at least quarterly (4 times per year) in the second and fourth year of the permit. The first period of monitoring to begin on the date one year following the date of issuance of this permit. Each year of monitoring (four quarters) shall be reported no later than the following March. The report to NMED shall be postmarked no later that the 31st day of the following March.

* * * * *

P. Storm Water Discharges Associated With Industrial Activity From Motor Freight Transportation Facilities, Petroleum Bulk Oil Stations and Terminals, Rail Transportation Facilities, and United States Postal Service Transportation Facilities

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4. Monitoring and Reporting Requirements

(a) The following facilities shall conduct analytical monitoring of the parameters indicated and the data reported to the New Mexico State Program Manager at the address above (Part VI.B). A copy of the data shall be kept with the Pollution Prevention Plan. Monitoring for the additional parameters indicated shall be conducted at least quarterly (4 times per year) in the second and fourth year of the permit. The first period of monitoring to begin on the date one year following the date of issuance of this permit. Each year of monitoring (four quarters) shall be reported no later than the following March. The report to NMED shall be postmarked no later that the 31st day of the following March.

(1) Railroad transportation: shall monitor COD, NO_3+NO_2, TKN, NH_3, TSS, total Zn, and oil & grease;

(2) Local & highway passenger transportation: shall monitor NO_3+NO_2, NH_3, oil & grease, TSS, and TKN;
(3) Motor freight transportation & warehousing: shall monitor NO_3+NO_2, NH_3, TSS, total Zn, TKN, and oil & grease;
(4) U.S. Postal Service: shall monitor total Zn;
(5) Petroleum bulk stations: shall monitor TKN, NO_3+NO_2, NH_3, and TSS.

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Q. Storm Water Discharges Associated With Industrial Activity From Water Transportation Facilities That Have Vehicle Maintenance Shops and/or Equipment Cleaning Operations

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5. Monitoring and Reporting Requirements

(a) * * * In addition to the parameters listed in Table Q–1 all facilities shall monitor TSS, NO_3+NO_2, NH_3, and TKN and the data reported to the New Mexico State Program Manager at the address above (Part VI.B.). A copy of the data shall be kept with the Pollution Prevention Plan. Monitoring for the additional parameters indicated shall be conducted at least quarterly (4 times per year) in the second and fourth year of the permit. The first period of monitoring to begin on the date one year following the date of issuance of this permit. Each year of monitoring (four quarters) shall be reported no later than the following March. The report to NMED shall be postmarked no later that the 31st day of the following March.

* * * * *

S. Storm Water Discharges Associated With Industrial Activity From Vehicle Maintenance Areas, Equipment Cleaning Areas, or Deicing Areas Located at Air Transportation Facilities

* * * * *

5. Monitoring and Reporting Requirements

(a) * * * In addition to the parameters listed in Table S–1 the following facilities shall conduct monitoring of the additional parameters indicated and the data reported to the New Mexico State Program Manager at the address above (Part VI.B.). A copy of the data shall be kept with the Pollution Prevention Plan. Monitoring for the additional parameters indicated shall be conducted at least quarterly (4 times per year) in the second and fourth year of the permit. The first period of monitoring to begin on the date one year following the date of issuance of this permit. Each year of monitoring (four quarters) shall be reported no later than the following March. The report to NMED shall be postmarked no later that the 31st day of the following March.

(1) Vehicle maintenance and/or cleaning areas: shall monitor oil & grease, COD, TSS;

* * * * *

(b) Quarterly Visual Examination of Storm Water Quality. Storm water discharge from vehicle maintenance, cleaning or deicing areas shall be visually examined once each quarter as specified below. These facilities shall perform and document a visual examination of a storm water discharge associated with industrial activity from each outfall, except discharges exempted below. The examination(s) must be made at least once in each of the following 3-month periods: January through March, April through June, July through September, and October through December. The examination shall be made during daylight hours unless there is insufficient rainfall or snow melt to produce a runoff event.

(1) Examinations shall be made of samples collected within the first 30 minutes (or as soon thereafter as practical, but not to exceed 1 hour) of when the runoff or snow melt begins discharging. The examination shall document observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution. The examination must be conducted in a well lit area. No analytical tests are required to be performed on the samples. All such samples shall be collected from the discharge resulting from a storm event that is greater than 0.1 inches in magnitude and that occurs at least 72 hours from the previously measurable (greater than 0.1 inch rainfall) storm event. Where practicable, the same individual should carry out the collection and examination of discharges for the entire permit term.

(2) Visual examination reports must be maintained onsite in the pollution prevention plan. The report shall include the examination date and time, examination personnel, the nature of the discharge (i.e., runoff or snow melt), visual quality of the storm water discharge (including observations of color, odor, clarity, floating solids, settled solids, suspended solids, foam, oil sheen, and other obvious indicators of storm water pollution), and probable sources of any observed storm water contamination.

(3) When a facility has two or more outfalls that, based on a consideration of industrial activity, significant materials, and management practices and activities within the area drained by the outfall, the permittee reasonably believes discharge substantially identical effluents, the permittee may collect a sample of effluent of one of such outfalls and report that the examination data also applies to the substantially identical outfall(s) provided that the permittee includes in the storm water pollution prevention plan a description of the location of the outfalls and explains in detail why the outfalls are expected to discharge substantially identical effluents. In addition, for each outfall that the permittee believes is representative, an estimate of the size of the drainage area (in square feet) and an estimate of the runoff coefficient of the drainage area [e.g., low (under 40 percent), medium (40 to 65 percent), or high (above 65 percent)] shall be provided in the plan.

(4) When a discharger is unable to collect samples over the course of the visual examination period as a result of adverse climatic conditions, the discharger must document the reason for not performing the visual examination and retain this documentation onsite with the records of the visual examinations. Adverse weather conditions that may prohibit the collection of samples include weather conditions that create dangerous conditions for personnel (such as local flooding, high winds, hurricane, tornadoes, electrical storms, etc.) or otherwise make the collection of a sample impracticable (drought, extended frozen conditions, etc.).

(5) When a discharger is unable to conduct visual storm water examinations at an inactive and unstaffed site, the operator of the facility may exercise a waiver of the monitoring requirement as long as the facility remains inactive and unstaffed. The facility must maintain a certification with the pollution prevention plan stating that the site is inactive and unstaffed so that performing visual examinations during a qualifying event is not feasible.

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T. Storm Water Discharges Associated With Industrial Activity From Treatment Works.

* * * * *

5. Monitoring and Reporting Requirements

(a) * * * In addition to the visual monitoring, all facilities shall conduct analytical monitoring of BOD, NO_3+NO_2, TKN, NH_3, TSS, and fecal coliform, and the data reported to the New Mexico State Program Manager at the address above (Part VI.B). A copy of the data shall be kept with the Pollution Prevention Plan. Monitoring for the additional parameters indicated shall be conducted at least quarterly (4 times per year) in the second and fourth year of the permit. The first period of monitoring to begin on the date one year following the date of issuance of this permit. Each year of monitoring (four quarters) shall be reported no later than the following March. The report to NMED shall be postmarked no later that the 31st day of the following March.

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U. Storm Water Discharges Associated With Industrial Activity From Food and Kindred Products Facilities

* * * * *

5. Monitoring and Reporting Requirements

(a) * * * In addition to the parameters listed in Table U–1,2 the following facilities shall conduct monitoring of the additional parameters indicated and the data reported to the New Mexico State Program Manager at the address above (Part VI.B). A copy of the data shall be kept with the Pollution Prevention Plan. Monitoring for the additional parameters indicated shall be conducted at least quarterly (4 times per year) in the second and fourth year of the permit. The first period of monitoring to begin on the date one year following the date of issuance of this permit. Each year of monitoring (four quarters) shall be reported no later than the following March. The report to NMED shall be postmarked no later that the 31st day of the following March.

(1) Grain mill products: shall monitor COD, total Zn, TKN, NO_3+NO_2, NH_3, and total phosphorus;
(2) Fats and oils products: shall monitor TKN and NH_3;
(3) Dairy products: shall monitor BOD, COD, NO_3+NO_2, TKN, NH_3, and TSS;
(4) Meat products: shall monitor NO_3+NO_2, TKN, and TSS;

(5) Canned, frozen & preserved fruits: shall monitor NO_3+NO_2, NH_3, COD, and TKN;
(6) Bakery products: shall monitor TKN, NO_3+NO_2, NH_3, and TSS;
(7) Beverage facilities: shall monitor total Zn;
(8) Miscellaneous: shall monitor TKN, NO_3+NO_2, NH_3, and TSS.

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W. Storm Water Discharges Associated With Industrial Activity From Wood and Metal Furniture and Fixture Manufacturing Facilities

* * * * *

5. Monitoring and Reporting Requirements

(a) All facilities shall conduct analytical monitoring of NO_3+NO_2, TKN, NH_3, TSS and total Zn, and the data reported to the New Mexico State Program Manager at the address above (Part VI.B). A copy of the data shall be kept with the Pollution Prevention Plan. Monitoring for the additional parameters indicated shall be conducted at least quarterly (4 times per year) in the second and fourth year of the permit. The first period of monitoring to begin on the date one year following the date of issuance of this permit. Each year of monitoring (four quarters) shall be reported no later than the following March. The report to NMED shall be postmarked no later that the 31st day of the following March.

* * * * *

Y. Storm Water Discharges Associated With Industrial Activity From Rubber, Miscellaneous Plastic Products, and Miscellaneous Manufacturing Industries

* * * * *

5. Monitoring and Reporting Requirements

(a) * * * In addition to the parameters listed in Table Y–1 the following facilities shall conduct monitoring of the additional parameters indicated and the data reported to the New Mexico State Program Manager at the address above (Part VI.B). A copy of the data shall be kept with the Pollution Prevention Plan. Monitoring for the additional parameters indicated shall be conducted at least quarterly (4 times per year) in the second and fourth year of the permit. The first period of monitoring to begin on the date one year following the date of issuance of this permit. Each year of monitoring (four quarters) shall be reported no later than the following March. The report to NMED shall be postmarked no later that the 31st day of the following March.

(1) Rubber products manufacturing: shall monitor TSS, TKN, NO_3+NO_2, NH_3, and total Hg;
(2) Miscellaneous plastics products: shall monitor NO_3+NO_2, NH_3, TKN, TSS, and total Hg.

* * * * *

Z. Storm Water Discharges Associated With Industrial Activity From Leather Tanning and Finishing Facilities

* * * * *

5. Monitoring and Reporting Requirements

(a) * * * In addition to the visual monitoring, all facilities shall conduct analytical monitoring of COD, NO_3+NO_2, TKN, NH_3, and TSS, and the data reported to the New Mexico State Program Manager at the address above (Part VI.B). A copy of the data shall be kept with the Pollution Prevention Plan. Monitoring for the additional parameters indicated shall be conducted at least quarterly (4 times per year) in the second and fourth year of the permit. The first period of monitoring to begin on the date one year following the date of issuance of this permit. Each year of monitoring (four quarters) shall be reported no later than the following March. The report to NMED shall be postmarked no later that the 31st day of the following March.

* * * * *

AA. Storm Water Discharges Associated With Industrial Activity From Fabricated Metal Products Industry

* * * * *

5. Monitoring and Reporting Requirements

(a) * * * In addition to the parameters listed in Table AA–1,2 the following facilities shall conduct monitoring of the additional parameters indicated and the data reported to the New Mexico State Program Manager at the address above (Part VI.B). A copy of the data shall be kept with the Pollution Prevention Plan. Monitoring for the additional parameters indicated shall be conducted at least quarterly (4 times per year) in the second and fourth year of the permit. The first period of monitoring to begin on the date one year following the date of issuance of this permit. Each year of monitoring (four quarters) shall be reported no later than the following March. The report to NMED shall be postmarked no later that the 31st day of the following March.

(1) Metal products except coating: shall monitor TKN, NH3, and TSS;
(2) Metal coating & engraving: shall monitor TKN, and NH3.

* * * * *

AC. Storm Water Discharges Associated With Industrial Activity From Facilities That Manufacture Electronic and Electrical Equipment and Components, Photographic and Optical Goods

* * * * *

5. Monitoring and Reporting Requirements

(a) All facilities shall conduct analytical monitoring of total Aluminum (Al), total Zn and total Hg, and the data reported to the New Mexico State Program Manager at the address above (Part VI.B). A copy of the data shall be kept with the Pollution Prevention Plan. Monitoring for the additional parameters indicated shall be conducted at least quarterly (4 times per year) in the second and fourth year of the permit. The first period of monitoring to begin on the date one year following the date of issuance of this permit. Each year of monitoring (four quarters) shall be reported no later than the following March. The report to NMED shall be postmarked no later that the 31st day of the following March.

In addition to the above-referenced conditions, per 40 CFR 122.44(d)(6) to ensure consistency with work element 6 of the State-adopted Water Quality Management Plan (WQMP) approved by EPA under Section 208(b) of the CWA, NMED is requiring that all permittees covered under this general permit, who are required to do sampling, be additionally required to monitor and report pH.

* * * * *

E. Oklahoma (OKR05###)*

Oklahoma 401 certification special permit conditions revise the permit as follows:

Part I.B.3. Limitations on Coverage. Insert the following paragraph:

f. Discharges to Oklahoma Outstanding Resource Waters and Scenic Rivers. "New" point source discharges of storm water associated with industrial activity (those commencing after the June 25, 1992, effective date of the Oklahoma Water Quality Standards—Oklahoma Annotated Code Title 785, Chapter 45) to the following waters:

(1) waterbodies designated as "Outstanding Resource Waters" and/or "Scenic Rivers" in Appendix A of the Oklahoma Water Quality Standards;

(2) Oklahoma waterbodies located within the watersheds of waterbodies designated as "Scenic Rivers" in Appendix A of the Oklahoma Water Quality Standards; and

(3) waterbodies located within the boundaries of Oklahoma Water Quality Standards Appendix B areas which are specifically designated as "Outstanding Resource Waters" in Appendix A of the Oklahoma Water Quality Standards.

D. Texas (TXR05###)*

Texas 401 certification special permit conditions revise the permit as follows:

1. The following sections are added to Part V of the permit:

Part V. Numeric Effluent Limitations

* * * * *

C. All Discharges to Inland Waters

The maximum allowable concentrations of each of the hazardous metals, stated in terms of milligrams per liter (mg/l), for discharges to inland waters are as follows:

Total metal	Monthly average	Daily composite	Single grab
Arsenic	0.1	0.2	0.3
Barium	1.0	2.0	4.0
Cadmium	0.05	0.1	0.2
Chromium	0.5	1.0	5.0

Total metal	Monthly average	Daily composite	Single grab
Copper	0.5	1.0	2.0
Lead	0.5	1.0	1.5
Manganese	1.0	2.0	3.0
Mercury	0.005	0.005	0.01
Nickel	1.0	2.0	3.0
Selenium	0.05	0.1	0.2
Silver	0.05	0.1	0.2
Zinc	1.0	2.0	6.0

C. All Discharges to Tidal Waters

The maximum allowable concentrations of each of the hazardous metals, stated in terms of milligrams per liter (mg/l), for discharges to tidal waters are as follows:

Total metal	Monthly average	Daily composite	Single grab
Arsenic	0.1	0.2	0.3
Barium	1.0	2.0	4.0
Cadmium	0.1	0.2	0.3
Chromium	0.5	1.0	5.0
Copper	0.5	1.0	2.0
Lead	0.5	1.0	1.5
Manganese	1.0	2.0	3.0
Mercury	0.005	0.005	0.01
Nickel	1.0	2.0	3.0
Selenium	0.10	0.2	0.3
Silver	0.05	0.1	0.2
Zinc	1.0	2.0	6.0

2. The following section is added to Part VI. of the permit:

* * * * *

D. *Toxicity Testing.* All facilities that have demonstrated significant lethality, which has not been controlled, shall continue to perform WET testing in accordance with the requirements below. Permittees that are required to monitor for acute whole effluent toxicity shall initiate the series of tests described below within 180 days after the issuance of this permit or within 90 days after the commencement of a new discharge.

The permittee shall test the effluent for lethality in accordance with the provisions of this section. Such testing will determine if an effluent sample meets the Texas Surface Water Quality Standard listed at 31 TAC § 307.6(e)(2)(B) of greater than 50% survival of the appropriate test organisms in 100% effluent for a 24-hour period.

1. Test Procedures

a. The permittee shall conduct acute 24 hour static toxicity tests on both an appropriate invertebrate and an appropriate fish (vertebrate) test species (EPA/600/4–90–027 Rev. 9/91, Section 6.1.). Freshwater species must be used for discharges to freshwater water bodies. Due to the non-saline nature of rainwater, freshwater test species should also be used for discharges to estuarine, marine or other naturally saline waterbodies.

The following tests shall be used:

1. Acute static 24-hour definitive toxicity test using *Daphnia pulex*. A minimum of four (4) replicates with a minimum of five (5) organisms per replicate shall be used for this test.

2. Acute static 24-hour definitive toxicity test using fathead minnow (*Pimephales promelas*). A minimum of four (4) replicates with a minimum of ten (10) organisms per replicate shall be used for this test.

b. Five dilutions in addition to an appropriate control (0% effluent), shall be used in the toxicity tests. These effluent concentrations shall be 6%, 13%, 25%, 50% and 100%. The control and/or dilution water shall consist of a standard, synthetic, moderately hard, reconstituted water. If more than 10% of the test organisms in any control die, that test, including the control and all effluent dilution(s), shall be repeated, with all results from *both* tests reported.

c. All test organisms, procedures and quality assurance criteria used shall be in accordance with *Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms*, EPA/600/4–90–027 (Rev. September 1991). EPA has proposed to establish regulations regarding these test methods (December 4, 1989, 53 *FR* 50216).

d. Tests shall be conducted semiannually (twice per year) on a grab sample of the discharge at 100% strength (no dilution), the dilutions specified in paragraph b. above, and a control consisting of either receiving water or synthetic dilution water. Results of all tests conducted with any species shall be reported according to EPA/600/4–90–027 (Rev. September 1991), Section 12, Report Preparation, and the report retained onsite. The test results shall be summarized in the format used on Table VI–A and submitted to EPA with the Discharge Monitoring Reports (DMR's). On the DMR, the permittee shall report test results in accordance with the instructions on Table VI–A.

3. The following definitions are added to Part X of the permit:

Part X. Definitions

"Inland Waters"—all surface waters in the State other than "tidal waters" as defined below.

"Tidal Waters"—those waters of the Gulf of Mexico within the jurisdiction of the State of Texas, bays and estuaries thereto, and those portions of the river systems which are subject to the ebb and flow of the tides, and to the intrusion of marine waters.

Region IX

Arizona (AZR05###) and Federal Facilities in Arizona (AZR05*##F)*

Arizona 401 certification special permit conditions revise the permit as follows:

1. Part I section B is amended by the addition of the following:

Part I. Coverage Under This Permit

* * * * *

B. Eligibility

* * * * *

8. Compliance with Water Quality Standards of the State of Arizona

Discharges authorized by this permit shall not cause or contribute to a violation of any applicable water quality standard of the State of Arizona (Arizona Administrative Code, Title 18, Chapter 11).

2. The following language is added to Part II section D:

Part II. Notification Requirements

* * * * *

D. Where to Submit

Notices of Intent shall also be submitted to the State of Arizona Department of Environmental Quality at the following address: Storm Water Coordinator, Arizona Department of Environmental Quality, 3033 N. Central Avenue, Phoenix, Arizona 85012.

NOIs submitted to the State of Arizona shall include the well registration number if storm water associated with industrial activity is discharged to a dry well or an injection well.

3. The following language is added to Part IV section E.2:

Part IV. Storm Water Pollution Prevention Plans

* * * * *

E. Special Pollution Prevention Plan Requirements

* * * * *

2. *Additional Requirements for Storm Water Discharges Associated With Industrial Activity From Facilities Subject to EPCRA Section 313 Requirements*

* * * * *

e. SARA Section 313 (Community Right to Know) Facilities shall have the following requirement:

Liquid storage areas for Section 313 water priority chemicals shall be operated to minimize discharges of Section 313 chemicals. Appropriate measures to minimize discharges of Section 313 chemicals shall include secondary containment provided for at least the entire contents of the largest tank plus sufficient freeboard to allow for the *25-year, 24-hour precipitation event,* a strong spill contingency and integrity testing plan, and/or other equivalent measures.

4. Part IV. Section E is amended by the addition of the following:

Part IV. Storm Water Pollution Prevention Plans

* * * * *

E. Special Pollution Prevention Plan Requirements

* * * * *

5. Delineation of Facility Areas Below Base Elevation

All facilities with any portion of the facility that is located at or below the Base Elevation shall delineate on the site map those portions of the facility that are located at or below the Base Elevation.

5. The following language is added to Part VI section B.2:

Part VI. Monitoring and Reporting Requirements

* * * * *

B. Reporting: Where to Submit

* * * * *

2. *Additional Notification.* Facilities subject to monitoring and reporting requirements shall also submit Discharge Monitoring Report Form(s) and other required monitoring information to the State of Arizona Department of Environmental Quality at the following address: Storm

Water Coordinator/DMR, Arizona Department of Environmental Quality, 3033 N. Central Avenue, Phoenix, Arizona 85012.

6. The following is added to Part IX section B:

Part IX. Termination of Coverage

* * * * *

B. Addresses

Notices of Termination shall also be submitted to the State of Arizona Department of Environmental Quality at the following address: Storm Water Coordinator, Arizona Department of Environmental Quality, 3033 N. Central Avenue, Phoenix, Arizona 85012.

7. The following definitions are added to Part X of the permit:

Part X. Definitions

"Significant Sources of Non-Storm Water"—includes, but is not limited to discharges which could cause or contribute to violations of water quality standards of the State of Arizona, and discharges which could include releases of oil or hazardous substances in excess of reportable quantities under Section 311 of the Clean Water Act (see 40 CFR 110.10 and CFR 117.21) or Section 102 of CERCLA (see CFR 302.4).

"Base Elevation"—elevation of a surface waterbody having a one percent chance of being equaled or exceeded during any given year.

Region X

F. Washington (WAR05###)*

Washington 401 certification special permit conditions revise the permit as follows:

1. Part I section B is amended by the addition of the following:

Part I. Coverage Under This Permit

* * * * *

B. Eligibility

* * * * *

8. Compliance with Washington Water Quality and Sediment Standards

Discharges authorized by this permit shall not cause or contribute to a violation of any applicable water quality standard of the State of Washington, specifically Chapter 173-201A WAC Surface Water Quality Standards, Chapter 173-204 WAC Sediment Standards, and the National Toxics Rule for human health related to water quality standards.

Addendum A—Pollutants Identified in Tables II and III of Appendix D of 40 CFR Part 122

Table II.—Organic Toxic Pollutants in Each of Four Fractions in Analysis by Gas Chromatography/Mass Spectroscopy (GS/MS)

Volatiles

1V acrolein
2V acrylonitrile
3V benzene
5V bromoform
6V carbon tetrachloride
7V chlorobenzene
8V chlorodibromomethane
9V chloroethane
10V 2-chloroethylvinyl ether
11V chloroform
12V dichlorobromomethane
14V 1,1-dichloroethane
15V 1,2-dichloroethane
16V 1,1-dichloroethylene
17V 1,2-dichloropropane
18V 1,3-dichloropropylene
19V ethylbenzene
20V methyl bromide
21V methyl chloride
22V methylene chloride
23V 1,1,2,2-tetrachloroethane
24V tetrachloroethylene
25V toluene
26V 1,2-trans-dichloroethylene
27V 1,1,1-trichloroethane
28V 1,1,2-trichloroethane
29V trichloroethylene
31V vinyl chloride

Acid Compounds

1A 2-chlorophenol
2A 2,4-dichlorophenol
3A 2,4-dimethylphenol
4A 4,6-dinitro-o-cresol
5A 2,4-dinitrophenol
6A 2-nitrophenol
7A 4-nitrophenol
8A p-chloro-m-cresol
9A pentachlorophenol
10A phenol
11A 2,4,6-trichlorophenol

Base/Neutral

1B acenaphthene
2B acenaphthylene
3B anthracene
4B benzidine
5B benzo(a)anthracene
6B benzo(a)pyrene
7B 3,4-benzofluoranthene
8B benzo(ghi)perylene
9B benzo(k)fluoranthene
10B bis(2-chloroethoxy)methane
11B bis(2-chloroethyl)ether
12B bis(2-chloroisopropyl)ether
13B bis (2-ethylhexyl)phthalate
14B 4-bromophenyl phenyl ether
15B butylbenzyl phthalate
16B 2-chloronaphthalene
17B 4-chlorophenyl phenyl ether
18B chrysene
19B dibenzo(a,h)anthracene
20B 1,2-dichlorobenzene
21B 1,3-dichlorobenzene
22B 1,4-dichlorobenzene
23B 3,3'-dichlorobenzidine
24B diethyl phthalate
25B dimethyl phthalate
26B di-n-butyl phthalate
27B 2,4-dinitrotoluene
28B 2,6-dinitrotoluene
29B di-n-octyl phthalate
30B 1,2-diphenylhydrazine (as azobenzene)
31B fluroranthene
32B fluorene
33B hexachlorobenzene
34B hexachlorobutadiene
35B hexachlorocyclopentadiene
36B hexachloroethane
37B indeno(1,2,3-cd)pyrene
38B isophorone
39B napthalene
40B nitrobenzene
41B N-nitrosodimethylamine
42B N-nitrosodi-n-propylamine
43B N-nitrosodiphenylamine
44B phenanthrene
45B pyrene
46B 1,2,4-trichlorobenzene

Pesticides

1P aldrin
2P alpha-BHC
3P beta-BHC
4P gamma-BHC
5P delta-BHC
6P chlordane
7P 4,4'-DDT
8P 4,4'-DDE
9P 4,4'-DDD
10P dieldrin
11P alpha-endosulfan
12P beta-endosulfan
13P endosulfan sulfate
14P endrin
15P endrin aldehyde
16P heptachlor
17P heptachlor epoxide
18P PCB-1242
19P PCB-1254
20P PCB-1221
21P PCB-1232
22P PCB-1248
23P PCB-1260
24P PCB-1016
25P toxaphene

Table III.—Other Toxic Pollutants (Metals and Cyanide) and Total Phenols

Antimony, Total
Arsenic, Total
Beryllium, Total
Cadmium, Total
Chromium, Total
Copper, Total
Lead, Total
Mercury, Total
Nickel, Total
Selenium, Total
Silver, Total
Thallium, Total
Zinc, Total
Cyanide, Total
Phenols, Total

Table V.—Toxic Pollutants and Hazardous Substances Required To Be Identified by Existing Dischargers if Expected To Be Present

Toxic Pollutants

Asbestos

Hazardous Substances

Acetaldehyde
Allyl alcohol
Allyl chloride
Amyl acetate
Aniline
Benzonitrile
Benzyl chloride
Butyl acetate
Butylamine
Captan
Carbaryl
Carbofuran
Carbon disulfide
Chlorpyrifos

Coumaphos
Cresol
Crotonaldehyde
Cyclohexane
2,4-D (2,4-Dichlorophenoxy acetic acid)
Diazinon
Dicamba
Dichlobenil
Dichlone
2,2-Dichloropropionic acid
Dichlorvos
Diethyl amine
Dimethyl amine
Dinitrobenzene
Diquat
Disulfoton
Diuron
Epichlorohydrin
Ethion
Ethylene diamine
Ethylene dibromide
Formaldehyde
Furfural
Guthion
Isoprene
Isopropanolamine Dodecylbenzenesulfonate
Kelthane
Kepone
Malathion
Mercaptodimethur
Methoxychlor
Methyl mercaptan
Methyl methacrylate
Methyl parathion
Mevinphos
Mexacarbate
Monoethyl amine
Monomethyl amine
Naled
Napthenic acid
Nitrotoluene
Parathion
Phenosulfanate
Phosgene
Propargite
Propylene oxide
Pyrethrins
Quinoline
Resorcinol
Strontium
Strychnine
Styrene
2,4,5-T (2,4,5-Trichlorophenoxy acetic acid)
TDE (Tetrachlorodiphenylethane)
2,4,5-TP [2-(2,4,5-Trichlorophenoxy) propanoic acid]
Trichlorofan
Triethanolamine dodecylbenzenesulfonate
Triethylamine
Trimethylamine
Uranium
Vanadium
Vinyl acetate
Xylene
Xylenol
Zirconium

BILLING CODE 6560-50-P

R0016542

THIS FORM REPLACES PREVIOUS FORM 3510-6 (8-92)
See Reverse for Instructions

Form Approved. OMB No. 2040-0086
Approval expires: 8-31-98

NPDES FORM

EPA

United States Environmental Protection Agency
Washington, DC 20460

Notice of Intent (NOI) for Storm Water Discharges Associated with Industrial Activity Under a NPDES General Permit

Submission of this Notice of Intent constitutes notice that the party identified in Section II of this form intends to be authorized by a NPDES permit issued for storm water discharges associated with industrial activity in the State identified in Section III of this form. Becoming a permittee obligates such discharger to comply with the terms and conditions of the permit. ALL NECESSARY INFORMATION MUST BE PROVIDED ON THIS FORM.

I. Permit Selection: You must indicate the NPDES Storm Water general permit under which you are applying for coverage. Check one of these.

Baseline Industrial ☐ Baseline Construction ☐ Multi-Sector (Group Permit) ☐

II. Facility Operator Information

Name: ______ Phone: ______

Address: ______ Status of Owner/Operator: ☐

City: ______ State: ____ ZIP Code: ______

III. Facility/Site Location

Name: ______

Is the facility located on Indian Lands? (Y or N) ☐

Address: ______

City: ______ State: ____ ZIP Code: ______

Latitude: ______ Longitude: ______ Quarter: ____ Section: ____ Township: ______ Range: ______

IV. Site Activity Information

MS4 Operator Name: ______

Receiving Water Body: ______

If you are filing as a co-permittee, enter storm water general permit number: ______

SIC or Designated Activity Code: Primary: ______ 2nd: ______

Is the facility required to submit monitoring data? (1, 2, 3, or 4) ☐

If You Have Another Existing NPDES Permit, Enter Permit Number: ______

Multi-Sector Permit Applicants Only:

Based on the instructions provided in Addendum H of the Multi-Sector permit, are species identified in Addendum H in proximity to the storm water discharges to be covered under this permit, or the areas of BMP construction to control those storm water discharges? (Y or N) ☐

Will construction (land disturbing activities) be conducted for storm water controls? (Y or N) ☐

Is applicant subject to and in compliance with a written historic preservation agreement? (Y or N) ☐

V. Additional Information Required for Construction Activities Only

Project Start Date: ______ Completion Date: ______ Estimated Area to be Disturbed (in Acres): ______

Is the Storm Water Pollution Prevention Plan in compliance with State and/or Local sediment and erosion plans? (Y or N) ☐

VI. Certification: The certification statement in Box 1 applies to all applicants.
The certification statement in Box 2 applies only to facilities applying for the Multi-Sector storm water general permit.

BOX 1

ALL APPLICANTS:

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

BOX 2

MULTI-SECTOR STORM WATER GENERAL PERMIT APPLICANTS ONLY:

I certify under penalty of law that I have read and understand the Part I.B. eligibility requirements for coverage under the Multi-Sector storm water general permit, including those requirements relating to the protection of species identified in Addendum H.

To the best of my knowledge, the discharges covered under this permit, and construction of BMPs to control storm water run-off, are not likely to and will not likely adversely affect any species identified in Addendum H of the Multi-Sector storm water general permit or are otherwise eligible for coverage due to previous authorization under the Endangered Species Act.

To the best of my knowledge, I further certify that such discharges, and construction of BMPs to control storm water run-off, do not have an effect on properties listed or eligible for listing on the National Register of Historic Places under the National Historic Preservation Act, or are otherwise eligible for coverage due to a previous agreement under the National Historic Preservation Act.

I understand that continued coverage under the Multi-Sector general permit is contingent upon maintaining eligibility as provided for in Part I.B.

Print Name: ______ Date: ______

Signature: ______

EPA Form 3510-6 (8-98)

R0016543

Instructions - EPA Form 3510-6
Notice Of Intent (NOI) For Storm Water Discharges Associated With Industrial Activity
To Be Covered Under a NPDES General Permit

Who Must File A Notice Of Intent (NOI) Form

Federal law at 40 CFR Part 122 prohibits point source discharges of storm water associated with industrial activity to a water body(ies) of the U.S. without a National Pollutant Discharge Elimination System (NPDES) permit. The operator of an industrial activity that has such a storm water discharge must submit a NOI to obtain coverage under a NPDES Storm Water General Permit. If you have questions about whether you need a permit under the NPDES Storm Water program, or if you need information as to whether a particular program is administered by EPA or a state agency, telephone or write to the Notice of Intent Processing Center at (703) 931-3230.

Where To File NOI Form

NOIs must be sent to the following address: Storm Water Notice of Intent (4203)
401 M Street, S.W.
Washington, DC 20460

Completing The Form

You must type or print, using upper-case letters, in the appropriate areas only. Please place each character between the marks. Abbreviate if necessary to stay within the number of characters allowed for each item. Use one space for breaks between words, but not for punctuation marks unless they are needed to clarify your response. If you have any questions on this form, call the Notice of Intent Processing Center at (703) 931-3230.

Section I Permit Selection

You must indicate the NPDES storm water general permit under which you are applying for coverage. Check one box only. The Baseline Industrial and Baseline Construction permits were issued in September 1992. The Multi-Sector Permit became effective October 1, 1995.

Section II Facility Operator Information

Provide the legal name of the person, firm, public organization, or any other entity that operates the facility or site described in this application. The name of the operator may or may not be the same as the name of the facility. The responsible party is the legal entity that controls the facility's operation, rather than the plant or site manager. Do not use a colloquial name. Enter the complete address and telephone number of the operator.

Enter the appropriate letter to indicate the legal status of the operator of the facility: F = Federal; S = State; M = Public (other than federal or state); P = Private.

Section III Facility/Site Location Information

Enter the facility's or site's official or legal name and complete street address, including city, state, and ZIP code. If the facility or site lacks a street address, indicate the state and either the latitude and longitude of the facility to the nearest 15 seconds or the quarter, section, township, and range (to the nearest quarter section) of the approximate center of the site. Do not provide a P.O. Box number as the street address.

Indicate whether the facility is located on Indian lands.

Section IV Site Activity Information

If the storm water discharges to a municipal separate storm sewer system (MS4), enter the name of the operator of the MS4 (e.g., municipality name, county name) and the receiving water of the discharge from the MS4. (A MS4 is defined as a conveyance or system of conveyances (including roads with drainage systems, municipal streets, catch basins, curbs, gutters, ditches, man-made channels, or storm drains) that is owned or operated by a state, city, town, borough, county, parish, district, association, or other public body which is designed or used for collecting or conveying storm water.)

If the facility discharges storm water directly to receiving water(s), enter the name of the receiving water(s).

If you are filing as a co-permittee and a storm water general permit number has been issued, enter that number in the space provided.

Indicate the monitoring status of the facility. Refer to the permit for information on monitoring requirements. Indicate the monitoring status by entering one of the following:

1 = Not subject to monitoring requirements under the conditions of the permit.
2 = Subject to monitoring requirements and required to submit data.
3 = Subject to monitoring requirements but not required to submit data.
4 = Subject to monitoring requirements but submitting certification for monitoring exclusion.

List, in descending order of significance, up to two 4-digit standard industrial classification (SIC) codes that best describe the principal products or services provided at the facility or site identified in Section III of this application. If you are applying for coverage under the construction general permit, enter "CO" (which represents SIC codes 1500 - 1799).

For industrial activities defined in 40 CFR 122.26(b)(14)(i)-(xi) that do not have SIC codes that accurately describe the principal products produced or services provided, use the following 2-character codes.

HZ = Hazardous waste treatment, storage, or disposal facilities, including those that are operating under interim status or a permit under subtitle C of RCRA [40 CFR 122.26 (b)(14)(iv)];
LF = Landfills, land application sites, and open dumps that receive or have received any industrial wastes, including those that are subject to regulation under subtitle D of RCRA [40 CFR 122.26 (b)(14)(v)];
SE = Steam electric power generating facilities, including coal handling sites [40 CFR 122.26 (b)(14)(vii)];
TW = Treatment works treating domestic sewage or any other sewage sludge or wastewater treatment device or system, used in the storage, treatment, recycling, and reclamation of municipal or domestic sewage [40 CFR 122.26 (b)(14)(ix)]; or,
CO = Construction activities [40 CFR 122.26 (b)(14)(x)].

If there is another NPDES permit presently issued for the facility or site listed in Section III, enter the permit number. If an application for the facility has been submitted but no permit number has been assigned, enter the application number.

Facilities applying for coverage under the Multi-Sector storm water general permit must answer the last three questions in Section IV. Refer to Addendum H of the Multi-Sector general permit for a list of species that are either proposed or listed as threatened or endangered. "BMP" means "Best Management Practices" that are used to control storm water discharges.

Indicate whether any construction will be conducted to install or develop storm water runoff controls.

Section V Additional Information Required for Construction Activities Only

Construction activities must complete Section V in addition to Sections I through IV. Only construction activities need to complete Section V.

Enter the project start date and the estimated completion date for the entire development plan.

Provide an estimate of the total number of acres of the site on which soil will be disturbed (round to the nearest acre).

Indicate whether the storm water pollution prevention plan for the site is in compliance with approved state and/or local sediment and erosion plans, permits, or storm water management plans.

Section VI Certification

Federal statutes provide for severe penalties for submitting false information on this application form. Federal regulations require this application to be signed as follows:

For a corporation: by a responsible corporate officer, which means: (i) president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision making functions, or (ii) the manager of one or more manufacturing, production, or operating facilities employing more than 250 persons or having gross annual sales or expenditures exceeding $25 million (in second-quarter 1980 dollars), if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures;

For a partnership or sole proprietorship: by a general partner or the proprietor; or

For a municipality, state, Federal, or other public facility: by either a principal executive officer or ranking elected official.

Paperwork Reduction Act Notice

Public reporting burden for this application is estimated to average 0.5 hours per application, including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding the burden estimate, any other aspect of the collection of information, or suggestions for improving this form, including any suggestions which may increase or reduce this burden to: Chief, Information Policy Branch, 2136, U.S. Environmental Protection Agency, 401 M Street, SW, Washington, DC 20460, or Director, Office of Information and Regulatory Affairs, Office of Management and Budget, Washington, DC 20503.

THIS FORM REPLACES PREVIOUS FORM 3510-7 (8-92)
Please See Instructions Before Completing This Form

Form Approved. OMB No. 2040-0086
Approval expires: 8-31-98

NPDES FORM

EPA

United States Environmental Protection Agency
Washington, DC 20460

Notice of Termination (NOT) of Coverage Under a NPDES General Permit for Storm Water Discharges Associated with Industrial Activity

Submission of this Notice of Termination constitutes notice that the party identified in Section II of this form is no longer authorized to discharge storm water associated with industrial activity under the NPDES program. ALL NECESSARY INFORMATION MUST BE PROVIDED ON THIS FORM.

I. Permit Information

NPDES Storm Water General Permit Number: ____________

Check Here if You are No Longer the Operator of the Facility: ☐

Check Here if the Storm Water Discharge is Being Terminated: ☐

II. Facility Operator Information

Name: ____________ Phone: ____________

Address: ____________

City: ____________ State: ____ ZIP Code: ____________

III. Facility/Site Location Information

Name: ____________

Address: ____________

City: ____________ State: ____ ZIP Code: ____________

Latitude: ______ Longitude: ______ Quarter: ____ Section: ____ Township: ______ Range: ______

IV. Certification:

I certify under penalty of law that all storm water discharges associated with industrial activity from the identified facility that are authorized by a NPDES general permit have been eliminated or that I am no longer the operator of the facility or construction site. I understand that by submitting this Notice of Termination, I am no longer authorized to discharge storm water associated with industrial activity under this general permit, and that discharging pollutants in storm water associated with industrial activity to waters of the United States is unlawful under the Clean Water Act where the discharge is not authorized by a NPDES permit. I also understand that the submittal of this Notice of Termination does not release an operator from liability for any violations of this permit or the Clean Water Act.

Print Name: ____________ Date: ____________

Signature: ____________

Instructions for Completing Notice of Termination (NOT) Form

Who May File a Notice of Termination (NOT) Form

Permittees who are presently covered under an EPA-issued National Pollutant Discharge Elimination System (NPDES) General Permit (including the 1995 Multi-Sector Permit) for Storm Water Discharges Associated with Industrial Activity may submit a Notice of Termination (NOT) form when their facilities no longer have any storm water discharges associated with industrial activity as defined in the storm water regulations at 40 CFR 122.26(b)(14), or when they are no longer the operator of the facilities.

For construction activities, elimination of all storm water discharges associated with industrial activity occurs when disturbed soils at the construction site have been finally stabilized and temporary erosion and sediment control measures have been removed or will be removed at an appropriate time, or that all storm water discharges associated with industrial activity from the construction site that are authorized by a NPDES general permit have otherwise been eliminated. Final stabilization means that all soil-disturbing activities at the site have been completed, and that a uniform perennial vegetative cover with a density of 70% of the cover for unpaved areas and areas not covered by permanent structures has been established, or equivalent permanent stabilization measures (such as the use of riprap, gabions, or geotextiles) have been employed.

Where to File NOT Form

Send this form to the the following address:

Storm Water Notice of Termination (4203)
401 M Street, S.W.
Washington, DC 20460

Completing the Form

Type or print, using upper-case letters, in the appropriate areas only. Please place each character between the marks. Abbreviate if necessary to stay within the number of characters allowed for each item. Use only one space for breaks between words, but not for punctuation marks unless they are needed to clarify your response. If you have any questions about this form, telephone or write the Notice of Intent Processing Center at (703) 931-3230.

EPA Form 3510-7 (8-98)

Instructions - EPA Form 3510-7
Notice of Termination (NOT) of Coverage Under The NPDES General Permit for Storm Water Discharges Associated With Industrial Activity

Section I Permit Information

Enter the existing NPDES Storm Water General Permit number assigned to the facility or site identified in Section III. If you do not know the permit number, telephone or write your EPA Regional storm water contact person.

Indicate your reason for submitting this Notice of Termination by checking the appropriate box:

If there has been a change of operator and you are no longer the operator of the facility or site identified in Section III, check the corresponding box.

If all storm water discharges at the facility or site identified in Section III have been terminated, check the corresponding box.

Section II Facility Operator Information

Give the legal name of the person, firm, public organization, or any other entity that operates the facility or site described in this application. The name of the operator may or may not be the same name as the facility. The operator of the facility is the legal entity which controls the facility's operation, rather than the plant or site manager. Do not use a colloquial name. Enter the complete address and telephone number of the operator.

Section III Facility/Site Location Information

Enter the facility's or site's official or legal name and complete address, including city, state and ZIP code. If the facility lacks a street address, indicate the state, the latitude and longitude of the facility to the nearest 15 seconds, or the quarter, section, township, and range (to the nearest quarter section) of the approximate center of the site.

Section IV Certification

Federal statutes provide for severe penalties for submitting false information on this application form. Federal regulations require this application to be signed as follows:

For a corporation: by a responsible corporate officer, which means: (i) president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision making functions, or (ii) the manager of one or more manufacturing, production, or operating facilities employing more than 250 persons or having gross annual sales or expenditures exceeding $25 million (in second-quarter 1980 dollars), if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures;

For a partnership or sole proprietorship: by a general partner or the proprietor; or

For a municipality, State, Federal, or other public facility: by either a principal executive officer or ranking elected official.

Paperwork Reduction Act Notice

Public reporting burden for this application is estimated to average 0.5 hours per application, including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding the burden estimate, any other aspect of the collection of information, or suggestions for improving this form, including any suggestions which may increase or reduce this burden to: Chief, Information Policy Branch, 2136, U.S. Environmental Protection Agency, 401 M Street, SW, Washington, DC 20460, or Director, Office of Information and Regulatory Affairs, Office of Management and Budget, Washington, DC 20503.

BILLING CODE 6560-50-C

ADDENDUM D.—PARTIAL LIST OF LARGE, MEDIUM, AND DESIGNATED MUNICIPALITIES

[Incorporated Places]

State	Place name
Alaska	Anchorage city.*
Alabama	Adamsville city.
	Alabaster city.
	Bessemer city.
	Birmingham city.*
	Brighton city.
	Brookside town.
	Chickasaw city.
	Creola city.
	Daphne city.
	Fairfield city.
	Fairhope city.
	Fultondale city.
	Gardendale city.
	Graysville city.
	Helena city.
	Homewood city.
	Hoover city.
	Hueytown city.
	Huntsville city.*
	Indian Springs.
	Irondale city.
	Leeds city.
	Lipscomb city.
	Madison city.
	Maytown town.
	Midfield city.
	Mobile city.*
	Montgomery city.*
	Moody town.
	Mountain Brook city.
	Mulga town.
	Pelham city.
	Pleasant Grove city.
	Prichard city.
	Saraland city.
	Satsuma city.
	Tarrant city.
	Trussville city.
	Vestavia Hills city.
Arkansas	Little Rock city.*
Arizona	Glendale city.†
	Mesa city.*
	Phoenix city.*
	Scottsdale city.†
	Tempe city.*
	Tucson city.*
California	Agoura Hills city.
	Alameda city.
	Albany city.
	Alhambra city.
	Anaheim city.*
	Arcadia city.
	Artesia city.
	Atherton town.
	Azusa city.
	Bakersfield city.*
	Baldwin Park city.
	Bell city.
	Bellflower city.
	Bell Gardens city.
	Belmont city.
	Berkeley city.*
	Beverly Hills city.
	Big Bear Lake city.
	Bradbury city.
	Brentwood city.
	Brisbane city.

ADDENDUM D.—PARTIAL LIST OF LARGE, MEDIUM, AND DESIGNATED MUNICIPALITIES—Continued

[Incorporated Places]

State	Place name
	Burbank city.
	Burlingame city.
	Camarillo city.
	Campbell city.
	Carlsbad city.
	Carson city.
	Cerritos city.
	Chula Vista city.
	Claremont city.
	Clayton city.
	Colma town.
	Commerce city.
	Compton city.
	Concord city.
	Contra Costa county (15 cities).
	Coronado city.
	Covina city.
	Cudahy city.
	Culver City city.
	Cupertino city.
	Daly City city.
	Del Mar city.
	Diamond Bar city.
	Downey city.
	Duarte city.
	Dublin city.
	East Palo Alto city.
	El Cajon city.
	El Monte city.
	El Segundo city.
	Emeryville city.
	Encinitas city.
	Escondido city.
	Fairfield city.
	Fillmore city.
	Folsom city.
	Foster City city.
	Fremont city.*
	Fresno city.*
	Fullerton city.*
	Galt city.
	Gardena city.
	Garden Grove city.*
	Gilroy city.
	Glendale city.*
	Glendora city.
	Half Moon Bay city.
	Hawaiian Gardens city.
	Hawthorne city.
	Hayward city.†
	Hermosa Beach city.
	Hidden Hills city.
	Hillsborough town.
	Huntington Beach city.*
	Huntington Park city.
	Imperial Beach city.
	Industry city.
	Inglewood city.†
	Irvine city.†
	Irwindale city.
	La Canada Flintridge city.
	Laguna Beach city.
	Lake Tahoe Basin (1 city)

ADDENDUM D.—PARTIAL LIST OF LARGE, MEDIUM, AND DESIGNATED MUNICIPALITIES—Continued

[Incorporated Places]

State	Place name
	Lakewood city.
	La Mesa city.
	La Mirada city.
	La Palma city.
	La Puente city.
	La Verne city.
	Lawndale city.
	Lemon Grove city.
	Livermore city.
	Lomita city.
	Long Beach city.*
	Los Alamitos city.
	Los Altos city.
	Los Altos Hills town.
	Los Angeles city.*
	Los Gatos town.
	Lynwood city.
	Manhattan Beach city.
	Maywood city.
	Menlo Park city.
	Millbrae city.
	Milpitas city.
	Modesto city.*
	Monrovia city.
	Montebello city.
	Monterey Park city.
	Monte Sereno city.
	Moorpark city.
	Moreno Valley city.†
	Mountain View city.
	National City city.
	Newark city.
	Norwalk city.
	Oakland city.*
	Oceanside city.†
	Ojai city.
	Ontario city.†
	Orange city.†
	Orange county (17 cities).
	Oxnard city.*
	Pacifica city.
	Palo Alto city.
	Palos Verdes Estates city.
	Paramount city.
	Pasadena city.*
	Pico Rivera city.
	Piedmont city.
	Pleasanton city.
	Pomona city.†
	Port Hueneme city.
	Poway city.
	Rancho Cucamonga city.†
	Rancho Palos Verdes city.
	Redondo Beach city.
	Redwood City city.
	Riverside city.*
	Riverside county (10 cities).
	Rolling Hills city.
	Rolling Hills Estates city.
	Rosemead city.
	Sacramento city.*
	Salinas city.†

ADDENDUM D.—PARTIAL LIST OF LARGE, MEDIUM, AND DESIGNATED MUNICIPALITIES—Continued

[Incorporated Places]

State	Place name
	San Bernardino city.*
	San Bernardino county (13 cities).
	San Bruno city.
	San Carlos city.
	San Diego city.*
	San Dimas city.
	San Fernando city.
	San Gabriel city.
	San Jose city.*
	San Leandro city.
	San Marcos city.
	San Marino city.
	San Mateo city.
	Santa Ana city.*
	Santa Clara.
	Santa Clarita city.†
	Santa Fe Springs city.
	Santa Monica city.
	Santa Paula city.
	Santa Rosa city.†
	Santee city.
	Saratoga city.
	Seal Beach city.
	Sierra Madre city.
	Signal Hill city.
	Simi Valley city.†
	Solana Beach city.
	South El Monte city.
	South Gate city.
	South Pasadena city.
	South San Francisco city.
	Stockton city.*
	Suisun City city.
	Sunnyvale city.*
	Temple City city.
	Thousand Oaks city†.
	Torrance city.*
	Union City city.
	Vallejo city†.
	Vernon city.
	Vista city.
	Walnut city.
	West Covina city.
	West Hollywood city.
	Westlake Village city.
	Whittier city.
	Woodside town.
Colorado	Aurora city.*
	Colorado Springs city.*
	Denver city.*
	Englewood city.
	Lakewood city.*
	Pueblo city.
Connecticut	Stamford city.*
District of Columbia	Washington city.*
Delaware	Arden village.
	Ardencroft village.
	Ardentown village.
	Bellefonte town.
	Delaware City city.
	Elsmere town.
	Middletown town.
	Newark city.
	New Castle city.
	Newport town.
	Odessa town.
	Townsend town.
	Wilmington city.
Florida	Apopka city.
	Atlantic Beach city.
	Atlantis city.
	Auburndale city.
	Bal Harbour village.
	Bartow city.
	Bay Harbor Islands town.
	Bay Lake city.
	Belleair town.
	Belleair Beach city.
	Belleair Bluffs city.
	Belle Glade city.
	Belle Isle city.
	Boca Raton city.
	Boynton Beach city.
	Briny Breezes town.
	Century town.
	Clearwater city.
	Cloud Lake town.
	Coconut Creek city.
	Cooper City city.
	Coral Gables city.
	Coral Springs city.
	Dania city.
	Davenport city.
	Davie town.
	Deerfield Beach city.
	Delray Beach city.
	Dundee town.
	Dunedin city.
	Eagle Lake city.
	Eatonville town.
	Edgewood city.
	Fort Lauderdale city.*
	Fort Meade city.
Florida	Frostproof city
	Glen Ridge town.
	Golden Beach town.
	Golf village.
	Golfview town.
	Greenacres City city.
	Gulfport city.
	Gulf Stream town.
	Haines City city.
	Hallandale city.
	Haverhill town.
	Hialeah city.*
	Hialeah Gardens city.
	Highland Beach town.
	Highland Park village.
	Hillcrest Heights town.
	Hollywood city.*
	Homestead city.
	Hypoluxo town.
	Indian Creek village.
	Indian Rocks Beach city.
	Jacksonville Beach city.
	Jacksonville city.*
	Juno Beach town.
	Jupiter town.
	Jupiter Inlet Colony town.
	Key Biscayne village.
	Kenneth City town.
	Lake Alfred city.
	Lake Buena Vista city.
	Lake Clarke Shores town.
	Lake Hamilton town.
	Lakeland city.
	Lake Park town.
	Lake Wales city.
	Lake Worth city.
	Lantana town.
	Largo city.
	Lauderdale-by-the-Sea town.
	Lauderdale Lakes city.
	Lauderhill city.
	Lighthouse Point city.
	Longboat Key town.
	Madeira Beach city.
	Maitland city.
	Manalapan town.
	Mangonia Park town.
	Margate city.
	Medley town.
	Miami city.*
	Miami Beach city.
	Miami Shores village.
	Miami Springs city.
	Miramar city.
	Mulberry city.
	Neptune Beach city.
	North Bay Village city.
	North Lauderdale city.
	North Miami city.
	North Miami Beach city.
	North Palm Beach village.
	North Port city.
	North Redington Beach town.
	Oakland Park city.
	Ocean Ridge town.
	Ocoee city.
	Oldsmar city.
	Opa-locka city.
	Orlando city.*
	Pahokee city.
	Palm Beach town.
	Palm Beach Gardens city.
	Palm Beach Shores town.
	Palm Springs village.
	Parkland city.
	Pembroke Park town.
	Pembroke Pines city.
	Pennsuee
	Pensacola city.
	Pinellas Park city.
	Plantation city.
	Plant City city.
	Polk City town.
	Pompano Beach city.
	Redington Beach town.

ADDENDUM D.—PARTIAL LIST OF LARGE, MEDIUM, AND DESIGNATED MUNICIPALITIES—Continued

[Incorporated Places]

State	Place name
	Redington Shores town.
	Riviera Beach city.
	Royal Palm Beach village.
	Safety Harbor city.
	St. Petersburg Beach city.
	St. Petersburg city.*
	Sarasota city.
	Sea Ranch Lakes village.
	Seminole city.
	South Bay city.
	South Miami city.
	South Palm Beach town.
	South Pasadena city.
	Sunrise city.
	Surfside town.
	Sweetwater city.
	Tallahassee city.†
	Tamarac city.
	Tampa city.*
	Tarpon Springs city.
	Temple Terrace city.
	Tequesta village.
	Treasure Island city.
	Venice city.
	West Miami city.
	West Palm Beach city.
	Wilton Manors city.
	Winter Garden city.
	Winter Haven city.
	Winter Park city.
Georgia	Acworth city.
	Alpharetta city.
	Atlanta city.*
	Austell city.
	Bloomingdale city.
	Buford city.
	Chamblee city.
	Clarkston city.
	College Park city.
	Columbus city.*
	Decatur city.
	Doraville city.
	Duluth city.
	East Point city.
	Fairburn city.
	Forest Park city.
	Garden City city.
	Hapeville city.
	Jonesboro city.
	Kennesaw city.
	Lawrenceville city.
	Lilburn city.
	Lithonia city.
	Macon city.*
	Marietta city.
	Morrow city.
	Norcross city.
	Palmetto city.
	Payne city.
	Pooler city.
	Powder Springs city.
	Riverdale city.
	Roswell city.
	Savannah city.*
	Smyrna city.
	Snellville city
	Stone Mountain city.
	Sugar Hill city.
	Suwanee city.
	Thunderbolt town.
	Union City city.
Iowa	Cedar Rapids city.*
	Davenport city.
	Des Moines city.*
Idaho	Boise City city.*
	Garden City city.
Illinois	Rockford city.*
	Springfield city.†
Indiana	Fort Wayne city.*
	Indianapolis city.*
Kansas	Kansas City city.*
	Overland Park city.†
	Topeka city.*
	Wichita city.*
Kentucky	Lexington-Fayette.*
	Louisville city.*
Louisiana	Baton Rouge city.*
	New Orleans city.*
	Shreveport city.*
Massachusetts	Boston city.*
	Worcester city.*
Maryland	Baltimore city.*
Michigan	Ann Arbor city.*
	Flint city.*
	Grand Rapids city.*
	Sterling Heights city.*
	Warren city.*
Minnesota	Minneapolis city.*
	St. Louis Park city.
	St. Paul city.*
Missouri	Independence city.*
	Kansas City city.*
	Springfield city.*
Mississippi	Jackson city.*
Nebraska	Lincoln city.*
	Omaha city.*
New Mexico	Albuquerque city.*
Nevada	Henderson city.
	Las Vegas city.*
	North Las Vegas city.
	Reno city.*
	Sparks city.
New York	New York city.*
	(Bronx Borough).
	(Brooklyn Borough).
	(Manhattan Borough).
	(Queens Borough).
	(Staten Island Borough).
North Carolina	Charlotte city.*
	Durham city.*
	Fayetteville city.
	Greensboro city.*
	Raleigh city.*
	Winston-Salem city.*
Ohio	Akron city.*
	Cincinnati city.*
	Cleveland city.*
	Columbus city.*
	Dayton city.*
	Toledo city.*
Oklahoma	Oklahoma City city.*
	Tulsa city.*
Oregon	Banks city.
	Barlow city.
	Beaverton city.
	Canby city.
	Cornelius city.
	Durham city.
	Estacada city.
	Eugene city.*
	Fairview city.
	Forest Grove city.
	Gaston city.
	Gladstone city.
	Gresham city.
	Happy Valley city.
	Hillsboro city.
	Johnson City city.
	King City city.
	Lake Oswego city.
	Milwaukie city.
	Molalla city.
	North Plains city.
	Oregon City city.
	Portland city.*
	Rivergrove city.
	Salem city.†
	Sandy city.
	Sherwood city.
	Tigard city
	Tualatin city.
	West Linn city.
	Wilsonville city.
Pennsylvania	Allentown city.*
	Philadelphia city.*
South Dakota	Sioux Falls City.
Tennessee	Bartlett town.
	Belle Meade city.
	Berry Hill city.
	Chattanooga city.*
	Collierville town.
	East Ridge city.
	Forest Hills city.
	Germantown city.
	Goodlettsville city.
	Knoxville city.*
	Lakewood city.
	Memphis city.*
	Nashville-Davidson.*
	Oak Hill city.
	Red Bank city.
	Ridgetop town.
Texas	Abilene city.†
	Amarillo city.*
	Arlington city.*
	Austin city.*
	Beaumont city.*
	Corpus Christi city.*
	Dallas city.*
	El Paso city.*
	Fort Worth city.*
	Garland city.*
	Houston city.*
	Irving city.*
	Laredo city.†
	Lubbock city.*
	Mesquite city.†

R0016549

ADDENDUM D.—PARTIAL LIST OF LARGE, MEDIUM, AND DESIGNATED MUNICIPALITIES—Continued

[Incorporated Places]

State	Place name
	Pasadena city.*
	Plano city.†
	San Antonio city.*
	Waco city.*
Utah	Salt Lake City city.*
Virginia	Chesapeake city.*
	Hampton city.*
	Newport News city.*
	Norfolk city.*
	Portsmouth city.*
	Richmond city.*
	Roanoke city.
	Virginia Beach city.*
Washington	Seattle city.*
	Tacoma city.*
Wisconsin	Madison city.*
	Milwaukee city.*

Note: Unless indicated otherwise, municipalities have been designated.

* Identified in November 1990 rule.

† 1990 Census population increased to over 100,000.

PARTIAL LIST OF LARGE, MEDIUM, AND DESIGNATED MUNICIPALITIES

[Counties]

State	County
Alabama	Baldwin county.[1]
	Jefferson county.[6]
	Mobile county.[7]
	Shelby county.[8]
	St. Clair county.[9]
Arizona	Pima County.*
California	Alameda County.*
	Contra Costa County.*
	Kern County.*
	Lake Tahoe Basin.*
	(2 counties).
	Los Angeles County.*
	Orange County.*
	Riverside County.*
	Sacramento County.
	San Bernardino County.*
	San Diego County.*
	San Mateo County.
	Santa Clara County.
	Ventura County.
Colorado	Arapahoe County.†
Delaware	New Castle County.*
Florida	Broward County.*
	Dade County.*
	Escambia County.*
	Hillsborough County.*
	Lee County.†
	Manatee County.†
	Orange County.*
	Palm Beach County.*
	Pasco County.†
	Pinellas County.*
	Polk County.*
	Sarasota County.*
	Seminole County.†
Georgia	Bibb County.
	Chatham County.
	Clayton County.*
	Cobb County.*
	DeKalb County.*
	Fulton County.†
	Gwinnett County.†
	Muscogee County.
	Richmond County.*
Hawaii	Honolulu County.*
Kentucky	Jefferson County.
Louisiana	East Baton Rouge Parish.†
	Jefferson Parish.*
Maryland	Anne Arundel County.*
	Baltimore County.*
	Carroll County.
	Charles County.
	Frederick County.
	Harford County.
	Howard County.†
	Montgomery County.*
	Prince George's County.*
	Washington County.
North Carolina	Cumberland County.*
Nevada	Clark County.*
	Washoe County.
Oregon	Clackamas County.
	Multnomah County.
	Washington County.*
South Carolina	Greenville County.*
	Richland County.*
Texas	Harris County.*
Utah	Salt Lake County.*
Virginia	Arlington County.*
	Chesterfield County.*
	Fairfax County.*
	Henrico County.*
	Prince William County.†
Washington	Clark County.†
	King County.*
	Pierce County.*
	Snohomish County.*
	Spokane County.†

[6] County was listed in regulation; however, population dropped below 100,000 in 1990 census.

[7] Unincorporated areas defined as: beginning at the mouth of the South Fork Deer River and extending west to SW corner Section 18, Township 6 South, Range 2 West, thence north to NW corner, Section 6, Township 2 South, Range 2 West, thence east to the Mobile County line, thence south along the county line to U.S. Highway 90 bridge.

[8] All unincorporated areas of Shelby County within the drainage basin of the Cahaba River upstream of the confluence of Shoal Creek and the Cahaba River.

[9] Unincorporated areas of St. Clair County within the drainage basin of the Cahaba River.

* Identified in November 1990 rule.

† 1990 Census unincorporated, urbanized population increased to more than 100,000.

PARTIAL LIST OF LARGE, MEDIUM, AND DESIGNATED MUNICIPALITIES [BOUNDARIES NOT DEFINED BY CENSUS]

State	Municipal separate storm sewer system
Alaska	DOT.[1]
	University of Alaska.
Alabama	Highway Department.
Arizona	DOT.
California	Alameda County Flood Control District.
	Zone 7 of the Alameda County.
	Flood Control District.
	DOT.
	Coachella Valley Area.
	Contra Costa County Flood Control District.
	Orange County Flood Control District.
	Riverside Flood Control District.
	San Bernardino Flood Control District.
	San Diego Unified Port District.
	Santa Clara Valley Water District.
Colorado	DOT.
	Highway Department.
Delaware	DOT.
Florida	DOT.

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PARTIAL LIST OF LARGE, MEDIUM, AND DESIGNATED MUNICIPALITIES [BOUNDARIES NOT DEFINED BY CENSUS]—Continued

State	Municipal separate storm sewer system
	Urban Water Control Districts.
Hawaii	DOT.
Idaho	DOT.
Illinois	DOT.
Indiana	DOT.
Kansas	Fairfax Drainage District.
	Kaw Valley Drainage District.
Louisiana	DOT.
Maryland	State Highway Administration.
Michigan	University of Michigan.
	DOT.
Minnesota	DOT.
North Carolina	DOT.
Nevada	Clark County Flood Control District.
	DOT.
New Mexico	Albuquerque Metropolitan Flood Control Authority.
	DOT.
Ohio	DOT.
Oklahoma	DOT.
Oregon	DOT.
	Port of Portland.
Pennsylvania	DOT.
South Carolina	Harbor of Charleston.
Tennessee	DOT.
Texas	Harris County Flood Control District.
	DOT.
Utah	DOT.
Wisconsin	DOT.
	University of Wisconsin.

[1] Department of Transportation.

Addendum E—Basic Format for Environmental Assessment

This is the basic format for the Environmental Assessment prepared by EPA from the review of the applicant's Environmental Information Document (EID) required for new source NPDES permits. Comprehensive information should be provided for those items or issues that are affected; the greater the impact, the more detailed information needed. The EID should contain a brief statement addressing each item listed below, even if the item is not applicable. The statement should at least explain why the item is not applicable.

A. General Information
1. Name of applicant
2. Type of facility
3. Location of facility
4. Product manufactured

B. Description Summaries
1. Describe the proposed facility and construction activity
2. Describe all ancillary construction not directly involved with the production processes
3. Describe briefly the manufacturing processes and procedures
4. Describe the plant site, its history, and the general area

C. Environmental Concerns
1. Historical and Archeological (include a statement from the State Historical Preservation Officer)
2. Wetlands Protection and 100-year Floodplain Management (the Army Corps of Engineers must be contacted if any wetland area of floodplain is affected)
3. Agricultural Lands (a prime farmland statement from the Soil Conservation Service must be included
4. Coastal Zone Management and Wild and Scenic Rivers
5. Endangered Species Protection and Fish and Wildlife Protection (a statement from the U.S. Fish and Wildlife Service must be included)
6. Air, Water, and Land Issues: quality, effects, usage levels, municipal services used, discharges and emissions, runoff and wastewater control, geology and soils involved, land-use compatibility, solid and hazardous waste disposal, natural and man-made hazards involved.
7. Biota concerns: floral, faunal, aquatic resources, inventories, and effects
8. Community Infrastructures available and resulting effects: social, economic, health, safety, educational, recreational, housing, transportation, and road resources

Basic Environmental Information Document Guidelines for New Source Category Industries

I. General Information

A. Name of Applicant and Proposed Facility:

B. Description of Site and Location:

C. Description of Project, Product, and Process:

ADDENDUM F—SECTION 313 WATER PRIORITY CHEMICALS

CAS No.	Common name
75–07–0	Acetaldehyde.
107–02–8	Acrolein.
107–13–1	Acrylonitrile.
309–00–2	Aldrin[1,4:5,8-Dimethanonaphthalene, 1, 2, 3, 4, 10, 10-hexachloro-1, 4, 4a, 5, 8, 8a hexahydro-(1.alpha., 4.alpha., 4a.beta., 5.alpha., 8.alpha., 8a.beta.)-].
107–05–1	Allyl Chloride.
7429–90–5	Aluminum (fume or dust).
7664–41–7	Ammonia.
62–53–3	Aniline.
120–12–7	Anthracene.
7440–36–0	Antimony.
7647189	Antimony pentachloride.
28300745	Antimony potassium tartrate.
7789619	Antimony tribromide.
10025919	Antimony trichloride.
7783564	Antimony trifluoride.
1309644	Antimony trioxide.
7440–38–2	Arsenic.
1303328	Arsenic disulfide.
1303282	Arsenic pentoxide.
7784341	Arsenic trichloride.
1327533	Arsenic trioxide.
1303339	Arsenic trisulfide.
1332–21–4	Asbestos (friable).
542621	Barium cyanide.
71–43–2	Benzene.
92–87–5	Benzidine.
100470	Benzonitrile.
218019	Benzo(a)phenanthrene.
50328	Benzo(a)pyrene.
205992	Benzo(b)fluoranthene.
205823	Benzo(j)fluoranthene.
207089	Benzo(k)fluoranthene.
189559	Benzo(rst)pentaphene.
56553	Benzo(a)anthracene.
100–44–7	Benzyl chloride.
7440–41–7	Beryllium.
7787475	Beryllium chloride.
7787497	Beryllium fluoride.
7787555	Beryllium nitrate.
111–44–4	Bis(2-chloroethyl) ether.
75–25–2	Bromoform.
74–83–9	Bromomethane (Methyl bromide).
85–68–7	Butyl benzyl phthalate.
7440–43–9	Cadmium.
543908	Cadmium acetate.
7789426	Cadmium bromide.
10108642	Cadmium chloride.
7778441	Calcium arsenate.
52740166	Calcium arsenite.
13765190	Calcium chromate.
592018	Calcium cyanide.
133–06–2	Captan [1H-Isoindole-1,3(2H)-dione,3a,4,7,7a-tetrahydro-2-[(trichloromethyl)thio]-].
63–25–2	Carbaryl [1-Naphthalenol, methylcarbamate].
75–15–0	Carbon disulfide.
1563662	Carbofuran.
56–23–5	Carbon tetrachloride.
57–74–9	Chlordane [4,7-Methanoindan,1,2,4,5,6,7,8,8- octachloro-2,3,3a,4,7,7a-hexahydro-].
7782–50–5	Chlorine.
59–50–7	4-Chloro 3-methyl phenol.
	p-Chloro-*m*-cresol.
108–90–7	Chlorobenzene.
75–00–3	Chloroethane (Ethyl chloride).
67–66–3	Chloroform.
74–87–3	Chloromethane (Methyl chloride).
95–57–8	2-Chlorophenol.
106–48–9	4-Chlorophenol.
75729	Chlorotrifluoromethane.
1066304	Chromic acetate.
11115745	Chromic acid.
10101538	Chromic sulfate.
7440–47–3	Chromium.

ADDENDUM F—SECTION 313 WATER PRIORITY CHEMICALS—Continued

CAS No.	Common name
1308–14–1	Chromium (Tri).
10049055	Chromous chloride.
7789437	Cobaltous bromide.
544183	Cobaltous formate.
14017415	Cobaltous sulfamate.
7440–50–8	Copper.
108–39–4	*m*-Cresol.
9548–7	*o*-Cresol.
106–44–5	*p*-Cresol.
4170303	Crotonaldehyde.
1319–77–3	Cresol (mixed isomers).
142712	Cupric acetate.
12002038	Cupric acetoarsenite.
7447394	Cupric chloride.
3251238	Cupric nitrate.
5893663	Cupric oxalate.
7758987	Cupric sulfate.
10380297	Cupric sulfate, ammoniated.
815827	Cupric tartrate.
57–12–5	Cyanide.
506774	Cyanogen chloride.
333415	Diazinon.
94–75–7	2,4-D [Acetic acid, (2,4-dichlorophenoxy)-].
226368	Dibenz(a,h)acridine.
224420	Dibenz(a,j)acridene.
5385751	Dibenzo(a,e)fluoranthene.
192654	Dibenzo(a,e)pyrene.
53703	Dibenzo(a,h)anthracene.
189640	Dibenzo(a,l)pyrene.
191300	Dibenzo(a,h)pyrene.
194592	7,H-Dibenzo(c,g)carbazole.
106–93–4	1,2-Dibromoethane (Ethylene dibromide).
84–74–2	Dibutyl phthalate.
1929733	2,4 D Butoxyethyl ester.
94804	2,4 D Butyl ester.
2971382	2,4 D Chlorocrotyl ester.
1918009	Dicamba.
95–50–1	1,2-Dichlorobenzene.
541–73–1	1,3-Dichlorobenzene.
106–46–7	1,4-Dichlorobenzene.
91–94–1	3,3'-Dichlorobenzidine.
75–27–4	Dichlorobromomethane.
107–06–2	1,2-Dichloroethane (Ethylene dichloride).
75434	Dichlorofluoromethane.
540–59–0	1,2-Dichloroethylene.
120–83–2	2,4-Dichlorophenol.
78–87–5	1,2-Dichloropropane.
10061026	trans-1,3-Dichloropropene.
542–75–6	1,3-Dichloropropylene.
62–73–7	Dichlorvos [Phosphoric acid, 2,2-dichloroethenyl dimethyl ester].
115–32–2	Dicofol [Benzenemethanol, 4-chloro-.alpha.-(4-chlorophenyl)-.alpha.-(trichloromethyl)-].
177–81–7	Di-(2-ethylhexyl) phthalate (DEHP).
84–66–2	Diethyl phthalate.
124403	Dimethylamine.
57976	7,12-Dimethylbenz(a)anthracene.
105–67–9	2,4-Dimethylphenol.
131–11–3	Dimethyl phthalate.
534–52–1	4,6-Dinitro-*o*-cresol.
51–28–5	2,4-Dinitrophenol.
121–14–2	2,4-Dinitrotoluene.
606–20–2	2,6-Dinitrotoluene.
117–84–0	*n*-Dioctyl phthalate.
122–66–7	1,2-Diphenylhydrazine (Hydrazobenzene).
94111	2,4-D Isopropyl ester.
106–89–8	Epichlorohydrin.
1320189	2,4-D Propylene glycol butyl ether ester.
330541	Diuron.
100–41–4	Ethylbenzene.
106934	Ethylene dibromide.
50–00–0	Formaldehyde.
76–44–8	Heptachlor [1,4,5,6,7,8,8-Heptachloro-3a,4,7,7a-tetrahydro-4,7-methano-1H-indene].
118–74–1	Hexachlorobenzene.

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ADDENDUM F—SECTION 313 WATER PRIORITY CHEMICALS—Continued

CAS No.	Common name
319846	alpha-Hexachlorocyclohexane.
87–68–3	Hexachloro-1,3-butadiene.
77–47–4	Hexachlorocyclopentadiene.
67–72–1	Hexachloroethane.
7647–01–0	Hydrochloric acid.
74–90–8	Hydrogen cyanide.
7664–39–3	Hydrogen fluoride.
193395	Indeno[1,2,3-cd]pyrene.
7439–92–1	Lead.
301042	Lead acetate.
7784409	Lead arsenate.
7645252	Do.
10102484	Do.
7758954	Lead chloride.
13814965	Lead fluoborate.
7783462	Lead fluoride.
10101630	Lead iodide.
10099748	Lead nitrate.
7428480	Lead stearate.
1072351	Do.
52652592	Do.
7446142	Lead sulfate.
1314870	Lead sulfide.
592870	Lead thiocyanate.
58–89–9	Lindane [Cyclohexane, 1,2,3,4,5,6-hexachloro-(1.alpha.,3.beta.,4.alpha.,5.alpha.,6.beta.)-].
14307258	Lithium chromate.
121755	Malathion.
108–31–6	Maleic anhydride.
592041	Mercuric cyanide.
10045940	Mercuric nitrate.
7783359	Mercuric sulfate.
592858	Mercuric thiocyanate.
7782867	Mercurous nitrate.
7439–97–6	Mercury.
72–43–5	Methoxychlor [Benzene, 1,1'-(2,2,2-trichloroethylidene)bis[4-methoxy-].
80–62–6	Methyl methacrylate.
75865	2-Methyllactonitrile.
3697243	5-Methylchrysene.
298000	Methyl parathion.
7786347	Mevinphos.
300765	Naled.
91–20–3	Naphthalene.
7440–02–0	Nickel.
15699180	Nickel ammonium sulfate.
37211055	Nickel chloride.
7718549	Do.
12054487	Nickel hydroxide.
14216752	Nickel nitrate.
7786814	Nickel sulfate.
7697–37–2	Nitric acid.
98–95–3	Nitrobenzene.
88–75–5	2-Nitrophenol.
100–02–7	4-Nitrophenol.
5522430	1-Nitropyrene.
62–75–9	*N*-Nitrosodimethylamine.
86–30–6	*N*-Nitrosodiphenylamine.
621–64–7	*N*-Nitrosodi-*n*-propylamine.
56–38–2	Parathion [Phosphorothioic acid, O,O-diethyl-O-(4-nitrophenyl) ester].
87–86–5	Pentachlorophenol (PCP).
85018	Phenanthrene.
108–95–2	Phenol.
7664–38–2	Phosphoric acid.
7723–14–0	Phosphorus (yellow or white).
1336–36–3	Polychlorinated biphenyls (PCBs).
7784410	Potassium arsenate.
10124502	Potassium arsenite.
7778509	Potassium bichromate.
7789006	Potassium chromate.
151508	Potassium cyanide.
2312358	Propargite.
75–56–9	Propylene oxide.
91–22–5	Quinoline.

ADDENDUM F—SECTION 313 WATER PRIORITY CHEMICALS—Continued

CAS No.	Common name
7782–49–2	Selenium.
7446084	Selenium oxide.
7440–22–4	Silver.
7761888	Silver nitrate.
7631892	Sodium arsenate.
7784465	Sodium arsenite.
10588019	Sodium bichromate.
7775113	Sodium chromate.
143339	Sodium cyanide.
7632000	Sodium nitrite.
10102188	Sodium selenite.
7782823	Do.
7789062	Strontium chromate.
NA	Strychnine and salts.
100–42–5	Styrene.
7664–93–9	Sulfuric acid.
79–34–5	1,1,2,2-Tetrachloroethane.
127–18–4	Tetrachloroethylene (Perchloroethylene).
935–95–5	2,3,5,6-Tetrachlorophenol.
78002	Tetraethyl lead.
7440–28–0	Thallium.
10031591	Thallium sulfate.
108–88–3	Toluene.
8001–35–2	Toxaphene.
52–68–6	Trichlorfon [Phosphonic acid, (2,2,2-trichloro-1-hydroxyethyl)-dimethylester].
120–82–1	1,2,4-Trichlorobenzene.
71–55–6	1,1,1-Trichloroethane (Methyl chloroform).
79–00–5	1,1,2-Trichloroethane.
79–01–6	Trichloroethylene.
95–95–4	2,4,5-Trichlorophenol.
88–06–2	2,4,6-Trichlorophenol.
121448	Triethylamine.
7440–62–2	Vanadium (fume or dust).
108–05–4	Vinyl acetate.
75–01–4	Vinyl chloride.
75–35–4	Vinylidene chloride.
108–38–3	*m*-Xylene.
95–47–6	*o*-Xylene.
106–42–3	*p*-Xylene.
1330–20–7	Xylene (mixed isomers).
7440–66–6	Zinc (fume or dust).
557346	Zinc acetate.
14639975	Zinc ammonium chloride.
14639986	Do.
52628258	Do.
1332076	Zinc borate.
7699458	Zinc bromide.
3486359	Zinc carbonate.
7646857	Zinc chloride.
557211	Zinc cyanide.
7783495	Zinc fluoride.
557415	Zinc formate.
7779864	Zinc hydrosulfite.
7779886	Zinc nitrate.
127822	Zinc phenolsulfonate.
1314847	Zinc phosphide.
16871719	Zinc silicofluoride.
7733020	Zinc sulfate.

Addendum G—List of Applicable References

The following guidance manuals contain valuable information in assisting permittees in complying with the permit conditions of the multi-sector general permit and are available from The Office of Water Resources Center, USEPA—RC–4100, 401 M Street, SW., Washington, DC 20460, Telephone: (202) 260-7786.

Storm Water Management for Industrial Activities, Developing Pollution Prevention Plans and Best Management Practices (EPA–832–R–92–006, September 1992).

Summary: Storm Water Management for Industrial Activities, Developing Pollution Prevention Plans and Best Management Practices (October 1992).

NPDES Storm Water Sampling Guidance Document (EPA 833–B–92–001, July 1992).

Addendum H—Endangered Species Guidance

I. Instructions

Below is a list of species that EPA has determined may be affected by the activities covered by the multi-sector general permit (MSGP). These species are listed by county. In order to get MSGP coverage, applicants must:

- Indicate in box provided on the NOI whether any species listed in this Addendum are in proximity to the facility, and
- Certify pursuant to Section II.B.12 of the MSGP that their storm water discharges, and BMPs constructed to control storm water runoff, are not likely, and will not be likely to adversely affect species identified in Addendum H of this permit.

To do this, please follow steps 1 through 4 below.

Step 1: Review the County Species List to Determine if any Species are Located in the Discharging Facility County

If no species are listed in a facility's county or if a facility's county is not found on the list, an applicant is eligible for MSGP coverage and may indicate in the NOI that no species are found in proximity and provide the necessary certification. If species are located in the county, follow step 2 below. Where a facility is located in more than one county, the lists for all counties should be reviewed.

Step 2: Determine if any Species may be Found "In Proximity" to the Facility

A species is in proximity to a facility's storm water discharge when the species is:

- Located in the path or immediate area through which or over which contaminated point source storm water flows from industrial activities to the point of discharge into the receiving water.
- Located in the immediate vicinity of, or nearby, the point of discharge into receiving waters.
- Located in the area of a site where storm water BMPs are planned or are to be constructed.

The area in proximity to be searched/surveyed for listed species will vary with the size of the facility, the nature and quantity of the storm water discharges, and the type of receiving waters. Given the number of facilities potentially covered by the MSGP, no specific method to determine whether species are in proximity is required for permit coverage under the MSGP. Instead, applicants should use the method or methods which best allow them to determine to the best of their knowledge whether species are in proximity to their particular facility. These methods may include:

- *Conducting visual inspections:* This method may be particularly suitable for facilities that are smaller in size, facilities located in non-natural settings such as highly urbanized areas or industrial parks where there is little or no nature habitat; and facilities that discharge directly into municipal storm water collection systems. For other facilities, a visual survey of the facility site and storm water drainage areas may be insufficient to determine whether species are likely to be located in proximity to the discharge.
- *Contacting the nearest State Wildlife Agency or U.S. Fish and Wildlife Service (FWS) or National Marine Fisheries Service (NMFS) offices.* Many endangered and threatened species are found in well-defined areas or habitats. That information is frequently known to state or federal wildlife agencies. FWS has offices in every state. NMFS has regional offices in: Gloucester, Massachusetts; St. Petersburg, Florida; Long Beach, California; Portland, Oregon; and Juneau, Alaska.
- *Contacting local/regional conservation groups.* These groups inventory species and their locations and maintain lists of sightings and habitats.
- *Conducting a formal biological survey.* Larger facilities with extensive storm water discharges may choose to conduct biological surveys as the most effective way to assess whether species are located in proximity and whether there are likely adverse effects.

If no species are in proximity, an applicant is eligible for MSGP coverage and may indicate that in the NOI and provide the necessary certification. If listed species are found in proximity to a facility, applicants must follow step 3 below.

Step 3: Determine if Species Could be Adversely Affected by the Facility's Storm Water Discharges or by BMPS to Control Those Discharges

Scope of Adverse Effects: Potential adverse effects from storm water include:

- *Hydrological.* Storm water may cause siltation, sedimentation or induce other changes in the receiving waters such as temperature, salinity or pH. These effects will vary with the amount of storm water discharged and the volume and condition of the receiving water. Where a storm water discharge constitutes a minute portion of the total volume of the receiving water, adverse hydrological effects are less likely.
- *Habitat.* Storm water may drain or inundate listed species habitat.
- *Toxicity.* In some cases, pollutants in storm water may have toxic effects on listed species.

The scope of effects to consider will vary with each site. Applicants must also consider the likelihood of adverse effects on species from any BMPs to control storm water. Most adverse impact from BMPs are likely to occur from the construction activities.

Using earlier ESA authorizations for MSGP eligibility: In some cases, a facility may be eligible for MSGP coverage because actual or potential adverse affects were addressed or discounted through an earlier ESA authorization. Examples of such authorization include:

- An earlier ESA section 7 consultation for that facility.
- A section 10(a) permit issued for the facility.
- An area-wide Habitat Conservation Plan applicable to that facility.
- A clearance letter from the Services (which discounts the possibility of an adverse impact from the facility).

In order for applicants to use an earlier ESA authorization to meet eligibility requirements: (1) The authorization must adequately address impacts for storm water discharges and BMPs from the facility on endangered and threatened species, (2) it must be current because there have been no subsequent changes in facility operations or circumstances which might impact species in ways not considered in the earlier authorization, and (3) the applicant must comply with any requirements from those authorizations to avoid or mitigate adverse effects to species. Applicants who wish to pursue this approach should carefully review documentation for those authorizations ensure that the above conditions are met.

If adverse effects are not likely, an applicant is eligible for MSGP coverage and may indicate in the NOI that species are found in proximity and provide the necessary certification. If adverse effects are likely, follow step 4 below.

Step 4: Determine if Measures can be Implemented to Avoid any Adverse Effects

If an applicant determines that adverse effects are likely, it can receive coverage if appropriate measures are undertaken to avoid or eliminate any actual or potential adverse affects prior to applying for permit coverage. These measures may involve relatively simple changes to facility operations such as re-routing a storm water discharge to bypass an area where species are located.

At this stage, applicants may wish to contact the FWS and/or NMFS to see what appropriate measures might be suitable to avoid or eliminate adverse impacts to species.

If applicants adopt these measures, they must continue to abide by them during the course of permit coverage.

If appropriate measures are not available, the applicant is not eligible at that time for coverage under the MSGP. Applicants should contact the appropriate EPA regional office about either:

- Entering into Section 7 consultation in order to obtain MSGP coverage, or
- Obtaining an individual NPDES storm water permit.

II. County/Species List

[The following list identifies federally listed or proposed U.S. species by State and County. It has been updated through March 31, 1995.]

State/County	Group name	Inventory name	Scientific name	IR/FF*
ALASKA				
ALEUTIAN ISLANDS	BIRDS	GOOSE, ALEUTIAN CANADA	Branta canadensis leucopareia.	
ALEUTIANS EAST	BIRDS	EIDER, STELLER'S	POLYSTICTA STELLERI.	
ALEUTIANS, WEST	BIRDS	EIDER, STELLER'S	POLYSTICTA STELLERI.	
NORTH SLOPE	BIRDS	CURLEW, ESKIMO	Numenius borealis.	
ARIZONA				
APACHE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	MINNOW, LOACH	Tiaroga cobitis.	
		SPINEDACE, LITTLE COLORADO	Lepidomeda vittata.	
		TROUT, APACHE	Salmo apache.	
	PLANTS	SEDGE, NAVAJO	Carex specuicola.	
COCHISE	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	CATFISH, YAQUI	Ictalurus pricei.	
		CHUB, YAQUI	Gila purpurea.	
		PUPFISH, DESERT	Cyprinodon macularius.	
		SHINER, BEAUTIFUL	Notropis formosus.	
		TOPMINNOW, GILA (YAQUI)	Poeciliopsis occidentalis.	
COCONINO	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	CHUB, HUMPBACK	Gila cypha.	
		SPINEDACE, LITTLE COLORADO	Lepidomeda vittata.	
		SUCKER, RAZORBACK	XYRAUCHEN TEXANUS.	
	PLANTS	SEDGE, NAVAJO	Carex specuicola.	
	SNAILS	AMBERSNAIL, KANAB	OXYLOMA HAYDENI KANABENSIS.	
GILA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	MINNOW, LOACH	Tiaroga cobitis.	
		SQUAWFISH, COLORADO	Ptychocheilus lucius.	
		SUCKER, RAZORBACK	XYRAUCHEN TEXANUS.	
		TOPMINNOW, GILA (YAQUI)	Poeciliopsis occidentalis.	
GRAHAM	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	MINNOW, LOACH	Tiaroga cobitis.	
		PUPFISH, DESERT	Cyprinodon macularius.	
		SPIKEDACE	Meda fulgida.	
		SUCKER, RAZORBACK	XYRAUCHEN TEXANUS.	
		TOPMINNOW, GILA (YAQUI)	Poeciliopsis occidentalis.	
		TROUT, APACHE	Salmo apache.	
GREENLEE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	MINNOW, LOACH	Tiaroga cobitis.	
		SPIKEDACE	Meda fulgida.	
		SUCKER, RAZORBACK	XYRAUCHEN TEXANUS.	
		TROUT, APACHE	Salmo apache.	
LA PAZ	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		RAIL, YUMA CLAPPER	Rallus longirostris yumanensis.	
	FISHES	CHUB, BONYTAIL	Gila elegans.	
		PUPFISH, DESERT	Cyprinodon macularius.	
		SUCKER, RAZORBACK	XYRAUCHEN TEXANUS.	
MARICOPA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		RAIL, YUMA CLAPPER	Rallus longirostris yumanensis.	
	FISHES	PUPFISH, DESERT	Cyprinodon macularius.	
		TOPMINNOW, GILA (YAQUI)	Poeciliopsis occidentalis.	
MOHAVE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		RAIL, YUMA CLAPPER	Rallus longirostris yumanensis.	
	FISHES	CHUB, BONYTAIL	Gila elegans.	
		CHUB, HUMPBACK	Gila cypha.	
		CHUB, VIRGIN RIVER	Gila robusta seminuda.	
		SUCKER, RAZORBACK	XYRAUCHEN TEXANUS.	
	PLANTS	CYCLADENIA, JONES	Cycladenia humilis var. jonesii.	
	SNAILS	AMBERSNAIL, KANAB	OXYLOMA HAYDENI KANABENSIS.	
NAVAJO	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	CHUB, HUMPBACK	Gila cypha.	
		MINNOW, LOACH	Tiaroga cobitis.	

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II. COUNTY/SPECIES LIST—Continued

[The following list identifies federally listed or proposed U.S. species by State and County. It has been updated through March 31, 1995.]

State/County	Group name	Inventory name	Scientific name	IR/FF*
		SPINEDACE, LITTLE COLORADO	Lepidomeda vittata.	
		TROUT, APACHE	Salmo apache.	
	PLANTS	SEDGE, NAVAJO	Carex specuicola.	
PIMA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	CRUSTACEAN	TALUSSNAIL, SAN XAVIER	SONORELLA EREMITA.	
	FISHES	PUPFISH, DESERT	Cyprinodon macularius.	
		TOPMINNOW, GILA (YAQUI)	Poeciliopsis occidentalis.	
PINAL	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		RAIL, YUMA CLAPPER	Rallus longirostris yumanensis.	
	FISHES	MINNOW, LOACH	Tiaroga cobitis.	
		PUPFISH, DESERT	Cyprinodon macularius.	
		SPIKEDACE	Meda fulgida.	
		SUCKER, RAZORBACK	XYRAUCHEN TEXANUS.	
		TOPMINNOW, GILA (YAQUI)	Poeciliopsis occidentalis.	
SANTA CRUZ	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	CHUB, SONORA	Gila ditaenia.	
		TOPMINNOW, GILA (YAQUI)	Poeciliopsis occidentalis.	
YAVAPAI	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		FALCON, PEREGRINE	Falco peregrinus.	
	FISHES	PUPFISH, DESERT	Cyprinodon macularius.	
		SPIKEDACE	Meda fulgida.	
		SQUAWFISH, COLORADO	Ptychocheilus lucius.	
		SUCKER, RAZORBACK	XYRAUCHEN TEXANUS.	
		TOPMINNOW, GILA (YAQUI)	Poeciliopsis occidentalis.	
		TROUT, GILA	Salmo gilae.	
YUMA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		FALCON, PEREGRINE	Falco peregrinus.	
		PELICAN, BROWN	Pelicanus occidentalis.	
		RAIL, YUMA CLAPPER	Rallus longirostris yumanensis.	
	FISHES	SUCKER, RAZORBACK	XYRAUCHEN TEXANUS.	
CALIFORNIA				
ALAMEDA	BIRDS	PELICAN, BROWN	Pelicanus occidentalis	IR
		PLOVER, WESTERN SNOWY	CHARADRIUS ALEXANDRINUS NIVOSUS.	IR
		RAIL, CALIFORNIA CLAPPER	Rallus longirostris obsoletus	IR
		TERN, CALIFORNIA LEAST	Sterna antillarum browni	IR
	CRUSTACEAN	LINDERIELLA, CALIFORNIA	LINDERIELLA OCCIDENTALIS	IR
		SHRIMP, LONGHORN FAIRY	BRANCHINECTA LONGIANTENNA	IR
		SHRIMP, VERNAL POOL FAIRY	BRANCHINECTA LYNCHI	IR
	FISHES	SALMON, CHINOOK (SNAKE RIVER SPRING.	ONCORHYNCHUS TSHAWYTSCHA	IR
ALPINE	FISHES	TROUT, LAHONTAN CUTTHROAT	Salmo clarki henshawi	IR
		TROUT, PAIUTE CUTTHROAT	Salmo clarki seleniris	IR
AMADOR	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
BUTTE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
		GOOSE, ALEUTIAN CANADA	Branta canadensis leucopareia	IR
	CRUSTACEAN	SHRIMP, CONSERVANCY FAIRY	BRANCINECTA CONSERVATIO	IR
		SHRIMP, VERNAL POOL TADPOLE	LEPIDURUS PACKARDI	IR
	FISHES	SALMON, CHINOOK (WINTER-RUN)	ONCORHYNCHUS TSHAWYTSCHA	IR
CALAVERAS	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	CRUSTACEAN	SHRIMP, VERNAL POOL TADPOLE	LEPIDURUS PACKARDI	IR
COLUSA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
		GOOSE, ALEUTIAN CANADA	Branta canadensis leucopareia	IR
	CRUSTACEAN	SHRIMP, VERNAL POOL TADPOLE	LEPIDURUS PACKARDI	IR
CONTRA COSTA	BIRDS	GOOSE, ALEUTIAN CANADA	Branta canadensis leucopareia	IR
		PELICAN, BROWN	Pelicanus occidentalis	IR
		RAIL, CALIFORNIA CLAPPER	Rallus longirostris obsoletus	IR
		TERN, CALIFORNIA LEAST	Sterna antillarum browni	IR
	CRUSTACEAN	LINDERIELLA, CALIFORNIA	LINDERIELLA OCCIDENTALIS	IR
		SHRIMP, LONGHORN FAIRY	BRANCHINECTA LONGIANTENNA	IR
		SHRIMP, VERNAL POOL FAIRY	BRANCHINECTA LYNCHI	IR
	FISHES	SALMON, CHINOOK (WINTER-RUN)	ONCORHYNCHUS TSHAWYTSCHA	IR
DEL NORTE	AMPHIBIANS	FROG, CALIFORNIA RED-LEGGED	RANA AURORA DRAYTONII	IR
	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
		GOOSE, ALEUTIAN CANADA	Branta canadensis leucopareia	IR
		MURRELET, MARBLED	BRACHYRAMPHUS MARMORATUS	IR
		PELICAN, BROWN	Pelicanus occidentalis	IR
		PLOVER, WESTERN SNOWY	CHARADRIUS ALEXANDRINUS NIVOSUS.	IR
EL DORADO	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR

II. COUNTY/SPECIES LIST—Continued

[The following list identifies federally listed or proposed U.S. species by State and County. It has been updated through March 31, 1995.]

State/County	Group name	Inventory name	Scientific name	IR/FF*
	CRUSTACEAN	SHRIMP, VERNAL POOL TADPOLE	LEPIDURUS PACKARDI	IR
	FISHES	TROUT, LAHONTAN CUTTHROAT	Salmo clarki henshawi	IR
FRESNO	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	TROUT, LITTLE KERN GOLDEN	Salmo aguabonita whitei	IR
		TROUT, PAIUTE CUTTHROAT	Salmo clarki seleniris	IR
GLENN	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
		GOOSE, ALEUTIAN CANADA	Branta canadensis leucopareia	IR
		MURRELET, MARBLED	BRACHYRAMPHUS MARMORATUS	IR
	CRUSTACEAN	SHRIMP, VERNAL POOL TADPOLE	LEPIDURUS PACKARDI	IR
	FISHES	SALMON, CHINOOK (WINTER-RUN)	ONCORHYNCHUS TSHAWYTSCHA	IR
HUMBOLDT	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
		GOOSE, ALEUTIAN CANADA	Branta canadensis leucopareia	IR
		MURRELET, MARBLED	BRACHYRAMPHUS MARMORATUS	IR
		PELICAN, BROWN	Pelicanus occidentalis	IR
		PLOVER, WESTERN SNOWY	CHARADRIUS ALEXANDRINUS NIVOSUS.	IR
	REPTILES	TURTLE, OLIVE (PACIFIC) RIDLEY SEA	Lepidochelys olivacea	IR
IMPERIAL	AMPHIBIANS	TOAD, ARROYO SOUTHWESTERN	BUFO MICROSCAPHUS CALIFORNICUS.	IR
	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
		GOOSE, ALEUTIAN CANADA	Branta canadensis leucopareia	IR
		PELICAN, BROWN	Pelicanus occidentalis	IR
		RAIL, YUMA CLAPPER	Rallus longirostris yumanensis	IR
	FISHES	CHUB, BONYTAIL	Gila elegans	IR
		PUPFISH, DESERT	Cyprinodon macularius	IR
		SQUAWFISH, COLORADO	Ptychocheilus lucius	IR
		SUCKER, RAZORBACK	XYRAUCHEN TEXANUS	IR
INYO	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
		GOOSE, ALEUTIAN CANADA	Branta canadensis leucopareia	IR
	FISHES	CHUB, OWENS TUI	Gila bicolor snyderi	IR
		PUPFISH, OWENS	Cyprinodon radiosus	IR
		TROUT, LAHONTAN CUTTHROAT	Salmo clarki henshawi	IR
	PLANTS	CENTAURY, SPRING-LOVING	Centaurium namophilum var. namophi	IR
		GUMPLANT, ASH MEADOWS	Grindelia fraxinopratensis	IR
		IVESIA, ASH MEADOWS	Ivesia kingii var. eremica	IR
KERN	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
KINGS	BIRDS	GOOSE, ALEUTIAN CANADA	Branta canadensis leucopareia	IR
LAKE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
		MURRELET, MARBLED	BRACHYRAMPHUS MARMORATUS	IR
	FISHES	SPLITTAIL, SACRAMENTO	POGONICHTHYS MACROLEPIDOTUS	IR
	PLANTS	COYOTE-THISTLE, LOCH LOMOND	Eryngium constancei	IR
		GOLDFIELDS, BURKE'S	Lasthenia burkei	IR
LASSEN	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	SUCKER, MODOC	Catostomus microps	IR
LOS ANGELES	AMPHIBIANS	TOAD, ARROYO SOUTHWESTERN	BUFO MICROSCAPHUS CALIFORNICUS.	IR
	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
		MURRELET, MARBLED	BRACHYRAMPHUS MARMORATUS	IR
		PELICAN, BROWN	Pelicanus occidentalis	IR
		PLOVER, WESTERN SNOWY	CHARADRIUS ALEXANDRINUS NIVOSUS.	IR
		RAIL, LIGHT-FOOTED CLAPPER	Rallus longirostris levipes	IR
		TERN, CALIFORNIA LEAST	Sterna antillarum browni	IR
	FISHES	CHUB, MOHAVE TUI	Gila bicolor mohavensis	IR
		STICKLEBACK, UNARMORED THREESPINE.	Gasterosteus aculeatus williamsoni	IR
	PLANTS	BIRD'S-BEAK, SALT MARSH	Cordylanthus maritimus ssp. mariti	IR
		BROOM, SAN CLEMENTE ISLAND	Lotus dendroideus ssp. traskiae	IR
		BUSH-MALLOW, SAN CLEMENTE ISLAND.	Malacothamnus clementinus	IR
		WATERCRESS, GAMBEL'S	RORIPPA GAMBELLII	IR
MADERA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	TROUT, LAHONTAN CUTTHROAT	Salmo clarki henshawi	IR
		TROUT, PAIUTE CUTTHROAT	Salmo clarki seleniris	IR
MARIN	AMPHIBIANS	FROG, CALIFORNIA RED-LEGGED	RANA AURORA DRAYTONII	IR
	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
		MURRELET, MARBLED	BRACHYRAMPHUS MARMORATUS	IR
		PELICAN, BROWN	Pelicanus occidentalis	IR
		PLOVER, WESTERN SNOWY	CHARADRIUS ALEXANDRINUS NIVOSUS.	IR
		RAIL, CALIFORNIA CLAPPER	Rallus longirostris obsoletus	IR

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II. COUNTY/SPECIES LIST—Continued

[The following list identifies federally listed or proposed U.S. species by State and County. It has been updated through March 31, 1995.]

State/County	Group name	Inventory name	Scientific name	IR/FF*
	CRUSTACEAN	SHRIMP, CALIFORNIA FRESHWATER	Syncaris pacifica	IR
	FISHES	SALMON, CHINOOK (WINTER-RUN)	ONCORHYNCHUS TSHAWYTSCHA	IR
MARIPOSA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
MENDOCINO	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
		GOOSE, ALEUTIAN CANADA	Branta canadensis leucopareia	IR
		MURRELET, MARBLED	BRACHYRAMPHUS MARMORATUS	IR
		PELICAN, BROWN	Pelicanus occidentalis	IR
		PLOVER, WESTERN SNOWY	CHARADRIUS ALEXANDRINUS NIVOSUS.	IR
	MAMMALS	BEAVER, POINT ARENA MOUNTAIN	Aplodontia rufa nigra	IR
	PLANTS	GOLDFIELDS, BURKE'S	Lasthenia burkei	IR
	REPTILES	TURTLE, OLIVE (PACIFIC) RIDLEY SEA	Lepidochelys olivacea	IR
MERCED	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
		GOOSE, ALEUTIAN CANADA	Branta canadensis leucopareia	IR
	CRUSTACEAN	LINDERIELLA, CALIFORNIA	LINDERIELLA OCCIDENTALIS	IR
		SHRIMP, CONSERVANCY FAIRY	BRANCINECTA CONSERVATIO	IR
		SHRIMP, VERNAL POOL FAIRY	BRANCHINECTA LYNCHI	IR
MODOC	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	SUCKER, LOST RIVER	Deltistes luxatus	IR
		SUCKER, MODOC	Catostomus microps	IR
		SUCKER, SHORTNOSE	Chasmistes brevirostris	IR
MONO	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
		GOOSE, ALEUTIAN CANADA	Branta canadensis leucopareia	IR
	FISHES	CHUB, OWENS TUI	Gila bicolor snyderi	IR
		PUPFISH, OWENS	Cyprinodon radiosus	IR
		TROUT, LAHONTAN CUTTHROAT	Salmo clarki henshawi	IR
		TROUT, PAIUTE CUTTHROAT	Salmo clarki seleniris	IR
MONTEREY	AMPHIBIANS	SALAMANDER, SANTA CRUZ LONG-TOED.	Ambystoma macrodactylum croceum	IR
	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
		MURRELET, MARBLED	BRACHYRAMPHUS MARMORATUS	IR
		PELICAN, BROWN	Pelicanus occidentalis	IR
		PLOVER, WESTERN SNOWY	CHARADRIUS ALEXANDRINUS NIVOSUS.	IR
		RAIL, CALIFORNIA CLAPPER	Rallus longirostris obsoletus	IR
		TERN, CALIFORNIA LEAST	Sterna antillarum browni	IR
	CRUSTACEAN	LINDERIELLA, CALIFORNIA	LINDERIELLA OCCIDENTALIS	IR
		SHRIMP, VERNAL POOL FAIRY	BRANCHINECTA LYNCHI	IR
	MAMMALS	OTTER, SOUTHERN SEA	Enhydra lutris nereis	IR
	REPTILES	TURTLE, OLIVE (PACIFIC) RIDLEY SEA	Lepidochelys olivacea	IR
NAPA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
		PELICAN, BROWN	Pelicanus occidentalis	IR
		PLOVER, WESTERN SNOWY	CHARADRIUS ALEXANDRINUS NIVOSUS.	IR
		RAIL, CALIFORNIA CLAPPER	Rallus longirostris obsoletus	IR
	CRUSTACEAN	LINDERIELLA, CALIFORNIA	LINDERIELLA OCCIDENTALIS	IR
		SHRIMP, CALIFORNIA FRESHWATER	Syncaris pacifica	IR
	FISHES	SALMON, CHINOOK (WINTER-RUN)	ONCORHYNCHUS TSHAWYTSCHA	IR
NEVADA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	TROUT, LAHONTAN CUTTHROAT	Salmo clarki henshawi	IR
ORANGE	AMPHIBIANS	TOAD, ARROYO SOUTHWESTERN	BUFO MICROSCAPHUS CALIFORNICUS.	IR
	BIRDS	MURRELET, MARBLED	BRACHYRAMPHUS MARMORATUS	IR
		PELICAN, BROWN	Pelicanus occidentalis	IR
		PLOVER, WESTERN SNOWY	CHARADRIUS ALEXANDRINUS NIVOSUS.	IR
		RAIL, LIGHT-FOOTED CLAPPER	Rallus longirostris levipes	IR
		TERN, CALIFORNIA LEAST	Sterna antillarum browni	IR
	CRUSTACEAN	SHRIMP, RIVERSIDE FAIRY	STREPTOCEPHALUS WOOTTONI	IR
	PLANTS	BIRD'S-BEAK, SALT MARSH	Cordylanthus maritimus ssp. mariti	IR
PLACER	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
		GOOSE, ALEUTIAN CANADA	Branta canadensis leucopareia	IR
	CRUSTACEAN	LINDERIELLA, CALIFORNIA	LINDERIELLA OCCIDENTALIS	IR
		SHRIMP, VERNAL POOL FAIRY	BRANCHINECTA LYNCHI	IR
		SHRIMP, VERNAL POOL TADPOLE	LEPIDURUS PACKARDI	IR
	FISHES	TROUT, LAHONTAN CUTTHROAT	Salmo clarki henshawi	IR
PLUMAS	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
RIVERSIDE	AMPHIBIANS	SALAMANDER, DESERT SLENDER	Batrachoseps aridus	IR
		TOAD, ARROYO SOUTHWESTERN	BUFO MICROSCAPHUS CALIFORNICUS.	IR
	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR

II. COUNTY/SPECIES LIST—Continued

[The following list identifies federally listed or proposed U.S. species by State and County. It has been updated through March 31, 1995.]

State/County	Group name	Inventory name	Scientific name	IR/FF*
		PELICAN, BROWN	Pelicanus occidentalis	IR
		RAIL, YUMA CLAPPER	Rallus longirostris yumanensis	IR
	CRUSTACEAN	LINDERIELLA, CALIFORNIA	LINDERIELLA OCCIDENTALIS	IR
		SHRIMP, RIVERSIDE FAIRY	STREPTOCEPHALUS WOOTTONI	IR
		SHRIMP, VERNAL POOL FAIRY	BRANCHINECTA LYNCHI	IR
	FISHES	CHUB, BONYTAIL	Gila elegans	IR
		PUPFISH, DESERT	Cyprinodon macularius	IR
		SQUAWFISH, COLORADO	Ptychocheilus lucius	IR
		SUCKER, RAZORBACK	XYRAUCHEN TEXANUS	IR
	PLANTS	BUTTON-CELERY, SAN DIEGO	ERYNGIUM ARISTULATUM VAR. PARISHII.	IR
		GRASS, CALIFORNIA ORCUTT	ORCUTTIA CALIFORNICA	IR
		MILK-VETCH, COACHELLA VALLEY	ASTRAGALUS LENTIGINOSUS VAR. COACH.	IR
		MINT, OTAY MESA	POGOGYNE NUDIUSCULA	IR
SACRAMENTO	BIRDS	EAGLE, BALD	Haliaeetus leucocephaius	IR
		GOOSE, ALEUTIAN CANADA	Branta canadensis leucopareia	IR
		PLOVER, WESTERN SNOWY	CHARADRIUS ALEXANDRINUS NIVOSUS.	IR
	CRUSTACEAN	LINDERIELLA, CALIFORNIA	LINDERIELLA OCCIDENTALIS	IR
		SHRIMP, VERNAL POOL FAIRY	BRANCHINECTA LYNCHI	IR
		SHRIMP, VERNAL POOL TADPOLE	LEPIDURUS PACKARDI	IR
	FISHES	SALMON, CHINOOK (WINTER-RUN)	ONCORHYNCHUS TSHAWYTSCHA	IR
		SMELT, DELTA	HYPOMESUS TRANSPACIFICUS	IR
SAN BENITO	BIRDS	EAGLE, BALD	Haliaeetus leucocephaius	IR
SAN BERNARDINO	AMPHIBIANS	TOAD, ARROYO SOUTHWESTERN	BUFO MICROSCAPHUS CALIFORNICUS.	IR
	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
		PLOVER, WESTERN SNOWY	CHARADRIUS ALEXANDRINUS NIVOSUS.	IR
		RAIL, YUMA CLAPPER	Rallus longirostris yumanensis	IR
	FISHES	CHUB, BONYTAIL	Gila elegans	IR
		CHUB, MOHAVE TUI	Gila bicolor mohavensis	IR
		PUPFISH, DESERT	Cyprinodon macularius	IR
		SQUAWFISH, COLORADO	Ptychocheilus lucius	IR
		STICKLEBACK, UNARMORED THREESPINE.	Gasterosteus aculeatus williamsoni	IR
		SUCKER, RAZORBACK	XYRAUCHEN TEXANUS	IR
	PLANTS	CHECKER-MALLOW, PEDATE	Sidalcea pedata	IR
		OXYTHECA, CUSHENBURY	OXYTHECA PARISHII VAR. GOODMANIANA.	IR
		WATERCRESS, GAMBEL'S	RORIPPA GAMBELLII	IR
SAN DIEGO	AMPHIBIANS	TOAD, ARROYO SOUTHWESTERN	BUFO MICROSCAPHUS CALIFORNICUS.	IR
	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
		GOOSE, ALEUTIAN CANADA	Branta canadensis leucopareia	IR
		MURRELET, MARBLED	BRACHYRAMPHUS MARMORATUS	IR
		PELICAN, BROWN	Pelicanus occidentalis	IR
		PLOVER, WESTERN SNOWY	CHARADRIUS ALEXANDRINUS NIVOSUS.	IR
		RAIL, LIGHT-FOOTED CLAPPER	Rallus longirostris levipes	IR
		TERN, CALIFORNIA LEAST	Sterna antillarum browni	IR
	CRUSTACEAN	SHRIMP, RIVERSIDE FAIRY	STREPTOCEPHALUS WOOTTONI	IR
	FISHES	CHUB, MOHAVE TUI	Gila bicolor mohavensis	IR
		PUPFISH, DESERT	Cyprinodon macularius	IR
		SHRIMP, SAN DIEGO FAIRY	BRANCHINECTA SANDIEGOENSIS	IR
		STICKLEBACK, UNARMORED THREESPINE.	Gasterosteus aculeatus williamsoni	IR
	PLANTS	BIRD'S-BEAK, SALT MARSH	Cordylanthus maritimus ssp. maritimus	IR
		BUTTON-CELERY, SAN DIEGO	ERYNGIUM ARISTULATUM VAR. PARISHII.	IR
		GRASS, CALIFORNIA ORCUTT	ORCUTTIA CALIFORNICA	IR
		MINT, OTAY MESA	POGOGYNE NUDIUSCULA	IR
		MINT, SAN DIEGO MESA	Pogogyne abramsii	IR
		WATERCRESS, GAMBEL'S	RORIPPA GAMBELLII	IR
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas	IR
		TURTLE, OLIVE (PACIFIC) RIDLEY SEA	Lepidochelys olivacea	IR
SAN FRANCISCO	BIRDS	GOOSE, ALEUTIAN CANADA	Branta canadensis leucopareia	IR
		PELICAN, BROWN	Pelicanus occidentalis	IR
		PLOVER, WESTERN SNOWY	CHARADRIUS ALEXANDRINUS NIVOSUS.	IR

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II. COUNTY/SPECIES LIST—Continued

[The following list identifies federally listed or proposed U.S. species by State and County. It has been updated through March 31, 1995.]

State/County	Group name	Inventory name	Scientific name	IR/FF*
SAN JOAQUIN	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
		GOOSE, ALEUTIAN CANADA	Branta canadensis leucopareia	IR
	CRUSTACEAN	LINDERIELLA, CALIFORNIA	LINDERIELLA OCCIDENTALIS	IR
		SHRIMP, VERNAL POOL FAIRY	BRANCHINECTA LYNCHI	IR
		SHRIMP, VERNAL POOL TADPOLE	LEPIDURUS PACKARDI	IR
	FISHES	SALMON, CHINOOK (WINTER-RUN)	ONCORHYNCHUS TSHAWYTSCHA	IR
		SMELT, DELTA	HYPOMESUS TRANSPACIFICUS	IR
SAN LUIS OBISPO	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
		GOOSE, ALEUTIAN CANADA	Branta canadensis leucopareia	IR
		MURRELET, MARBLED	BRACHYRAMPHUS MARMORATUS	IR
		PELICAN, BROWN	Pelicanus occidentalis	IR
		PLOVER, WESTERN SNOWY	CHARADRIUS ALEXANDRINUS NIVOSUS.	IR
		RAIL, CALIFORNIA CLAPPER	Rallus longirostris obsoletus	IR
		TERN, CALIFORNIA LEAST	Sterna antillarum browni	IR
	CRUSTACEAN	LINDERIELLA, CALIFORNIA	LINDERIELLA OCCIDENTALIS	IR
		SHRIMP, LONGHORN FAIRY	BRANCHINECTA LONGIANTENNA	IR
	MAMMALS	OTTER, SOUTHERN SEA	Enhydra lutris nereis	IR
	PLANTS	BIRD'S-BEAK, SALT MARSH	Cordylanthus maritimus ssp. maritimus	IR
		SANDWORT, MARSH	ARENARIA PALUDICOLA	IR
		SEA-BLITE, CALIFORNIA	SUAEDA CALIFORNICA	IR
		THISTLE, CHORRO CREEK BOG	CIRSIUM FONTINALE VAR. OBISPOENSE.	IR
		WATERCRESS, GAMBEL'S	RORIPPA GAMBELLII	IR
SAN MATEO	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
		MURRELET, MARBLED	BRACHYRAMPHUS MARMORATUS	IR
		PELICAN, BROWN	Pelicanus occidentalis	IR
		PLOVER, WESTERN SNOWY	CHARADRIUS ALEXANDRINUS NIVOSUS.	IR
		RAIL, CALIFORNIA CLAPPER	Rallus longirostris obsoletus	IR
		TERN, CALIFORNIA LEAST	Sterna antillarum browni	IR
	CRUSTACEAN	LINDERIELLA, CALIFORNIA	LINDERIELLA OCCIDENTALIS	IR
	PLANTS	THISTLE, FOUNTAIN	CIRSIUM FONTINALE VAR. FONTINALE	IR
SANTA BARBARA	AMPHIBIANS	TOAD, ARROYO SOUTHWESTERN	BUFO MICROSCAPHUS CALIFORNICUS.	IR
	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
		GOOSE, ALEUTIAN CANADA	Branta canadensis leucopareia	IR
		MURRELET, MARBLED	BRACHYRAMPHUS MARMORATUS	IR
		PELICAN, BROWN	Pelicanus occidentalis	IR
		PLOVER, WESTERN SNOWY	CHARADRIUS ALEXANDRINUS NIVOSUS.	IR
		RAIL, LIGHT-FOOTED CLAPPER	Rallus longirostris levipes	IR
		TERN, CALIFORNIA LEAST	Sterna antillarum browni	IR
	CRUSTACEAN	LINDERIELLA, CALIFORNIA	LINDERIELLA OCCIDENTALIS	IR
	FISHES	STICKLEBACK, UNARMORED THREESPINE.	Gasterosteus aculeatus williamsoni	IR
	MAMMALS	SEAL, GUADALUPE FUR	Arctocephalus townsendi	IR
	PLANTS	BIRD'S-BEAK, SALT MARSH	Cordylanthus maritimus ssp. maritimus	IR
SANTA CLARA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
		PELICAN, BROWN	Pelicanus occidentalis	IR
		PLOVER, WESTERN SNOWY	CHARADRIUS ALEXANDRINUS NIVOSUS.	IR
		RAIL, CALIFORNIA CLAPPER	Rallus longirostris obsoletus	IR
		TERN, CALIFORNIA LEAST	Sterna antillarum browni	IR
	PLANTS	THISTLE, FOUNTAIN	CIRSIUM FONTINALE VAR. FONTINALE	IR
SANTA CRUZ	AMPHIBIANS	SALAMANDER, SANTA CRUZ LONG-TOED.	Ambystoma macrodactylum croceum	IR
	BIRDS	MURRELET, MARBLED	BRACHYRAMPHUS MARMORATUS	IR
		PELICAN, BROWN	Pelicanus occidentalis	IR
		PLOVER, WESTERN SNOWY	CHARADRIUS ALEXANDRINUS NIVOSUS.	IR
	MAMMALS	OTTER, SOUTHERN SEA	Enhydra lutris nereis	IR
SHASTA	AMPHIBIANS	FROG, CALIFORNIA RED-LEGGED	RANA AURORA DRAYTONII	IR
	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	CRUSTACEAN	CRAYFISH, SHASTA	Pacifasticus fortis	IR
		SHRIMP, VERNAL POOL TADPOLE	LEPIDURUS PACKARDI	IR
	FISHES	SALMON, CHINOOK (WINTER-RUN)	ONCORHYNCHUS TSHAWYTSCHA	IR
SIERRA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	TROUT, LAHONTAN CUTTHROAT	Salmo clarki henshawi	IR
SISKIYOU	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
		GOOSE, ALEUTIAN CANADA	Branta canadensis leucopareia	IR

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II. COUNTY/SPECIES LIST—Continued

[The following list identifies federally listed or proposed U.S. species by State and County. It has been updated through March 31, 1995.]

State/County	Group name	Inventory name	Scientific name	IR/FF*
		MURRELET, MARBLED	BRACHYRAMPHUS MARMORATUS	IR
	FISHES	SUCKER, LOST RIVER	Deltistes luxatus	IR
SOLANO	BIRDS	GOOSE, ALEUTIAN CANADA	Branta canadensis leucopareia	IR
		PELICAN, BROWN	Pelicanus occidentalis	IR
		RAIL, CALIFORNIA CLAPPER	Rallus longirostris obsoletus	IR
	CRUSTACEAN	LINDERIELLA, CALIFORNIA	LINDERIELLA OCCIDENTALIS	IR
		SHRIMP, VERNAL POOL FAIRY	BRANCHINECTA LYNCHI	IR
		SHRIMP, VERNAL POOL TADPOLE	LEPIDURUS PACKARDI	IR
	FISHES	SALMON, CHINOOK (WINTER-RUN)	ONCORHYNCHUS TSHAWYTSCHA	IR
		SMELT, DELTA	HYPOMESUS TRANSPACIFICUS	IR
	PLANTS	GRASS, SOLANO	Tuctoria mucronata (=Orcuttia m.)	IR
SONOMA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
		MURRELET, MARBLED	BRACHYRAMPHUS MARMORATUS	IR
		PELICAN, BROWN	Pelicanus occidentalis	IR
		PLOVER, WESTERN SNOWY	CHARADRIUS ALEXANDRINUS NIVOSUS.	IR
		RAIL, CALIFORNIA CLAPPER	Rallus longirostris obsoletus	IR
	CRUSTACEAN	LINDERIELLA, CALIFORNIA	LINDERIELLA OCCIDENTALIS	IR
		SHRIMP, CALIFORNIA FRESHWATER	Syncaris pacifica	IR
	FISHES	SALMON, CHINOOK (WINTER-RUN)	ONCORHYNCHUS TSHAWYTSCHA	IR
	PLANTS	BIRD'S-BEAK, PENNELL'S	CORDYLANTHUS TENUS SSP.CAPILLARI.	IR
		GOLDFIELDS, BURKE'S	Lasthenia burkei	IR
		STICKYSEED, BAKER'S	Blennosperma bakeri	IR
STANISLAUS	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
		GOOSE, ALEUTIAN CANADA	Branta canadensis leucopareia	IR
	CRUSTACEAN	SHRIMP, VERNAL POOL TADPOLE	LEPIDURUS PACKARDI	IR
SUTTER	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
		GOOSE, ALEUTIAN CANADA	Branta canadensis leucopareia	IR
	CRUSTACEAN	SHRIMP, VERNAL POOL TADPOLE	LEPIDURUS PACKARDI	IR
	FISHES	SALMON, CHINOOK (WINTER-RUN)	ONCORHYNCHUS TSHAWYTSCHA	IR
TEHAMA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	CRUSTACEAN	SHRIMP, VERNAL POOL TADPOLE	LEPIDURUS PACKARDI	IR
	FISHES	SALMON, CHINOOK (WINTER-RUN)	ONCORHYNCHUS TSHAWYTSCHA	IR
TRINITY	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
TULARE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	TROUT, LITTLE KERN GOLDEN	Salmo aguabonita whitei	IR
TUOLUMNE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	TROUT, LAHONTAN CUTTHROAT	Salmo clarki henshawi	IR
VENTURA	AMPHIBIANS	TOAD, ARROYO SOUTHWESTERN	BUFO MICROSCAPHUS CALIFORNICUS.	IR
	BIRDS	PELICAN, BROWN	Pelicanus occidentalis	IR
		PLOVER, WESTERN SNOWY	CHARADRIUS ALEXANDRINUS NIVOSUS.	IR
		RAIL, LIGHT-FOOTED CLAPPER	Rallus longirostris levipes	IR
		TERN, CALIFORNIA LEAST	Sterna antillarum browni	IR
	CRUSTACEAN	LINDERIELLA, CALIFORNIA	LINDERIELLA OCCIDENTALIS	IR
		SHRIMP, CONSERVANCY FAIRY	BRANCINECTA CONSERVATIO	IR
	PLANTS	BIRD'S-BEAK, SALT MARSH	Cordylanthus maritimus ssp. mariti	IR
		GRASS, CALIFORNIA ORCUTT	ORCUTTIA CALIFORNICA	IR
		WATERCRESS, GAMBEL'S	RORIPPA GAMBELLII	IR
YOLO	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
		GOOSE, ALEUTIAN CANADA	Branta canadensis leucopareia	IR
		PLOVER, WESTERN SNOWY	CHARADRIUS ALEXANDRINUS NIVOSUS.	IR
	CRUSTACEAN	SHRIMP, VERNAL POOL TADPOLE	LEPIDURUS PACKARDI	IR
	FISHES	SALMON, CHINOOK (WINTER-RUN)	ONCORHYNCHUS TSHAWYTSCHA	IR
		SMELT, DELTA	HYPOMESUS TRANSPACIFICUS	IR
YUBA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
		PELICAN, BROWN	Pelicanus occidentalis	IR
	CRUSTACEAN	LINDERIELLA, CALIFORNIA	LINDERIELLA OCCIDENTALIS	IR
		SHRIMP, VERNAL POOL FAIRY	BRANCHINECTA LYNCHI	IR
		SHRIMP, VERNAL POOL TADPOLE	LEPIDURUS PACKARDI	IR
COLORADO				
ADAMS	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
ALAMOSA	BIRDS	CRANE, WHOOPING	Grus americana	IR
		EAGLE, BALD	Haliaeetus leucocephalus	IR
ARCHULETA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
BACA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
BENT	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR

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II. COUNTY/SPECIES LIST—Continued

[The following list identifies federally listed or proposed U.S. species by State and County. It has been updated through March 31, 1995.]

State/County	Group name	Inventory name	Scientific name	IR/FF*
BOULDER	BIRDS	CRANE, WHOOPING	Grus americana	IR
	FISHES	TROUT, GREENBACK CUTTHROAT	Salmo clarki stomias	IR
	PLANTS	LADIES'-TRESSES, UTE	Spiranthes diluvialis	IR
CHAFFEE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
CHEYENNE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
CLEAR CREEK	FISHES	TROUT, GREENBACK CUTTHROAT	Salmo clarki stomias	IR
CONEJOS	BIRDS	CRANE, WHOOPING	Grus americana	IR
		EAGLE, BALD	Haliaeetus leucocephalus	IR
COSTILLA	BIRDS	CRANE, WHOOPING	Grus americana	IR
CUSTER	FISHES	TROUT, GREENBACK CUTTHROAT	Salmo clarki stomias	IR
DELTA	BIRDS	CRANE, WHOOPING	Grus americana	IR
		EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	SQUAWFISH, COLORADO	Ptychocheilus lucius	IR
		SUCKER, RAZORBACK	XYRAUCHEN TEXANUS	IR
DOLORES	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
DOUGLAS	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	TROUT, GREENBACK CUTTHROAT	Salmo clarki stomias	IR
EAGLE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
EL PASO	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	TROUT, GREENBACK CUTTHROAT	Salmo clarki stomias	IR
FREMONT	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
GARFIELD	BIRDS	CRANE, WHOOPING	Grus americana	IR
		EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	SQUAWFISH, COLORADO	Ptychocheilus lucius	IR
		SUCKER, RAZORBACK	XYRAUCHEN TEXANUS	IR
GRAND	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
GUNNISON	BIRDS	CRANE, WHOOPING	Grus americana	IR
		EAGLE, BALD	Haliaeetus leucocephalus	IR
HINSDALE	BIRDS	CRANE, WHOOPING	Grus americana	IR
		EAGLE, BALD	Haliaeetus leucocephalus	IR
HUERFANO	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	TROUT, GREENBACK CUTTHROAT	Salmo clarki stomias	IR
JACKSON	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
JEFFERSON	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	PLANTS	LADIES'-TRESSES, UTE	Spiranthes diluvialis	IR
KIOWA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
LA PLATA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
LAKE	FISHES	TROUT, GREENBACK CUTTHROAT	Salmo clarki stomias	IR
LARIMER	BIRDS	CRANE, WHOOPING	Grus americana	IR
		EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	TROUT, GREENBACK CUTTHROAT	Salmo clarki stomias	IR
LAS ANIMAS	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
LINCOLN	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
LOGAN	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
MESA	BIRDS	CRANE, WHOOPING	Grus americana	IR
		EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	CHUB, BONYTAIL	Gila elegans	IR
		CHUB, HUMPBACK	Gila cypha	IR
		SQUAWFISH, COLORADO	Ptychocheilus lucius	IR
		SUCKER, RAZORBACK	XYRAUCHEN TEXANUS	IR
MOFFAT	BIRDS	CRANE, WHOOPING	Grus americana	IR
		EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	CHUB, BONYTAIL	Gila elegans	IR
		CHUB, HUMPBACK	Gila cypha	IR
		SQUAWFISH, COLORADO	Ptychocheilus lucius	IR
		SUCKER, RAZORBACK	XYRAUCHEN TEXANUS	IR
MONTEZUMA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	SQUAWFISH, COLORADO	Ptychocheilus lucius	IR
MONTROSE	BIRDS	CRANE, WHOOPING	Grus americana	IR
		EAGLE, BALD	Haliaeetus leucocephalus	IR
MORGAN	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	PLANTS	LADIES'-TRESSES, UTE	Spiranthes diluvialis	IR
OTERO	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
OURAY	BIRDS	CRANE, WHOOPING	Grus americana	IR
		EAGLE, BALD	Haliaeetus leucocephalus	IR
PARK	BIRDS	CRANE, WHOOPING	Grus americana	IR
		EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	TROUT, GREENBACK CUTTHROAT	Salmo clarki stomias	IR
	PLANTS	MUSTARD, PENLAND ALPINE FEN	Eutrema penlandii	IR
PROWERS	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
PUEBLO	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR

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II. COUNTY/SPECIES LIST—Continued

[The following list identifies federally listed or proposed U.S. species by State and County. It has been updated through March 31, 1995.]

State/County	Group name	Inventory name	Scientific name	IR/FF*
RIO BLANCO	BIRDS	CRANE, WHOOPING	Grus americana	IR
		EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	SQUAWFISH, COLORADO	Ptychocheilus lucius	IR
RIO GRANDE	BIRDS	CRANE, WHOOPING	Grus americana	IR
		EAGLE, BALD	Haliaeetus leucocephalus	IR
ROUTT	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
SAGUACHE	BIRDS	CRANE, WHOOPING	Grus americana	IR
		EAGLE, BALD	Haliaeetus leucocephalus	IR
SAN JUAN	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
SAN MIGUEL	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
SEDGWICK	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
SUMMIT	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	PLANTS	MUSTARD, PENLAND ALPINE FEN	Eutrema penlandii	IR
WASHINGTON	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
WELD	BIRDS	CRANE, WHOOPING	Grus americana	IR
		EAGLE, BALD	Haliaeetus leucocephalus	IR
	PLANTS	LADIES'-TRESSES, UTE	Spiranthes diluvialis	IR
YUMA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
CONNECTICUT				
FAIRFIELD	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
		PLOVER, PIPING	+haradrius melodus	IR
HARTFORD	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	STURGEON, SHORTNOSE	Acipenser brevirostrum	IR
LITCHFIELD	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
MIDDLESEX	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
		PLOVER, PIPING	+haradrius melodus	IR
	FISHES	STURGEON, SHORTNOSE	Acipenser brevirostrum	IR
NEW HAVEN	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
		PLOVER, PIPING	+haradrius melodus	IR
		TERN, ROSEATE	Sterna dougalli dougalli	IR
NEW LONDON	BIRDS	PLOVER, PIPING	+haradrius melodus	IR
WINDHAM	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
DISTRICT OF COLUMBIA				
DISTRICT OF COLUMBIA.	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	CRUSTACEAN	AMPHIPOD, HAY'S SPRING	Stygobromus hayi.	
DELAWARE				
KENT	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	FF
	FISHES	STURGEON, SHORTNOSE	Acipenser brevirostrum	FF
	PLANTS	PINK, SWAMP	Helonias bullata	FF
	REPTILES	TURTLE, HAWKSBILL SEA	Eretmochelys imbricata	FF
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii	FF
		TURTLE, LOGGERHEAD SEA	Caretta caretta	FF
NEW CASTLE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	FF
	FISHES	STURGEON, SHORTNOSE	Acipenser brevirostrum	FF
	PLANTS	PINK, SWAMP	Helonias bullata	FF
SUSSEX	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	FF
		PLOVER, PIPING	+haradrius melodus	FF
	PLANTS	PINK, SWAMP	Helonias bullata	FF
	REPTILES	TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii	FF
		TURTLE, LOGGERHEAD SEA	Caretta caretta	FF
FLORIDA				
ALACHUA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		STORK, WOOD	Mycteria americana.	
	CRUSTACEAN	SHRIMP, SQUIRREL CHIMNEY CAVE	Palaemonetes cummingi.	
BAKER	BIRDS	STORK, WOOD	Mycteria americana.	
BAY	BIRDS	PLOVER, PIPING	+haradrius melodus.	
		STORK, WOOD	Mycteria americana.	
	FISHES	STURGEON, GULF	Acipenser oxyrhynchus desotoi.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	PLANTS	BUTTERWORT, GODFREY'S	PINGUICULA IONANTHA.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	

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II. COUNTY/SPECIES LIST—Continued

[The following list identifies federally listed or proposed U.S. species by State and County. It has been updated through March 31, 1995.]

State/County	Group name	Inventory name	Scientific name	IR/FF*
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
BRADFORD	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		STORK, WOOD	Mycteria americana.	
BREVARD	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
		STORK, WOOD	Mycteria americana.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	PLANTS	SEAGRASS, JOHNSON'S	Halophila johnsonii.	
	REPTILES	SNAKE, ATLANTIC SALT MARSH	Nerodia fasciata taeniata.	
		TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
BROWARD	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		KITE, EVERGLADE SNAIL	Rostrhamus sociabilis plumbeus.	
		STORK, WOOD	Mycteria americana.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	PLANTS	SEAGRASS, JOHNSON'S	Halophila johnsonii.	
	REPTILES	CROCODILE, AMERICAN	Crocodylus acutus.	
		TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
CALHOUN	BIRDS	STORK, WOOD	Mycteria americana.	
	FISHES	STURGEON, GULF	Acipenser oxyrhynchus desotoi.	
CHARLOTTE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		STORK, WOOD	Mycteria americana.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
CITRUS	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		KITE, EVERGLADE SNAIL	Rostrhamus sociabilis plumbeus.	
		STORK, WOOD	Mycteria americana.	
	FISHES	STURGEON, GULF	Acipenser oxyrhynchus desotoi.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
CLAY	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		STORK, WOOD	Mycteria americana.	
	FISHES	STURGEON, SHORTNOSE	Acipenser brevirostrum.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
COLLIER	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		KITE, EVERGLADE SNAIL	Rostrhamus sociabilis plumbeus.	
		PLOVER, PIPING	+haradrius melodus.	
		STORK, WOOD	Mycteria americana.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	REPTILES	CROCODILE, AMERICAN	Crocodylus acutus.	
		TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
COLUMBIA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		STORK, WOOD	Mycteria americana.	
	FISHES	STURGEON, GULF	Acipenser oxyrhynchus desotoi.	
DADE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		KITE, EVERGLADE SNAIL	Rostrhamus sociabilis plumbeus.	

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II. COUNTY/SPECIES LIST—Continued

[The following list identifies federally listed or proposed U.S. species by State and County. It has been updated through March 31, 1995.]

State/County	Group name	Inventory name	Scientific name	IR/FF*
		PLOVER, PIPING	+haradrius melodus.	
		STORK, WOOD	Mycteria americana.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	PLANTS	SEAGRASS, JOHNSON'S	Halophila johnsonii.	
	REPTILES	CROCODILE, AMERICAN	Crocodylus acutus.	
		TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
DE SOTO	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		STORK, WOOD	Mycteria americana.	
DIXIE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		STORK, WOOD	Mycteria americana.	
	FISHES	STURGEON, GULF	Acipenser oxyrhynchus desotoi.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
DUVAL	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
		STORK, WOOD	Mycteria americana.	
	FISHES	STURGEON, SHORTNOSE	Acipenser brevirostrum.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
ESCAMBIA	BIRDS	PLOVER, PIPING	+haradrius melodus.	
		STORK, WOOD	Mycteria americana.	
	FISHES	STURGEON, GULF	Acipenser oxyrhynchus desotoi.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
FLAGLER	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		STORK, WOOD	Mycteria americana.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
FRANKLIN	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
		STORK, WOOD	Mycteria americana.	
	FISHES	STURGEON, GULF	Acipenser oxyrhynchus desotoi.	
	PLANTS	BEAUTY, HARPER'S	Harperocallis flava.	
		BUTTERWORT, GODFREY'S	PINGUICULA IONANTHA.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
GADSDEN	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		STORK, WOOD	Mycteria americana.	
	FISHES	STURGEON, GULF	Acipenser oxyrhynchus desotoi.	
GILCHRIST	BIRDS	STORK, WOOD	Mycteria americana.	
	FISHES	STURGEON, GULF	Acipenser oxyrhynchus desotoi.	
GLADES	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		KITE, EVERGLADE SNAIL	Rostrhamus sociabilis plumbeus.	
		STORK, WOOD	Mycteria americana.	
	FISHES	STURGEON, GULF	Acipenser oxyrhynchus desotoi.	

II. COUNTY/SPECIES LIST—Continued

[The following list identifies federally listed or proposed U.S. species by State and County. It has been updated through March 31, 1995.]

State/County	Group name	Inventory name	Scientific name	IR/FF*
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
GULF	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
		STORK, WOOD	Mycteria americana.	
	FISHES	STURGEON, GULF	Acipenser oxyrhynchus desotoi.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	PLANTS	BUTTERWORT, GODFREY'S	PINGUICULA IONANTHA.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
HAMILTON	BIRDS	STORK, WOOD	Mycteria americana.	
	FISHES	STURGEON, GULF	Acipenser oxyrhynchus desotoi.	
HARDEE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		STORK, WOOD	Mycteria americana.	
HENDRY	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		KITE, EVERGLADE SNAIL	Rostrhamus sociabilis plumbeus.	
		STORK, WOOD	Mycteria americana.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
HERNANDO	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		STORK, WOOD	Mycteria americana.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	PLANTS	BELLFLOWER, BROOKSVILLE	Campanula robinsiae.	
		WATER-WILLOW, COOLEY'S	Justicia cooleyi.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
HIGHLANDS	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		KITE, EVERGLADE SNAIL	Rostrhamus sociabilis plumbeus.	
		STORK, WOOD	Mycteria americana.	
HILLSBOROUGH	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
		STORK, WOOD	Mycteria americana.	
	FISHES	STURGEON, GULF	Acipenser oxyrhynchus desotoi.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
HOLMES	BIRDS	STORK, WOOD	Mycteria americana.	
INDIAN RIVER	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		KITE, EVERGLADE SNAIL	Rostrhamus sociabilis plumbeus.	
		STORK, WOOD	Mycteria americana.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	PLANTS	SEAGRASS, JOHNSON'S	Halophila johnsonii.	
	REPTILES	SNAKE, ATLANTIC SALT MARSH	Nerodia fasciata taeniata.	
		TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
JACKSON	BIRDS	STORK, WOOD	Mycteria americana.	
	FISHES	STURGEON, GULF	Acipenser oxyrhynchus desotoi.	
JEFFERSON	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		STORK, WOOD	Mycteria americana.	
	FISHES	STURGEON, GULF	Acipenser oxyrhynchus desotoi.	
	PLANTS	GOOSEBERRY, MICCOSUKEE (FLORIDA).	Ribes echinellum.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
LAFAYETTE	BIRDS	STORK, WOOD	Mycteria americana.	
	FISHES	STURGEON, GULF	Acipenser oxyrhynchus desotoi.	

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II. COUNTY/SPECIES LIST—Continued

[The following list identifies federally listed or proposed U.S. species by State and County. It has been updated through March 31, 1995.]

State/County	Group name	Inventory name	Scientific name	IR/FF*
LAKE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		KITE, EVERGLADE SNAIL	Rostrhamus sociabilis plumbeus.	
		STORK, WOOD	Mycteria americana.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
LEE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		KITE, EVERGLADE SNAIL	Rostrhamus sociabilis plumbeus.	
		PLOVER, PIPING	+haradrius melodus.	
		STORK, WOOD	Mycteria americana.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	REPTILES	CROCODILE, AMERICAN	Crocodylus acutus.	
		TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
LEON	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		STORK, WOOD	Mycteria americana.	
LEVY	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		STORK, WOOD	Mycteria americana.	
	FISHES	STURGEON, GULF	Acipenser oxyrhynchus desotoi.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
LIBERTY	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		STORK, WOOD	Mycteria americana.	
	FISHES	STURGEON, GULF	Acipenser oxyrhynchus desotoi.	
	PLANTS	BEAUTY, HARPER'S	Harperocallis flava.	
		BUTTERWORT, GODFREY'S	PINGUICULA IONANTHA.	
MADISON	BIRDS	STORK, WOOD	Mycteria americana.	
	FISHES	STURGEON, GULF	Acipenser oxyrhynchus desotoi.	
MANATEE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
		STORK, WOOD	Mycteria americana.	
	FISHES	STURGEON, GULF	Acipenser oxyrhynchus desotoi.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
MARION	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		KITE, EVERGLADE SNAIL	Rostrhamus sociabilis plumbeus.	
		STORK, WOOD	Mycteria americana.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
MARTIN	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		KITE, EVERGLADE SNAIL	Rostrhamus sociabilis plumbeus.	
		PLOVER, PIPING	+haradrius melodus.	
		STORK, WOOD	Mycteria americana.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	PLANTS	SEAGRASS, JOHNSON'S	Halophila johnsonii.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
MONROE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		KITE, EVERGLADE SNAIL	Rostrhamus sociabilis plumbeus.	
		PLOVER, PIPING	+haradrius melodus.	
		STORK, WOOD	Mycteria americana.	
		TERN, ROSEATE	Sterna dougalli dougalli.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	REPTILES	CROCODILE, AMERICAN	Crocodylus acutus.	
		TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	

II. COUNTY/SPECIES LIST—Continued

[The following list identifies federally listed or proposed U.S. species by State and County. It has been updated through March 31, 1995.]

State/County	Group name	Inventory name	Scientific name	IR/FF*
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
NASSAU	BIRDS	STORK, WOOD	Mycteria americana.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
OKALOOSA	BIRDS	PLOVER, PIPING	+haradrius melodus.	
		STORK, WOOD	Mycteria americana.	
	FISHES	DARTER, OKALOOSA	Etheostoma okaloosae.	
		STURGEON, GULF	Acipenser oxyrhynchus desotoi.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
OKEECHOBEE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		KITE, EVERGLADE SNAIL	Rostrhamus sociabilis plumbeus.	
		STORK, WOOD	Mycteria americana.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
ORANGE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		KITE, EVERGLADE SNAIL	Rostrhamus sociabilis plumbeus.	
		STORK, WOOD	Mycteria americana.	
OSCEOLA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		KITE, EVERGLADE SNAIL	Rostrhamus sociabilis plumbeus.	
		STORK, WOOD	Mycteria americana.	
PALM BEACH	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		KITE, EVERGLADE SNAIL	Rostrhamus sociabilis plumbeus.	
		PLOVER, PIPING	+haradrius melodus.	
		STORK, WOOD	Mycteria americana.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	PLANTS	GOURD, OKEECHOBEE	CUCURBITA OKEECHEOBEENSIS.	
		SEAGRASS, JOHNSON'S	Halophila johnsonii.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
PASCO	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
		STORK, WOOD	Mycteria americana.	
	FISHES	STURGEON, GULF	Acipenser oxyrhynchus desotoi.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
PINELLAS	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
		STORK, WOOD	Mycteria americana.	
	FISHES	STURGEON, GULF	Acipenser oxyrhynchus desotoi.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
POLK	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		KITE, EVERGLADE SNAIL	Rostrhamus sociabilis plumbeus.	
		STORK, WOOD	Mycteria americana.	
PUTNAM	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		STORK, WOOD	Mycteria americana.	
	FISHES	STURGEON, SHORTNOSE	Acipenser brevirostrum.	

II. COUNTY/SPECIES LIST—Continued

[The following list identifies federally listed or proposed U.S. species by State and County. It has been updated through March 31, 1995.]

State/County	Group name	Inventory name	Scientific name	IR/FF*
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
SANTA ROSA	BIRDS	PLOVER, PIPING	+haradrius melodus.	
		STORK, WOOD	Mycteria americana.	
	FISHES	STURGEON, GULF	Acipenser oxyrhynchus desotoi.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
SARASOTA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
		STORK, WOOD	Mycteria americana.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
SEMINOLE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		STORK, WOOD	Mycteria americana.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
ST. JOHNS	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
		STORK, WOOD	Mycteria americana.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
ST. LUCIE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		KITE, EVERGLADE SNAIL	Rostrhamus sociabilis plumbeus.	
		PLOVER, PIPING	+haradrius melodus.	
		STORK, WOOD	Mycteria americana.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	PLANTS	SEAGRASS, JOHNSON'S	Halophila johnsonii.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
SUMTER	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		KITE, EVERGLADE SNAIL	Rostrhamus sociabilis plumbeus.	
		STORK, WOOD	Mycteria americana.	
SUWANNEE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		STORK, WOOD	Mycteria americana.	
	FISHES	STURGEON, GULF	Acipenser oxyrhynchus desotoi.	
TAYLOR	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
		STORK, WOOD	Mycteria americana.	
	FISHES	STURGEON, GULF	Acipenser oxyrhynchus desotoi.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
UNION	BIRDS	STORK, WOOD	Mycteria americana.	
VOLUSIA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		KITE, EVERGLADE SNAIL	Rostrhamus sociabilis plumbeus.	
		PLOVER, PIPING	+haradrius melodus.	
		STORK, WOOD	Mycteria americana.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	REPTILES	SNAKE, ATLANTIC SALT MARSH	Nerodia fasciata taeniata.	
		TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	

II. COUNTY/SPECIES LIST—Continued

[The following list identifies federally listed or proposed U.S. species by State and County. It has been updated through March 31, 1995.]

State/County	Group name	Inventory name	Scientific name	IR/FF*
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
WAKULLA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
		STORK, WOOD	Mycteria americana.	
	FISHES	STURGEON, GULF	Acipenser oxyrhynchus desotoi.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
WALTON	BIRDS	PLOVER, PIPING	+haradrius melodus.	
		STORK, WOOD	Mycteria americana.	
	FISHES	DARTER, OKALOOSA	Etheostoma okaloosae.	
		STURGEON, GULF	Acipenser oxyrhynchus desotoi.	
	PLANTS	MEADOWRUE, COOLEY'S	Thalictrum cooleyi.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
WASHINGTON	BIRDS	STORK, WOOD	Mycteria americana.	
IDAHO				
ADA	FISHES	SALMON, CHINOOK (SNAKE RIVER SPRING.	ONCORHYNCHUS TSHAWYTSCHA.	
ADAMS	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	SALMON, CHINOOK (SNAKE RIVER SPRING.	ONCORHYNCHUS TSHAWYTSCHA.	
BANNOCK	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
BEAR LAKE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
BENEWAH	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
BINGHAM	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
BLAINE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	SALMON, CHINOOK	ONCORHYNCHUS TSHAWSTSCHA.	
		SALMON, CHINOOK (SNAKE RIVER SPRING.	ONCORHYNCHUS TSHAWYTSCHA.	
		SALMON, SNAKE RIVER SOCKEYE	ONCORHYNCHUS NERKA.	
BOISE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
BONNER	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	MAMMALS	BEAR, GRIZZLY	Ursus arctos (=U.a. horribilis).	
BONNEVILLE	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
BOUNDARY	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	MAMMALS	BEAR, GRIZZLY	Ursus arctos (=U.a. horribilis).	
BUTTE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
CAMAS	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
CANYON	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	SALMON, CHINOOK (SNAKE RIVER SPRING.	ONCORHYNCHUS TSHAWYTSCHA.	
CARIBOU	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
CASSIA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	SALMON, CHINOOK (SNAKE RIVER SPRING.	ONCORHYNCHUS TSHAWYTSCHA.	
CLARK	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
CLEARWATER	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	SALMON, CHINOOK	ONCORHYNCHUS TSHAWSTSCHA.	
		SALMON, CHINOOK (SNAKE RIVER SPRING.	ONCORHYNCHUS TSHAWYTSCHA.	
	MAMMALS	BEAR, GRIZZLY	Ursus arctos (=U.a. horribilis).	
CUSTER	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	SALMON, CHINOOK	ONCORHYNCHUS TSHAWSTSCHA.	
		SALMON, CHINOOK (SNAKE RIVER SPRING.	ONCORHYNCHUS TSHAWYTSCHA.	
		SALMON, SNAKE RIVER SOCKEYE	ONCORHYNCHUS NERKA.	
ELMORE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	CLAMS	LIMPET, BANBURY SPRINGS	Lanx n. sp..	
	FISHES	SALMON, CHINOOK (SNAKE RIVER SPRING, SUMMER).	ONCORHYNCHUS TSHAWYTSCHA.	

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II. COUNTY/SPECIES LIST—Continued

[The following list identifies federally listed or proposed U.S. species by State and County. It has been updated through March 31, 1995.]

State/County	Group name	Inventory name	Scientific name	IR/FF*
	SNAILS	SNAIL, BLISS RAPIDS	Family Hydrobiidae n. sp..	
		SNAIL, SNAKE RIVER PHYSA	Physa natricina.	
		SNAIL, UTAH VALVATA	Valvata utahensis.	
		SPRINGSNAIL, IDAHO	Fontelicella idahoensis.	
FRANKLIN	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
FREMONT	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	MAMMALS	BEAR, GRIZZLY	Ursus arctos (=U.a. horribilis).	
GEM	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
GOODING	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	CLAMS	LIMPET, BANBURY SPRINGS	Lanx n. sp..	
	FISHES	SALMON, CHINOOK (SNAKE RIVER SPRING, SUMMER).	ONCORHYNCHUS TSHAWYTSCHA.	
	SNAILS	SNAIL, BLISS RAPIDS	Family Hydrobiidae n. sp..	
		SNAIL, SNAKE RIVER PHYSA	Physa natricina.	
		SNAIL, UTAH VALVATA	Valvata utahensis.	
IDAHO	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	SALMON, CHINOOK	ONCORHYNCHUS TSHAWSTSCHA.	
		SALMON, CHINOOK (SNAKE RIVER SPRING, SUMMER).	ONCORHYNCHUS TSHAWYTSCHA.	
		SALMON, SNAKE RIVER SOCKEYE	ONCORHYNCHUS NERKA.	
	MAMMALS	BEAR, GRIZZLY	Ursus arctos (=U.a. horribilis).	
JEFFERSON	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
JEROME	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	SALMON, CHINOOK (SNAKE RIVER SPRING, SUMMER).	ONCORHYNCHUS TSHAWYTSCHA.	
KOOTENAI	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	PLANTS	HOWELLIA, WATER	HOWELLIA AQUATILIS.	
LATAH	PLANTS	HOWELLIA, WATER	HOWELLIA AQUATILIS.	
LEMHI	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	SALMON, CHINOOK	ONCORHYNCHUS TSHAWSTSCHA.	
		SALMON, CHINOOK (SNAKE RIVER SPRING, SUMMER).	ONCORHYNCHUS TSHAWYTSCHA.	
LEWIS	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	SALMON, CHINOOK	ONCORHYNCHUS TSHAWSTSCHA.	
		SALMON, CHINOOK (SNAKE RIVER SPRING, SUMMER).	ONCORHYNCHUS TSHAWYTSCHA.	
		SALMON, SNAKE RIVER SOCKEYE	ONCORHYNCHUS NERKA.	
MADISON	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
MINIDOKA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	SALMON, CHINOOK (SNAKE RIVER SPRING, SUMMER).	ONCORHYNCHUS TSHAWYTSCHA.	
NEZ PERCE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	SALMON, CHINOOK	ONCORHYNCHUS TSHAWSTSCHA.	
		SALMON, CHINOOK (SNAKE RIVER SPRING, SUMMER).	ONCORHYNCHUS TSHAWYTSCHA.	
		SALMON, SNAKE RIVER SOCKEYE	ONCORHYNCHUS NERKA.	
OWYHEE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	SALMON, CHINOOK (SNAKE RIVER SPRING, SUMMER).	ONCORHYNCHUS TSHAWYTSCHA.	
	SNAILS	SNAIL, BRUNEAU HOT SPRINGS	Bruneau Hot Springs snail (Genus/s.	
		SNAIL, SNAKE RIVER PHYSA	Physa natricina.	
		SPRINGSNAIL, IDAHO	Fontelicella idahoensis.	
PAYETTE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	SALMON, CHINOOK (SNAKE RIVER SPRING, SUMMER).	ONCORHYNCHUS TSHAWYTSCHA.	
POWER	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	SALMON, CHINOOK (SNAKE RIVER SPRING, SUMMER).	ONCORHYNCHUS TSHAWYTSCHA.	
	SNAILS	SNAIL, UTAH VALVATA	Valvata utahensis.	
SHOSHONE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	MAMMALS	BEAR, GRIZZLY	Ursus arctos (=U.a. horribilis).	
TETON	MAMMALS	BEAR, GRIZZLY	Ursus arctos (=U.a. horribilis).	
TWIN FALLS	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	SALMON, CHINOOK (SNAKE RIVER SPRING, SUMMER).	ONCORHYNCHUS TSHAWYTSCHA.	
	SNAILS	SNAIL, SNAKE RIVER PHYSA	Physa natricina.	
VALLEY	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	SALMON, CHINOOK	ONCORHYNCHUS TSHAWSTSCHA.	
		SALMON, CHINOOK (SNAKE RIVER SPRING, SUMMER).	ONCORHYNCHUS TSHAWYTSCHA.	
WASHINGTON	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	

II. COUNTY/SPECIES LIST—Continued

[The following list identifies federally listed or proposed U.S. species by State and County. It has been updated through March 31, 1995.]

State/County	Group name	Inventory name	Scientific name	IR/FF*
	FISHES	SALMON, CHINOOK (SNAKE RIVER SPRING, SUMMER).	ONCORHYNCHUS TSHAWYTSCHA.	
	....	....	.	
LOUISIANA				
	....	....	.	
ASCENSION	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	CLAMS	HEELSPLITTER, INFLATED	POTAMILUS INFLATUS.	
	FISHES	STURGEON, GULF	Acipenser oxyrhynchus desotoi.	
		STURGEON, PALLID	Scaphirhynchus albus.	
ASSUMPTION	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
AVOYELLES	FISHES	STURGEON, PALLID	Scaphirhynchus albus.	
BIENVILLE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
BOSSIER	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	STURGEON, PALLID	Scaphirhynchus albus.	
CADDO	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	STURGEON, PALLID	Scaphirhynchus albus.	
CALDWELL	FISHES	STURGEON, PALLID	Scaphirhynchus albus.	
CAMERON	BIRDS	PELICAN, BROWN	Pelicanus occidentalis.	
		PLOVER, PIPING	+haradrius melodus.	
	REPTILES	TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
CATAHOULA	FISHES	STURGEON, PALLID	Scaphirhynchus albus.	
CLAIBORNE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
CONCORDIA	FISHES	STURGEON, PALLID	Scaphirhynchus albus.	
DE SOTO	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
EAST BATON ROUGE.	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	CLAMS	HEELSPLITTER, INFLATED	POTAMILUS INFLATUS.	
	FISHES	STURGEON, GULF	Acipenser oxyrhynchus desotoi.	
		STURGEON, PALLID	Scaphirhynchus albus.	
EAST CARROLL	BIRDS	TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
	BIRDS	TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
	FISHES	STURGEON, PALLID	Scaphirhynchus albus.	
FRANKLIN	FISHES	STURGEON, PALLID	Scaphirhynchus albus.	
GRANT	CLAMS	PEARLSHELL, LOUISIANA	Margaritifera hembeli.	
	FISHES	STURGEON, PALLID	Scaphirhynchus albus.	
IBERIA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		PELICAN, BROWN	Pelicanus occidentalis.	
		PLOVER, PIPING	+haradrius melodus.	
	FISHES	STURGEON, PALLID	Scaphirhynchus albus.	
IBERVILLE	FISHES	STURGEON, PALLID	Scaphirhynchus albus.	
JEFFERSON	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		PELICAN, BROWN	Pelicanus occidentalis.	
		PLOVER, PIPING	+haradrius melodus.	
	FISHES	STURGEON, PALLID	Scaphirhynchus albus.	
	REPTILES	TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
LA SALLE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
LAFOURCHE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		PELICAN, BROWN	Pelicanus occidentalis.	
		PLOVER, PIPING	+haradrius melodus.	
	REPTILES	TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
LIVINGSTON	CLAMS	HEELSPLITTER, INFLATED	POTAMILUS INFLATUS.	
	FISHES	STURGEON, GULF	Acipenser oxyrhynchus desotoi.	
MADISON	BIRDS	TERN, CALIFORNIA LEAST	Sterna antillarum browni.	
	FISHES	STURGEON, PALLID	Scaphirhynchus albus.	
MOREHOUSE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	STURGEON, PALLID	Scaphirhynchus albus.	
NATCHITOCHES	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	STURGEON, PALLID	Scaphirhynchus albus.	
ORLEANS	BIRDS	PELICAN, BROWN	Pelicanus occidentalis.	
	FISHES	STURGEON, GULF	Acipenser oxyrhynchus desotoi.	
		STURGEON, PALLID	Scaphirhynchus albus.	
OUACHITA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	STURGEON, PALLID	Scaphirhynchus albus.	
PLAQUEMINES	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		PELICAN, BROWN	Pelicanus occidentalis.	

II. COUNTY/SPECIES LIST—Continued

[The following list identifies federally listed or proposed U.S. species by State and County. It has been updated through March 31, 1995.]

State/County	Group name	Inventory name	Scientific name	IR/FF*
		PLOVER, PIPING	+haradrius melodus.	
	FISHES	STURGEON, PALLID	Scaphirhynchus albus.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
POINTE COUPEE	FISHES	STURGEON, PALLID	Scaphirhynchus albus.	
RAPIDES	CLAMS	PEARLSHELL, LOUISIANA	Margaritifera hembeli.	
	FISHES	STURGEON, PALLID	Scaphirhynchus albus.	
RED RIVER	FISHES	STURGEON, PALLID	Scaphirhynchus albus.	
RICHLAND	FISHES	STURGEON, PALLID	Scaphirhynchus albus.	
SABINE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
ST. BERNARD	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		PELICAN, BROWN	Pelicanus occidentalis.	
		PLOVER, PIPING	+haradrius melodus.	
	FISHES	STURGEON, GULF	Acipenser oxyrhynchus desotoi.	
		STURGEON, PALLID	Scaphirhynchus albus.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
ST. CHARLES	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	STURGEON, GULF	Acipenser oxyrhynchus desotoi.	
		STURGEON, PALLID	Scaphirhynchus albus.	
ST. JAMES	FISHES	STURGEON, PALLID	Scaphirhynchus albus.	
ST. JOHN THE BAPTIST.	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	STURGEON, GULF	Acipenser oxyrhynchus desotoi.	
		STURGEON, PALLID	Scaphirhynchus albus.	
ST. LANDRY	FISHES	STURGEON, PALLID	Scaphirhynchus albus.	
ST. MARTIN	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	STURGEON, PALLID	Scaphirhynchus albus.	
ST. MARY	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		PELICAN, BROWN	Pelicanus occidentalis.	
		PLOVER, PIPING	+haradrius melodus.	
	FISHES	STURGEON, PALLID	Scaphirhynchus albus.	
	REPTILES	TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
ST. TAMMANY	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		PELICAN, BROWN	Pelicanus occidentalis.	
	FISHES	STURGEON, GULF	Acipenser oxyrhynchus desotoi.	
	REPTILES	TURTLE, RINGED SAWBACK	Graptemys oculifera.	
TANGIPAHOA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	STURGEON, GULF	Acipenser oxyrhynchus desotoi.	
TENSAS	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	STURGEON, PALLID	Scaphirhynchus albus.	
TERREBONNE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		PELICAN, BROWN	Pelicanus occidentalis.	
		PLOVER, PIPING	+haradrius melodus.	
	REPTILES	TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
UNION	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
VERMILION	BIRDS	PELICAN, BROWN	Pelicanus occidentalis.	
		PLOVER, PIPING	+haradrius melodus.	
	REPTILES	TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
WASHINGTON	FISHES	STURGEON, GULF	Acipenser oxyrhynchus desotoi.	
	REPTILES	TURTLE, RINGED SAWBACK	Graptemys oculifera.	
WEBSTER	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
WEST BATON ROUGE.	FISHES	STURGEON, PALLID	Scaphirhynchus albus.	
WEST CARROLL	FISHES	STURGEON, PALLID	Scaphirhynchus albus.	
WEST FELICIANA	FISHES	STURGEON, PALLID	Scaphirhynchus albus.	
WINN	FISHES	STURGEON, PALLID	Scaphirhynchus albus.	
MASSACHUSETTS				
BARNSTABLE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
		TERN, ROSEATE	Sterna dougalli dougalli.	
	REPTILES	TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	

II. COUNTY/SPECIES LIST—Continued

[The following list identifies federally listed or proposed U.S. species by State and County. It has been updated through March 31, 1995.]

State/County	Group name	Inventory name	Scientific name	IR/FF*
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
BRISTOL	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
	FISHES	STURGEON, SHORTNOSE	Acipenser brevirostrum.	
	REPTILES	TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
DUKES	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
	REPTILES	TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
ESSEX	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
	FISHES	STURGEON, SHORTNOSE	Acipenser brevirostrum.	
	REPTILES	TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
FRANKLIN	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	STURGEON, SHORTNOSE	Acipenser brevirostrum.	
	PLANTS	BULRUSH, NORTHEASTERN (=BARBED BRISTLE.	Scirpus ancistrochaetus.	
HAMPDEN	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	STURGEON, SHORTNOSE	Acipenser brevirostrum.	
HAMPSHIRE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	STURGEON, SHORTNOSE	Acipenser brevirostrum.	
MIDDLESEX	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
NANTUCKET	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
	REPTILES	TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
NORFOLK	REPTILES	TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
PLYMOUTH	BIRDS	CURLEW, ESKIMO	Numenius borealis.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
		TERN, ROSEATE	Sterna dougalli dougalli.	
	REPTILES	TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
		TURTLE, PLYMOUTH RED-BELLIED	Pseudemys (Chrysemys) rubriventris.	
SUFFOLK	REPTILES	TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
WORCESTER	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
MAINE				
ANDROSCOGGIN	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
AROOSTOOK	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	PLANTS	ORCHID, EASTERN PRAIRIE FRINGED	Platanthera leucophaea.	
CUMBERLAND	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
	FISHES	STURGEON, SHORTNOSE	Acipenser brevirostrum.	
HANCOCK	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
KENNEBEC	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
KNOX	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
LINCOLN	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
PENOBSCOT	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
PISCATAQUIS	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
SAGADAHOC	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
	FISHES	STURGEON, SHORTNOSE	Acipenser brevirostrum.	
SOMERSET	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
WALDO	FISHES	STURGEON, SHORTNOSE	Acipenser brevirostrum.	
WASHINGTON	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		TERN, ROSEATE	Sterna dougalli dougalli.	
YORK	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	

II. COUNTY/SPECIES LIST—Continued

[The following list identifies federally listed or proposed U.S. species by State and County. It has been updated through March 31, 1995.]

State/County	Group name	Inventory name	Scientific name	IR/FF*
		PLOVER, PIPING	+haradrius melodus.	
NORTHERN MARIANA ISLANDS				
WORCESTER	BIRDS	MALLARD, MARIANA	Anas oustaleti.	
		MEGAPODE, MICRONESIAN (LA PEROUSE'S).	Megapodius laperouse.	
	REPTILES	CROCODILE, SALTWATER	CROCODYLUS POROSUS.	
NEW HAMPSHIRE				
BELKNAP	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
CHESHIRE	CLAMS	MUSSEL, DWARF WEDGE	Alasmidonta heterodon.	
COOS	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
GRAFTON	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
HILLSBOROUGH	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
MERRIMACK	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
ROCKINGHAM	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
SULLIVAN	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	CLAMS	MUSSEL, DWARF WEDGE	Alasmidonta heterodon.	
	PLANTS	MILK-VETCH, JESUP'S	Astragalus robbinsii var. jesupi.	
NEW MEXICO				
			.	
BERNALILLO	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	MINNOW, RIO GRANDE SILVERY	HYBOGNATHUS AMARUS.	
CATRON	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	MINNOW, LOACH	Tiaroga cobitis.	
		SPIKEDACE	Meda fulgida.	
		TROUT, GILA	Salmo gilae.	
CHAVES	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
	FISHES	GAMBUSIA, PECOS	Gambusia nobilis.	
		SHINER, PECOS BLUNTNOSE	Notropis simus peconsensis.	
COLFAX	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
CURRY	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
DE BACA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	SHINER, PECOS BLUNTNOSE	Notropis simus peconsensis.	
DONA ANA	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
EDDY	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
	FISHES	GAMBUSIA, PECOS	Gambusia nobilis.	
		SHINER, PECOS BLUNTNOSE	Notropis simus peconsensis.	
GRANT	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	CHUB, CHIHUAHUA	Gila nigrescens.	
		MINNOW, LOACH	Tiaroga cobitis.	
		SHINER, BEAUTIFUL	Notropis formosus.	
		SPIKEDACE	Meda fulgida.	
		TOPMINNOW, GILA (YAQUI)	Poeciliopsis occidentalis.	
		TROUT, GILA	Salmo gilae.	
GUADALUPE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
HARDING	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
HIDALGO	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	SPIKEDACE	Meda fulgida.	
LEA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
LINCOLN	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
LOS ALAMOS	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
LUNA	BIRDS	CRANE, WHOOPING	Grus americana.	

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II. COUNTY/SPECIES LIST—Continued

[The following list identifies federally listed or proposed U.S. species by State and County. It has been updated through March 31, 1995.]

State/County	Group name	Inventory name	Scientific name	IR/FF*
		EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	SHINER, BEAUTIFUL	Notropis formosus.	
MCKINLEY	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
MORA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
OTERO	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	PLANTS	THISTLE, SACRAMENTO MOUNTAINS	Cirsium vinaceum.	
OTHER–999	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
QUAY	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
RIO ARRIBA	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
ROOSEVELT	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
SAN JUAN	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	SQUAWFISH, COLORADO	Ptychocheilus lucius.	
		SUCKER, RAZORBACK	XYRAUCHEN TEXANUS.	
SAN MIGUEL	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
SANDOVAL	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	MINNOW, RIO GRANDE SILVERY	HYBOGNATHUS AMARUS.	
SANTA FE	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
SIERRA	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocepnalus.	
	FISHES	TROUT, GILA	Salmo gilae.	
SOCORRO	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
	CRUSTACEAN	ISOPOD, SOCORRO	Thermosphaeroma (=Exosphaeroma) thermophilus.	
	FISHES	MINNOW, RIO GRANDE SILVERY	HYBOGNATHUS AMARUS.	
	SNAILS	SPRINGSNAIL, ALAMOSA	Tryonia alamosae.	
		SPRINGSNAIL, SOCORRO	Pyrgulopsis neomexicana.	
TAOS	BIRDS	CRANE, WHOOPING	Grus americana.	
	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
TORRANCE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
UNION	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
VALENCIA	BIRDS	CRANE, WHOOPING	Grus americana.	
	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	MINNOW, RIO GRANDE SILVERY	HYBOGNATHUS AMARUS.	
NEVADA				
CARSON CITY	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
CHURCHILL	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
CLARK	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
		GOOSE, ALEUTIAN CANADA	Branta canadensis leucopareia	IR
		RAIL, YUMA CLAPPER	Rallus longirostris yumanensis	IR
	FISHES	CHUB, BONYTAIL	Gila elegans	IR
		CHUB, VIRGIN RIVER	Gila robusta seminuda	IR
		DACE, MOAPA	Moapa coriacea	IR
		KILLIFISH, PAHRUMP	EMPETRICHYTHYS LATOS	IR
		PUPFISH, DEVILS HOLE	Cyprinodon diabolis	IR
		SUCKER, RAZORBACK	XYRAUCHEN TEXANUS	IR
		WOUNDFIN	Plagopterus argentissimus	IR
DOUGLAS	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
ELKO	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	DACE, CLOVER VALLEY SPECKLED	Rhinichthys osculus oligoporous	IR
		DACE, INDEPENDENCE VALLEY SPECKLED.	Rhinichthys osculus lethoporous	IR
		TROUT, LAHONTAN CUTTHROAT	Salmo clarki henshawi	IR
EUREKA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	TROUT, LAHONTAN CUTTHROAT	Salmo clarki henshawi	IR
HUMBOLDT	FISHES	DACE, DESERT	Eremichthys acros	IR
		TROUT, LAHONTAN CUTTHROAT	Salmo clarki henshawi	IR
LANDER	FISHES	TROUT, LAHONTAN CUTTHROAT	Salmo clarki henshawi	IR
LINCOLN	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	CHUB, PAHRANAGAT ROUNDTAIL	Gila robusta jordani	IR
		SPINEDACE, BIG SPRING	Lepidomeda mollispinis pratensis	IR
		SPRINGFISH, HIKO WHITE RIVER	Crenichthys baileyi grandis	IR
		SPRINGFISH, WHITE RIVER	Crenichthys baileyi baileyi	IR

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II. COUNTY/SPECIES LIST—Continued

[The following list identifies federally listed or proposed U.S. species by State and County. It has been updated through March 31, 1995.]

State/County	Group name	Inventory name	Scientific name	IR/FF*
	PLANTS	LADIES'-TRESSES, UTE	Spiranthes diluvialis	IR
LYON	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
MINERAL	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	SPRINGFISH, HIKO WHITE RIVER	Crenichthys baileyi grandis	IR
		SPRINGFISH, RAILROAD VALLEY	Crenichthys nevadae	IR
		TROUT, LAHONTAN CUTTHROAT	Salmo clarki henshawi	IR
	PLANTS	MILK-VETCH, SODAVILLE	ASTRAGALUS LENTIGINOSUS VAR. SESLQ MIMETRALIS.	IR
NYE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	POOLFISH, PAHRUMP	Empetrichthys latos	IR
		PUPFISH, ASH MEADOWS AMARGOSA	Cyprinodon nevadensis mionectes	IR
		PUPFISH, DEVILS HOLE	Cyprinodon diabolis	IR
		PUPFISH, WARM SPRINGS	Cyprinodon nevadensis pectoralis	IR
		SPINEDACE, WHITE RIVER	Lepidomeda albivallis	IR
		SPRINGFISH, RAILROAD VALLEY	Crenichthys nevadae	IR
		TROUT, LAHONTAN CUTTHROAT	Salmo clarki henshawi	IR
	INSECTS	NAUCORID, ASH MEADOWS	Ambrysus amargosus	IR
	PLANTS	CENTAURY,-SPRING-LOVING	Centaurium namophilum var. namophilum	IR
		GUMPLANT, ASH MEADOWS	Grindelia fraxinopratensis	IR
		IVESIA, ASH MEADOWS	Ivesia kingii var. eremica	IR
PERSHING	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
STOREY	FISHES	TROUT, LAHONTAN CUTTHROAT	Salmo clarki henshawi	IR
WASHOE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	CUI-UI	Chasmistes cujus	IR
		SUCKER, WARNER	Catostomus warnerensis	IR
		TROUT, LAHONTAN CUTTHROAT	Salmo clarki henshawi	IR
	PLANTS	BUCKWHEAT, STEAMBOAT	Eriogonum ovalifolium var. williamsiae	IR
WHITE PINE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	KILLIFISH, PAHRUMP	EMPETRICHYTHYS LATOS	IR
		SPINEDACE, WHITE RIVER	Lepidomeda albivallis	IR
OKLAHOMA				
ADAIR	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
ALFALFA	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
ATOKA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
BEAVER	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
BECKHAM	BIRDS	CRANE, WHOOPING	Grus americana.	
BLAINE	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
BRYAN	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
	REPTILES	ALLIGATOR, AMERICAN	Alligator mississippiensis.	
CADDO	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
CANADIAN	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	

II. COUNTY/SPECIES LIST—Continued

[The following list identifies federally listed or proposed U.S. species by State and County. It has been updated through March 31, 1995.]

State/County	Group name	Inventory name	Scientific name	IR/FF*
CARTER	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
CHEROKEE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
CHOCTAW	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	PLANTS	ORCHID, EASTERN PRAIRIE FRINGED	Platanthera leucophaea.	
CIMARRON	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
	FISHES	SHINER, ARKANSAS RIVER	NOTROPIS GIRARDI.	
CLEVELAND	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
COMANCHE	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
COTTON	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
CRAIG	FISHES	CAVEFISH, OZARK	Amblyopsis rosae.	
		MADTOM, NEOSHO	Noturus placidus.	
	PLANTS	ORCHID, WESTERN PRAIRIE FRINGED	Platanthera praeclara.	
CREEK	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
CUSTER	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
DELAWARE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	CAVEFISH, OZARK	Amblyopsis rosae.	
DEWEY	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
ELLIS	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
GARFIELD	BIRDS	CRANE, WHOOPING	Grus americana.	
GARVIN	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
GRADY	BIRDS	CRANE, WHOOPING	Grus americana.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	

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II. COUNTY/SPECIES LIST—Continued

[The following list identifies federally listed or proposed U.S. species by State and County. It has been updated through March 31, 1995.]

State/County	Group name	Inventory name	Scientific name	IR/FF*
GRANT	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
GREER	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
HARMON	BIRDS	CRANE, WHOOPING	Grus americana.	
		PLOVER, PIPING	+haradrius melodus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
HARPER	BIRDS	CRANE, WHOOPING	Grus americana.	
		PLOVER, PIPING	+haradrius melodus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
HASKELL	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
HUGHES	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
JACKSON	BIRDS	CRANE, WHOOPING	Grus americana.	
		PLOVER, PIPING	+haradrius melodus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
JEFFERSON	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
JOHNSTON	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
KAY	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
KINGFISHER	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
KIOWA	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
LE FLORE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
	CLAMS	ROCK-POCKETBOOK, OUACHITA	Arkansia (=Arcidens) wheeleri.	

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II. COUNTY/SPECIES LIST—Continued

[The following list identifies federally listed or proposed U.S. species by State and County. It has been updated through March 31, 1995.]

State/County	Group name	Inventory name	Scientific name	IR/FF*
		ROCK-POCKETBOOK, OUACHITA (=WHEELER'S PM).	Arkansia (=Arcidens) wheeleri.	
	FISHES	DARTER, LEOPARD	Percina pantherina.	
LINCOLN	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
LOGAN	BIRDS	CRANE, WHOOPING	Grus americana.	
		PLOVER, PIPING	+haradrius melodus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
LOVE	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
MAJOR	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
MARSHALL	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
MAYES	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	CAVEFISH, OZARK	Amblyopsis rosae.	
MCCLAIN	BIRDS	CRANE, WHOOPING	Grus americana.	
		PLOVER, PIPING	+haradrius melodus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
MCCURTAIN	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
	FISHES	DARTER, LEOPARD	Percina pantherina.	
	REPTILES	ALLIGATOR, AMERICAN	Alligator mississippiensis.	
MCINTOSH	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
MURRAY	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
MUSKOGEE	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
NOBLE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
NOWATA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
OKLAHOMA	BIRDS	CRANE, WHOOPING	Grus americana.	

II. COUNTY/SPECIES LIST—Continued

[The following list identifies federally listed or proposed U.S. species by State and County. It has been updated through March 31, 1995.]

State/County	Group name	Inventory name	Scientific name	IR/FF*
		EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
OSAGE	BIRDS	CRANE, WHOOPING	Grus americana.	
		CURLEW, ESKIMO	Numenius borealis.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
OTTAWA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	CAVEFISH, OZARK	Amblyopsis rosae.	
		MADTOM, NEOSHO	Noturus placidus.	
PAWNEE	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
PAYNE	BIRDS	CRANE, WHOOPING	Grus americana.	
		PLOVER, PIPING	+haradrius melodus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
PITTSBURG	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
PONTOTOC	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
POTTAWATOMIE	BIRDS	TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
PUSHMATAHA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	CLAMS	ROCK-POCKETBOOK, OUACHITA	Arkansia (=Arcidens) wheeleri.	
		ROCK-POCKETBOOK, OUACHITA (=WHEELER'S PM).	Arkansia (=Arcidens) wheeleri.	
	FISHES	DARTER, LEOPARD	Percina pantherina.	
ROGER MILLS	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
ROGERS	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
	PLANTS	ORCHID, WESTERN PRAIRIE FRINGED	Platanthera praeclara.	
SEMINOLE	BIRDS	TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
SEQUOYAH	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	

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[The following list identifies federally listed or proposed U.S. species by State and County. It has been updated through March 31, 1995.]

State/County	Group name	Inventory name	Scientific name	IR/FF*
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
STEPHENS	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
TEXAS	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
TILLMAN	BIRDS	CRANE, WHOOPING	Grus americana.	
		PLOVER, PIPING	+haradrius melodus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
TULSA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
WAGONER	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
WASHINGTON	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
WASHITA	BIRDS	CRANE, WHOOPING	Grus americana.	
WOODS	BIRDS	CRANE, WHOOPING	Grus americana.	
		CURLEW, ESKIMO	Numenius borealis.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
WOODWARD	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
		....		
OREGON				
BAKER	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
		MURRELET, MARBLED	BRACHYRAMPHUS MARMORATUS	IR
	FISHES	SALMON, CHINOOK (SNAKE RIVER SPRING/SUMMER.	ONCORHYNCHUS TSHAWYTSCHA	IR
BENTON	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
		GOOSE, ALEUTIAN CANADA	Branta canadensis leucopareia	IR
		PLOVER, WESTERN SNOWY	CHARADRIUS ALEXANDRINUS NIVOSUS.	IR
	FISHES	CHUB, OREGON	OREGONICHTHYS CRAMERI	IR
	PLANTS	CHECKER-MALLOW, NELSON'S	SIDALCEA NELSONIANA	IR
		LOMATIUM, BRADSHAW'S	Lomatium bradshawii	IR
CLACKAMAS	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	CHUB, OREGON	OREGONICHTHYS CRAMERI	IR
	PLANTS	CHECKER-MALLOW, NELSON'S	SIDALCEA NELSONIANA	IR
CLATSOP	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
		PELICAN, BROWN	Pelicanus occidentalis	IR
		PLOVER, WESTERN SNOWY	CHARADRIUS ALEXANDRINUS NIVOSUS.	IR
	FISHES	SALMON, SNAKE RIVER SOCKEYE	ONCORHYNCHUS NERKA	IR

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[The following list identifies federally listed or proposed U.S. species by State and County. It has been updated through March 31, 1995.]

State/County	Group name	Inventory name	Scientific name	IR/FF*
COLUMBIA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	SALMON, SNAKE RIVER SOCKEYE	ONCORHYNCHUS NERKA	IR
COOS	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
		GOOSE, ALEUTIAN CANADA	Branta canadensis leucopareia	IR
		PELICAN, BROWN	Pelicanus occidentalis	IR
		PLOVER, WESTERN SNOWY	CHARADRIUS ALEXANDRINUS NIVOSUS.	IR
CROOK	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
CURRY	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
		GOOSE, ALEUTIAN CANADA	Branta canadensis leucopareia	IR
		MURRELET, MARBLED	BRACHYRAMPHUS MARMORATUS	IR
		PELICAN, BROWN	Pelicanus occidentalis	IR
		PLOVER, WESTERN SNOWY	CHARADRIUS ALEXANDRINUS NIVOSUS.	IR
DESCHUTES	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
DOUGLAS	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
		GOOSE, ALEUTIAN CANADA	Branta canadensis leucopareia	IR
		MURRELET, MARBLED	BRACHYRAMPHUS MARMORATUS	IR
		PLOVER, WESTERN SNOWY	CHARADRIUS ALEXANDRINUS NIVOSUS.	IR
GILLIAM	FISHES	SALMON, SNAKE RIVER SOCKEYE	ONCORHYNCHUS NERKA	IR
GRANT	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
HARNEY	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	CHUB, BORAX LAKE	Gila boraxobius	IR
		TROUT, LAHONTAN CUTTHROAT	Salmo clarki henshawi	IR
HOOD RIVER	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	SALMON, SNAKE RIVER SOCKEYE	ONCORHYNCHUS NERKA	IR
JACKSON	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
JEFFERSON	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
JOSEPHINE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
KLAMATH	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	SUCKER, LOST RIVER	Deltistes luxatus	IR
		SUCKER, SHORTNOSE	Chasmistes brevirostris	IR
LAKE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	CHUB, HUTTON TUI	Gila bicolor ssp.	IR
		DACE, FOSKETT SPECKLED	Rhinichthys osculus ssp.	IR
		SUCKER, WARNER	Catostomus warnerensis	IR
LANE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
		GOOSE, ALEUTIAN CANADA	Branta canadensis leucopareia	IR
		MURRELET, MARBLED	BRACHYRAMPHUS MARMORATUS	IR
		PELICAN, BROWN	Pelicanus occidentalis	IR
		PLOVER, WESTERN SNOWY	CHARADRIUS ALEXANDRINUS NIVOSUS.	IR
	FISHES	CHUB, OREGON	OREGONICHTHYS CRAMERI	IR
	PLANTS	LOMATIUM, BRADSHAW'S	Lomatium bradshawii	IR
LINCOLN	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
		GOOSE, ALEUTIAN CANADA	Branta canadensis leucopareia	IR
		MURRELET, MARBLED	BRACHYRAMPHUS MARMORATUS	IR
		PELICAN, BROWN	Pelicanus occidentalis	IR
		PLOVER, WESTERN SNOWY	CHARADRIUS ALEXANDRINUS NIVOSUS.	IR
LINN	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	CHUB, OREGON	OREGONICHTHYS CRAMERI	IR
	PLANTS	CHECKER-MALLOW, NELSON'S	SIDALCEA NELSONIANA	IR
		LOMATIUM, BRADSHAW'S	Lomatium bradshawii	IR
MALHEUR	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	SALMON, CHINOOK (SNAKE RIVER SPRING/SUMMER.	ONCORHYNCHUS TSHAWYTSCHA	IR
MARION	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
		PLOVER, WESTERN SNOWY	CHARADRIUS ALEXANDRINUS NIVOSUS.	IR
	FISHES	CHUB, OREGON	OREGONICHTHYS CRAMERI	IR
	PLANTS	CHECKER-MALLOW, NELSON'S	SIDALCEA NELSONIANA	IR
		LOMATIUM, BRADSHAW'S	Lomatium bradshawii	IR
MORROW	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	SALMON, SNAKE RIVER SOCKEYE	ONCORHYNCHUS NERKA	IR
MULTNOMAH	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	SALMON, SNAKE RIVER SOCKEYE	ONCORHYNCHUS NERKA	IR
POLK	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
		MURRELET, MARBLED	BRACHYRAMPHUS MARMORATUS	IR
	FISHES	CHUB, OREGON	OREGONICHTHYS CRAMERI	IR

II. COUNTY/SPECIES LIST—Continued

[The following list identifies federally listed or proposed U.S. species by State and County. It has been updated through March 31, 1995.]

State/County	Group name	Inventory name	Scientific name	IR/FF*
	PLANTS	CHECKER-MALLOW, NELSON'S	SIDALCEA NELSONIANA	IR
		LOMATIUM, BRADSHAW'S	Lomatium bradshawii	IR
SHERMAN	FISHES	SALMON, SNAKE RIVER SOCKEYE	ONCORHYNCHUS NERKA	IR
TILLAMOOK	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
		GOOSE, ALEUTIAN CANADA	Branta canadensis leucopareia	IR
		MURRELET, MARBLED	BRACHYRAMPHUS MARMORATUS	IR
		PELICAN, BROWN	Pelicanus occidentalis	IR
		PLOVER, WESTERN SNOWY	CHARADRIUS ALEXANDRINUS NIVOSUS.	IR
	PLANTS	CHECKER-MALLOW, NELSON'S	SIDALCEA NELSONIANA	IR
UMATILLA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	SALMON, SNAKE RIVER SOCKEYE	ONCORHYNCHUS NERKA	IR
UNION	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	SALMON, CHINOOK (SNAKE RIVER SPRING/SUMMER.	ONCORHYNCHUS TSHAWYTSCHA	IR
WALLOWA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	SALMON, CHINOOK (SNAKE RIVER SPRING/SUMMER.	ONCORHYNCHUS TSHAWYTSCHA	IR
		SALMON, SNAKE RIVER SOCKEYE	ONCORHYNCHUS NERKA	IR
WASCO	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	SALMON, SNAKE RIVER SOCKEYE	ONCORHYNCHUS NERKA	IR
WASHINGTON	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	PLANTS	CHECKER-MALLOW, NELSON'S	SIDALCEA NELSONIANA	IR
WHEELER	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
YAMHILL	PLANTS	CHECKER-MALLOW, NELSON'S	SIDALCEA NELSONIANA	IR
PUERTO RICO				
ADJUNTAS	AMPHIBIANS	COQUI, GOLDEN	Eleutherodactylus jasperi.	
AGUADA	BIRDS	PELICAN, BROWN	Pelicanus occidentalis.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
AGUADILLA	BIRDS	PELICAN, BROWN	Pelicanus occidentalis.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
ANASCO	BIRDS	PELICAN, BROWN	Pelicanus occidentalis.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
ARECIBO	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	PLANTS	PALMA DE MANACA	Calyptronoma rivalis.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
ARROYA	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
BARCELONETA	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
CABO ROJO	BIRDS	PELICAN, BROWN	Pelicanus occidentalis.	
		PLOVER, PIPING	+haradrius melodus.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	PLANTS	COBANA NEGRA	Stahlia monosperma.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
CAMUY	PLANTS	PALMA DE MANACA	Calyptronoma rivalis.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
CAROLINA	BIRDS	PELICAN, BROWN	Pelicanus occidentalis.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
CATANO	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
CEIBA	BIRDS	PELICAN, BROWN	Pelicanus occidentalis.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
CIALES	PLANTS	FERN, THELYPTERIS INABONENSIS	THELYPTERIS INABONENSIS.	
		FERN, THELYPTERIS YAUCOENSIS	THELYPTERIS YAUCOENSIS.	
COAMO	AMPHIBIANS	TOAD, PUERTO RICAN CRESTED	Peltophryne lemur.	
CULEBRA	BIRDS	PELICAN, BROWN	Pelicanus occidentalis.	
		TERN, ROSEATE	Sterna dougalli dougalli.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	

II. COUNTY/SPECIES LIST—Continued

[The following list identifies federally listed or proposed U.S. species by State and County. It has been updated through March 31, 1995.]

State/County	Group name	Inventory name	Scientific name	IR/FF*
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
DORADO	AMPHIBIANS	TOAD, PUERTO RICAN CRESTED	Peltophryne lemur.	
	BIRDS	PELICAN, BROWN	Pelicanus occidentalis.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
FAJARDO	BIRDS	PELICAN, BROWN	Pelicanus occidentalis.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
GUANICA	AMPHIBIANS	TOAD, PUERTO RICAN CRESTED	Peltophryne lemur.	
	BIRDS	PELICAN, BROWN	Pelicanus occidentalis.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
GUAYAMA	BIRDS	PELICAN, BROWN	Pelicanus occidentalis.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
GUAYANILLA	BIRDS	PELICAN, BROWN	Pelicanus occidentalis.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
HATILLO	PLANTS	FERN, THELYPTERIS VERECUNDA	THELYPTERIS VERECUNDA.	
		PALMA DE MANACA	Calyptronoma rivalis.	
HUMACAO	BIRDS	PELICAN, BROWN	Pelicanus occidentalis.	
	REPTILES	TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
ISABELA	AMPHIBIANS	TOAD, PUERTO RICAN CRESTED	Peltophryne lemur.	
	REPTILES	TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
JUANA DIAZ	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
LAJAS	BIRDS	PELICAN, BROWN	Pelicanus occidentalis.	
		TERN, ROSEATE	Sterna dougalli dougalli.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	PLANTS	COBANA NEGRA	Stahlia monosperma.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
LOIZA	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
LUQUILLO	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	PLANTS	COBANA NEGRA	Stahlia monosperma.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
MANATI	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
MAUNABO	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
MAYAGUEZ	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
NAGUABO	BIRDS	PELICAN, BROWN	Pelicanus occidentalis.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
PATILLAS	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
PENUELAS	BIRDS	PELICAN, BROWN	Pelicanus occidentalis.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
PONCE	BIRDS	PELICAN, BROWN	Pelicanus occidentalis.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	PLANTS	FERN, THELYPTERIS INABONENSIS	THELYPTERIS INABONENSIS.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
QUEBRADILLAS	AMPHIBIANS	TOAD, PUERTO RICAN CRESTED	Peltophryne lemur.	
	PLANTS	FERN, THELYPTERIS VERECUNDA	THELYPTERIS VERECUNDA.	
		PALMA DE MANACA	Calyptronoma rivalis.	
RINCON	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
RIO GRANDE	PLANTS	COBANA NEGRA	Stahlia monosperma.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
SALINAS	BIRDS	PELICAN, BROWN	Pelicanus occidentalis.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	

II. COUNTY/SPECIES LIST—Continued

[The following list identifies federally listed or proposed U.S. species by State and County. It has been updated through March 31, 1995.]

State/County	Group name	Inventory name	Scientific name	IR/FF*
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
SAN JUAN	BIRDS	PELICAN, BROWN	Pelicanus occidentalis.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
SAN SEBASTIAN	PLANTS	FERN, THELYPTERIS VERECUNDA	THELYPTERIS VERECUNDA.	
		PALMA DE MANACA	Calyptronoma rivalis.	
SANTA ISABEL	BIRDS	PELICAN, BROWN	Pelicanus occidentalis.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
TOA BAJA	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
UTUADO	PLANTS	PALMA DE MANACA	Calyptronoma rivalis.	
VEGA ALTA	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
VEGA BAJA	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
VIEQUES	BIRDS	PELICAN, BROWN	Pelicanus occidentalis.	
	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
	PLANTS	COBANA NEGRA	Stahlia monosperma.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
YABUCOA	MAMMALS	MANATEE, WEST INDIAN (FLORIDA)	Trichechus manatus.	
YAUCO	BIRDS	PELICAN, BROWN	Pelicanus occidentalis.	
	PLANTS	FERN, THELYPTERIS YAUCOENSIS	THELYPTERIS YAUCOENSIS.	
	REPTILES	TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
RHODE ISLAND				
KENT	FISHES	STURGEON, SHORTNOSE	Acipenser brevirostrum	IR
NEWPORT	BIRDS	PLOVER, PIPING	+haradrius melodus	IR
	FISHES	STURGEON, SHORTNOSE	Acipenser brevirostrum	IR
WASHINGTON	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
		PLOVER, PIPING	+haradrius melodus	IR
	FISHES	STURGEON, SHORTNOSE	Acipenser brevirostrum	IR
TEXAS				
ANDERSON	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
ANGELINA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
ARANSAS	BIRDS	CRANE, WHOOPING	Grus americana.	
		CURLEW, ESKIMO	Numenius borealis.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
ARCHER	BIRDS	CRANE, WHOOPING	Grus americana.	
AUSTIN	AMPHIBIANS	TOAD, HOUSTON	Bufo houstonensis.	
	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
BAILEY	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
BASTROP	AMPHIBIANS	TOAD, HOUSTON	Bufo houstonensis.	
	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
BAYLOR	BIRDS	CRANE, WHOOPING	Grus americana.	
BEE	BIRDS	CRANE, WHOOPING	Grus americana.	
BELL	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
BEXAR	BIRDS	CRANE, WHOOPING	Grus americana.	
BLANCO	BIRDS	CRANE, WHOOPING	Grus americana.	
BOSQUE	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
BOWIE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	

II. COUNTY/SPECIES LIST—Continued

[The following list identifies federally listed or proposed U.S. species by State and County. It has been updated through March 31, 1995.]

State/County	Group name	Inventory name	Scientific name	IR/FF*
BRAZORIA	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
		PELICAN, BROWN	Pelicanus occidentalis.	
		PLOVER, PIPING	+haradrius melodus.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
BRAZOS	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
	PLANTS	LADIES'-TRESSES, NAVASOTA	Spiranthes parksii.	
BREWSTER	FISHES	GAMBUSIA, BIG BEND	Gambusia gaigei.	
BROWN	BIRDS	CRANE, WHOOPING	Grus americana.	
	REPTILES	SNAKE, CONCHO WATER	Nerodia harteri paucimaculata.	
BURLESON	AMPHIBIANS	TOAD, HOUSTON	Bufo houstonensis.	
	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
	PLANTS	LADIES'-TRESSES, NAVASOTA	Spiranthes parksii.	
BURNET	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
CALDWELL	BIRDS	CRANE, WHOOPING	Grus americana.	
	FISHES	DARTER, FOUNTAIN	Etheostoma fonticola.	
CALHOUN	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
		PELICAN, BROWN	Pelicanus occidentalis.	
		PLOVER, PIPING	+haradrius melodus.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
CAMERON	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		PELICAN, BROWN	Pelicanus occidentalis.	
		PLOVER, PIPING	+haradrius melodus.	
	FISHES	MINNOW, RIO GRANDE SILVERY	HYBOGNATHUS AMARUS.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
CASS	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
CHAMBERS	BIRDS	CURLEW, ESKIMO	Numenius borealis.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
		PELICAN, BROWN	Pelicanus occidentalis.	
		PLOVER, PIPING	+haradrius melodus.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
CHEROKEE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
CHILDRESS	BIRDS	CRANE, WHOOPING	Grus americana.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
CLAY	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
COKE	REPTILES	SNAKE, CONCHO WATER	Nerodia harteri paucimaculata.	
COLEMAN	BIRDS	CRANE, WHOOPING	Grus americana.	
	REPTILES	SNAKE, CONCHO WATER	Nerodia harteri paucimaculata.	
COLLINGSWORTH	BIRDS	CRANE, WHOOPING	Grus americana.	

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II. COUNTY/SPECIES LIST—Continued

[The following list identifies federally listed or proposed U.S. species by State and County. It has been updated through March 31, 1995.]

State/County	Group name	Inventory name	Scientific name	IR/FF**
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
COLORADO	AMPHIBIANS	TOAD, HOUSTON	Bufo houstonensis.	
	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
COMAL	AMPHIBIANS	SALAMANDER, SAN MARCOS	Eurycea nana.	
	FISHES	DARTER, FOUNTAIN	Etheostoma fonticola.	
COMANCHE	BIRDS	CRANE, WHOOPING	Grus americana.	
CONCHO	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	REPTILES	SNAKE, CONCHO WATER	Nerodia harteri paucimaculata.	
COOKE	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
CORYELL	BIRDS	CRANE, WHOOPING	Grus americana.	
DE WITT	BIRDS	CRANE, WHOOPING	Grus americana.	
EDWARDS	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	PLANTS	SNOWBELLS, TEXAS	Styrax texana.	
ELLIS	BIRDS	CRANE, WHOOPING	Grus americana.	
ERATH	BIRDS	CRANE, WHOOPING	Grus americana.	
FALLS	BIRDS	CRANE, WHOOPING	Grus americana.	
FANNIN	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
FAYETTE	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
FORT BEND	AMPHIBIANS	TOAD, HOUSTON	Bufo houstonensis.	
	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
FREESTONE	AMPHIBIANS	TOAD, HOUSTON	Bufo houstonensis.	
	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	PLANTS	LADIES'-TRESSES, NAVASOTA	Spiranthes parksii.	
GALVESTON	BIRDS	CURLEW, ESKIMO	Numenius borealis.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
		PELICAN, BROWN	Pelicanus occidentalis.	
		PLOVER, PIPING	+haradrius melodus.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
GILLESPIE	BIRDS	CRANE, WHOOPING	Grus americana.	
GOLIAD	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
GONZALES	BIRDS	CRANE, WHOOPING	Grus americana.	
GRAYSON	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		PLOVER, PIPING	+haradrius melodus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
GREGG	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
GRIMES	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	PLANTS	LADIES'-TRESSES, NAVASOTA	Spiranthes parksii.	
GUADALUPE	BIRDS	CRANE, WHOOPING	Grus americana.	
HALL	BIRDS	TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
	BIRDS	TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
HAMILTON	BIRDS	CRANE, WHOOPING	Grus americana.	
HARDEMAN	BIRDS	CRANE, WHOOPING	Grus americana.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	

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II. COUNTY/SPECIES LIST—Continued

[The following list identifies federally listed or proposed U.S. species by State and County. It has been updated through March 31, 1995.]

State/County	Group name	Inventory name	Scientific name	IR/FF*
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
HARDIN	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
HARRISON	AMPHIBIANS	TOAD, HOUSTON	Bufo houstonensis.	
	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
HASKELL	BIRDS	CRANE, WHOOPING	Grus americana.	
HAYS	AMPHIBIANS	SALAMANDER, SAN MARCOS	Eurycea nana.	
		SALAMANDER, TEXAS BLIND	Typhlomolge rathbuni.	
	BIRDS	CRANE, WHOOPING	Grus americana.	
	FISHES	DARTER, FOUNTAIN	Etheostoma fonticola.	
		GAMBUSIA, SAN MARCOS	Gambusia georgei.	
	PLANTS	WILD-RICE, TEXAS	Zizania texana.	
HEMPHILL	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
HENDERSON	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
HILL	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
HOOD	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
HOUSTON	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
HUNT	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
HUTCHINSON	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
IRION	REPTILES	SNAKE, CONCHO WATER	Nerodia harteri paucimaculata.	
JACKSON	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
		PELICAN, BROWN	Pelicanus occidentalis.	
JASPER	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	PLANTS	LADIES'-TRESSES, NAVASOTA	Spiranthes parksii.	
JEFF DAVIS	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	FISHES	GAMBUSIA, PECOS	Gambusia nobilis.	
		PUPFISH, COMANCHE SPRINGS	Cyprinodon elegans.	
	PLANTS	PONDWEED, LITTLE AGUJA CREEK	Potamogeton clystocarpus.	
JEFFERSON	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		PELICAN, BROWN	Pelicanus occidentalis.	
		PLOVER, PIPING	+haradrius melodus.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
JOHNSON	BIRDS	CRANE, WHOOPING	Grus americana.	
JONES	BIRDS	CRANE, WHOOPING	Grus americana.	
KARNES	BIRDS	CRANE, WHOOPING	Grus americana.	
KENEDY	BIRDS	CURLEW, ESKIMO	Numenius borealis.	
		PELICAN, BROWN	Pelicanus occidentalis.	
		PLOVER, PIPING	+haradrius melodus.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
KIMBLE	PLANTS	SNOWBELLS, TEXAS	Styrax texana.	
KING	BIRDS	CRANE, WHOOPING	Grus americana.	
KLEBERG	BIRDS	CURLEW, ESKIMO	Numeniius borealis.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
		PELICAN, BROWN	Pelicanus occidentalis.	
		PLOVER, PIPING	+haradrius melodus.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	

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[The following list identifies federally listed or proposed U.S. species by State and County. It has been updated through March 31, 1995.]

State/County	Group name	Inventory name	Scientific name	IR/FF*
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
KNOX	BIRDS	CRANE, WHOOPING	Grus americana.	
LAMAR	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
LAMPASAS	BIRDS	CRANE, WHOOPING	Grus americana.	
	REPTILES	SNAKE, CONCHO WATER	Nerodia harteri paucimaculata.	
LAVACA	AMPHIBIANS	TOAD, HOUSTON	Bufo houstonensis.	
	BIRDS	CRANE, WHOOPING	Grus americana.	
LEE	AMPHIBIANS	TOAD, HOUSTON	Bufo houstonensis.	
	BIRDS	CRANE, WHOOPING	Grus americana.	
LEON	AMPHIBIANS	TOAD, HOUSTON	Bufo houstonensis.	
	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	PLANTS	LADIES'-TRESSES, NAVASOTA	Spiranthes parksii.	
LIBERTY	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
LIMESTONE	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
LIPSCOMB	BIRDS	CRANE, WHOOPING	Grus americana.	
LLANO	BIRDS	CRANE, WHOOPING	Grus americana.	
MADISON	PLANTS	LADIES'-TRESSES, NAVASOTA	Spiranthes parksii.	
MARION	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
MASON	BIRDS	CRANE, WHOOPING	Grus americana.	
MATAGORDA	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
		PELICAN, BROWN	Pelicanus occidentalis.	
		PLOVER, PIPING	+haradrius melodus.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
MAVERICK	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
	REPTILES	SNAKE, CONCHO WATER	Nerodia harteri paucimaculata.	
MENARD	FISHES	GAMBUSIA, CLEAR CREEK	Gambusia heterochir.	
MIDLAND	BIRDS	CRANE, WHOOPING	Grus americana.	
MILAM	AMPHIBIANS	TOAD, HOUSTON	Bufo houstonensis.	
MILLS	BIRDS	CRANE, WHOOPING	Grus americana.	
	REPTILES	SNAKE, CONCHO WATER	Nerodia harteri paucimaculata.	
MONTAGUE	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
MONTGOMERY	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
MOORE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
MORRIS	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
NACOGDOCHES	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
NEWTON	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
NUECES	BIRDS	PELICAN, BROWN	Pelicanus occidentalis.	
		PLOVER, PIPING	+haradrius melodus.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SEA.	Lepidochelys kempii.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
OCHILTREE	BIRDS	CRANE, WHOOPING	Grus americana.	
ORANGE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
PALO PINTO	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
PANOLA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
PARKER	BIRDS	CRANE, WHOOPING	Grus americana.	
PECOS	FISHES	GAMBUSIA, PECOS	Gambusia nobilis.	
		PUPFISH, LEON SPRINGS	Cyprinodon bovinus.	

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[The following list identifies federally listed or proposed U.S. species by State and County. It has been updated through March 31, 1995.]

State/County	Group name	Inventory name	Scientific name	IR/FF*
POLK	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
POTTER	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
RANDALL	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
REAL	PLANTS	SNOWBELLS, TEXAS	Styrax texana.	
RED RIVER	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
REEVES	FISHES	GAMBUSIA, PECOS	Gambusia nobilis.	
		PUPFISH, COMANCHE SPRINGS	Cyprinodon elegans.	
REFUGIO	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
		PELICAN, BROWN	Pelicanus occidentalis.	
		PLOVER, PIPING	+haradrius melodus.	
ROBERTS	BIRDS	TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
ROBERTSON	AMPHIBIANS	TOAD, HOUSTON	Bufo houstonensis.	
	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
	PLANTS	LADIES'-TRESSES, NAVASOTA	Spiranthes parksii.	
RUNNELS	REPTILES	SNAKE, CONCHO WATER	Nerodia harteri paucimaculata.	
RUSK	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
SABINE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
SAN AUGUSTINE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
SAN JACINTO	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
SAN PATRICIO	BIRDS	CRANE, WHOOPING	Grus americana.	
		PELICAN, BROWN	Pelicanus occidentalis.	
		PLOVER, PIPING	+haradrius melodus.	
SAN SA BA	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
	REPTILES	SNAKE, CONCHO WATER	Nerodia harteri paucimaculata.	
SHACKELFORD	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
SHELBY	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
SOMERVELL	BIRDS	CRANE, WHOOPING	Grus americana.	
STARR	BIRDS	TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
STERLING	BIRDS	CRANE, WHOOPING	Grus americana.	
TARRANT	BIRDS	PLOVER, PIPING	+haradrius melodus.	
THROCKMORTON	BIRDS	CRANE, WHOOPING	Grus americana.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
TOM GREEN	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
	REPTILES	SNAKE, CONCHO WATER	Nerodia harteri paucimaculata.	
TRAVIS	AMPHIBIANS	SALAMANDER, BARTON SPRINGS	EURYCEA SOSORUM.	
	BIRDS	CRANE, WHOOPING	Grus americana.	
TRINITY	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
TYLER	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
UPSHUR	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
UVALDE	PLANTS	SNOWBELLS, TEXAS	Styrax texana.	
VAL VERDE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
	PLANTS	SNOWBELLS, TEXAS	Styrax texana.	
VICTORIA	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
		PELICAN, BROWN	Pelicanus occidentalis.	
WALKER	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus.	
WALLER	BIRDS	EAGLE, BALD	Haliaeetus leucocepnalus.	

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[The following list identifies federally listed or proposed U.S. species by State and County. It has been updated through March 31, 1995.]

State/County	Group name	Inventory name	Scientific name	IR/FF*
WASHINGTON	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
	PLANTS	LADIES'-TRESSES, NAVASOTA	Spiranthes parksii.	
WEBB	BIRDS	TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
WHARTON	BIRDS	CRANE, WHOOPING	Grus americana.	
		EAGLE, BALD	Haliaeetus leucocephalus.	
WHEELER	BIRDS	CRANE, WHOOPING	Grus americana.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
WICHITA	BIRDS	CRANE, WHOOPING	Grus americana.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
WILBARGER	BIRDS	CRANE, WHOOPING	Grus americana.	
		TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
WILLACY	BIRDS	CURLEW, ESKIMO	Numenius borealis.	
		PELICAN, BROWN	Pelicanus occidentalis.	
		PLOVER, PIPING	+haradrius melodus.	
	REPTILES	TURTLE, GREEN SEA	Chelonia mydas.	
		TURTLE, HAWKSBILL SEA	Eretmochelys imbricata.	
		TURTLE, KEMP'S (ATLANTIC) RIDLEY SE.	Lepidochelys kempii.	
		TURTLE, LEATHERBACK SEA	Dermochelys coriacea.	
		TURTLE, LOGGERHEAD SEA	Caretta caretta.	
WILLIAMSON	BIRDS	CRANE, WHOOPING	Grus americana.	
WILSON	BIRDS	CRANE, WHOOPING	Grus americana.	
WISE	BIRDS	CRANE, WHOOPING	Grus americana.	
YOUNG	BIRDS	CRANE, WHOOPING	Grus americana.	
ZAPATA	BIRDS	TERN, INTERIOR (POPULATION LEAST).	Sterna antillarum.	
		TERN, INTERIOR (POPULATION) LEAST.	Sterna antillarum.	
UTAH				
BEAVER	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	PLANTS	MILK-VETCH, RYDBERG	ASTRAGALUS PERIANUS	IR
BOX ELDER	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	TROUT, LAHONTAN CUTTHROAT	Salmo clarki henshawi	IR
CACHE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
CARBON	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	CHUB, BONYTAIL	Gila elegans	IR
		CHUB, HUMPBACK	Gila cypha	IR
		SQUAWFISH, COLORADO	Ptychocheilus lucius	IR
		SUCKER, RAZORBACK	XYRAUCHEN TEXANUS	IR
DAGGETT	BIRDS	CRANE, WHOOPING	Grus americana	IR
		EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	SQUAWFISH, COLORADO	Ptychocheilus lucius	IR
		SUCKER, RAZORBACK	XYRAUCHEN TEXANUS	IR
	PLANTS	LADIES'-TRESSES, UTE	Spiranthes diluvialis	IR
DAVIS	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
DUCHESNE	BIRDS	CRANE, WHOOPING	Grus americana	IR
		EAGLE, BALD	Haliaeetus leucocephalus	IR
	PLANTS	LADIES'-TRESSES, UTE	Spiranthes diluvialis	IR
EMERY	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	CHUB, BONYTAIL	Gila elegans	IR
		CHUB, HUMPBACK	Gila cypha	IR
		SQUAWFISH, COLORADO	Ptychocheilus lucius	IR
		SUCKER, RAZORBACK	XYRAUCHEN TEXANUS	IR
	PLANTS	CYCLADENIA, JONES	Cycladenia humilis var. jonesii	IR
GARFIELD	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	CHUB, BONYTAIL	Gila elegans	IR
		CHUB, HUMPBACK	Gila cypha	IR

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[The following list identifies federally listed or proposed U.S. species by State and County. It has been updated through March 31, 1995.]

State/County	Group name	Inventory name	Scientific name	IR/FF*
		SQUAWFISH, COLORADO	Ptychocheilus lucius	IR
		SUCKER, RAZORBACK	XYRAUCHEN TEXANUS	IR
	PLANTS	BUTTERCUP, AUTUMN	Ranunculus acriformis var. aestiva	IR
		CYCLADENIA, JONES	Cycladenia humilis var. jonesii	IR
		LADIES'-TRESSES, UTE	Spiranthes diluvialis	IR
		MILK-VETCH, RYDBERG	ASTRAGALUS PERIANUS	IR
GRAND	BIRDS	CRANE, WHOOPING	Grus americana	IR
		EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	CHUB, BONYTAIL	Gila elegans	IR
		CHUB, HUMPBACK	Gila cypha	IR
		SQUAWFISH, COLORADO	Ptychocheilus lucius	IR
		SUCKER, RAZORBACK	XYRAUCHEN TEXANUS	IR
	PLANTS	CYCLADENIA, JONES	Cycladenia humilis var. jonesii	IR
IRON	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	PLANTS	MILK-VETCH, RYDBERG	ASTRAGALUS PERIANUS	IR
JUAB	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
KANE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	CHUB, BONYTAIL	Gila elegans	IR
		SQUAWFISH, COLORADO	Ptychocheilus lucius	IR
		SUCKER, RAZORBACK	XYRAUCHEN TEXANUS	IR
	PLANTS	CYCLADENIA, JONES	Cycladenia humilis var. jonesii	IR
	SNAILS	AMBERSNAIL, KANAB	OXYLOMA HAYDENI KANABENSIS	IR
MILLARD	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
MORGAN	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
PIUTE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	PLANTS	MILK-VETCH, RYDBERG	ASTRAGALUS PERIANUS	IR
RICH	BIRDS	CRANE, WHOOPING	Grus americana	IR
		EAGLE, BALD	Haliaeetus leucocephalus	IR
SALT LAKE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	PLANTS	LADIES'-TRESSES, UTE	Spiranthes diluvialis	IR
SAN JUAN	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	CHUB, BONYTAIL	Gila elegans	IR
		CHUB, HUMPBACK	Gila cypha	IR
		SQUAWFISH, COLORADO	Ptychocheilus lucius	IR
		SUCKER, RAZORBACK	XYRAUCHEN TEXANUS	IR
	PLANTS	SEDGE, NAVAJO	Carex specuicola	IR
SANPETE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
SEVIER	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	PLANTS	MILK-VETCH, RYDBERG	ASTRAGALUS PERIANUS	IR
SUMMIT	BIRDS	CRANE, WHOOPING	Grus americana	IR
		EAGLE, BALD	Haliaeetus leucocephalus	IR
TOOELE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	PLANTS	LADIES'-TRESSES, UTE	Spiranthes diluvialis	IR
UINTAH	BIRDS	CRANE, WHOOPING	Grus americana	IR
		EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	CHUB, BONYTAIL	Gila elegans	IR
		CHUB, HUMPBACK	Gila cypha	IR
		SQUAWFISH, COLORADO	Ptychocheilus lucius	IR
		SUCKER, RAZORBACK	XYRAUCHEN TEXANUS	IR
	PLANTS	LADIES'-TRESSES, UTE	Spiranthes diluvialis	IR
UTAH	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	SUCKER, JUNE	Chasmistes liorus	IR
	PLANTS	LADIES'-TRESSES, UTE	Spiranthes diluvialis	IR
WASATCH	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
WASHINGTON	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	CHUB, VIRGIN RIVER	Gila robusta seminuda	IR
		WOUNDFIN	Plagopterus argentissimus	IR
WAYNE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	FISHES	CHUB, BONYTAIL	Gila elegans	IR
		CHUB, HUMPBACK	Gila cypha	IR
		SQUAWFISH, COLORADO	Ptychocheilus lucius	IR
		SUCKER, RAZORBACK	XYRAUCHEN TEXANUS	IR
	PLANTS	LADIES'-TRESSES, UTE	Spiranthes diluvialis	IR
WEBER	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR
	PLANTS	LADIES'-TRESSES, UTE	Spiranthes diluvialis	IR
VERMONT				
ADDISON	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,F
BENNINGTON	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,F
CALEDONIA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,F
CHITTENDEN	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,F

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[The following list identifies federally listed or proposed U.S. species by State and County. It has been updated through March 31, 1995.]

State/County	Group name	Inventory name	Scientific name	IR/FF*
ESSEX	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,F
FRANKLIN	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,F
GRAND ISLE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,F
LAMOILLE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,F
ORANGE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,F
ORLEANS	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,F
RUTLAND	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,F
WASHINGTON	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,F
WINDHAM	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,F
	PLANTS	BULRUSH, NORTHEASTERN (=BARBED BRIS.	Scirpus ancistrochaetus	IR,F
WINDSOR	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,F
	CLAMS	MUSSEL, DWARF WEDGE	Alasmidonta heterodon	IR,F
	PLANTS	MILK-VETCH, JESUP'S	Astragalus robbinsii var. jesupi	IR,F
WASHINGTON				
ADAMS	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,FF
ASOTIN	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,FF
	FISHES	SALMON, CHINOOK (SNAKE RIVER SPRING/SUMMER).	ONCORHYNCHUS TSHAWYTSCHA	IR,FF
		SALMON, SNAKE RIVER SOCKEYE	ONCORHYNCHUS NERKA	IR,FF
BENTON	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,FF
	FISHES	SALMON, SNAKE RIVER SOCKEYE	ONCORHYNCHUS NERKA	IR,FF
CHELAN	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,FF
	MAMMALS	BEAR, GRIZZLY	Ursus arctos (=U.a. horribilis)	IR,FF
CLALLAM	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,FF
		MURRELET, MARBLED	BRACHYRAMPHUS MARMORATUS	IR,FF
		PELICAN, BROWN	Pelicanus occidentalis	IR,FF
CLARK	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,FF
	FISHES	SALMON, SNAKE RIVER SOCKEYE	ONCORHYNCHUS NERKA	IR,FF
	PLANTS	HOWELLIA, WATER	HOWELLIA AQUATILIS	IR,FF
COLUMBIA	FISHES	SALMON, CHINOOK (SNAKE RIVER SPRING/SUMMER.	ONCORHYNCHUS TSHAWYTSCHA	IR,FF
		SALMON, SNAKE RIVER SOCKEYE	ONCORHYNCHUS NERKA	IR,FF
COWLITZ	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,FF
		MURRELET, MARBLED	BRACHYRAMPHUS MARMORATUS	IR,FF
	FISHES	SALMON, SNAKE RIVER SOCKEYE	ONCORHYNCHUS NERKA	IR,FF
	PLANTS	CHECKER-MALLOW, NELSON'S	SIDALCEA NELSONIANA	IR,FF
DOUGLAS	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,FF
FERRY	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,FF
	MAMMALS	BEAR, GRIZZLY	Ursus arctos (=U.a. horribilis)	IR,FF
FRANKLIN	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,FF
	FISHES	SALMON, CHINOOK (SNAKE RIVER SPRING/SUMMER).	ONCORHYNCHUS TSHAWYTSCHA	IR,FF
		SALMON, SNAKE RIVER SOCKEYE	ONCORHYNCHUS NERKA	IR,FF
GARFIELD	FISHES	SALMON, CHINOOK (SNAKE RIVER SPRING/SUMMER).	ONCORHYNCHUS TSHAWYTSCHA	IR,FF
		SALMON, SNAKE RIVER SOCKEYE	ONCORHYNCHUS NERKA	IR,FF
GRANT	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,FF
GRAYS HARBOR	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,FF
		MURRELET, MARBLED	BRACHYRAMPHUS MARMORATUS	IR,FF
		PELICAN, BROWN	Pelicanus occidentalis	IR,FF
		PLOVER, WESTERN SNOWY	CHARADRIUS ALEXANDRINUS NIVOSUS.	IR,FF
ISLAND	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,FF
		MURRELET, MARBLED	BRACHYRAMPHUS MARMORATUS	IR,FF
JEFFERSON	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,FF
		MURRELET, MARBLED	BRACHYRAMPHUS MARMORATUS	IR,FF
		PELICAN, BROWN	Pelicanus occidentalis	IR,FF
KING	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,FF
		MURRELET, MARBLED	BRACHYRAMPHUS MARMORATUS	IR,FF
	MAMMALS	BEAR, GRIZZLY	Ursus arctos (=U.a. horribilis)	IR,FF
KITSAP	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,FF
		MURRELET, MARBLED	BRACHYRAMPHUS MARMORATUS	IR,FF
KITTITAS	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,FF
		MURRELET, MARBLED	BRACHYRAMPHUS MARMORATUS	IR,FF
	MAMMALS	BEAR, GRIZZLY	Ursus arctos (=U.a. horribilis)	IR,FF
KLICKITAT	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,FF
	FISHES	SALMON, SNAKE RIVER SOCKEYE	ONCORHYNCHUS NERKA	IR,FF
LEWIS	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,FF
		MURRELET, MARBLED	BRACHYRAMPHUS MARMORATUS	IR,FF

II. COUNTY/SPECIES LIST—Continued

[The following list identifies federally listed or proposed U.S. species by State and County. It has been updated through March 31, 1995.]

State/County	Group name	Inventory name	Scientific name	IR/FF*
	MAMMALS	BEAR, GRIZZLY	Ursus arctos (=U.a. horribilis)	IR,FF
LINCOLN	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,FF
MASON	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,FF
	PLANTS	HOWELLIA, WATER	HOWELLIA AQUATILIS	IR,FF
OKANOGAN	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,FF
	MAMMALS	BEAR, GRIZZLY	Ursus arctos (=U.a. horribilis)	IR,FF
PACIFIC	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,FF
		GOOSE, ALEUTIAN CANADA	Branta canadensis leucopareia	IR,FF
		MURRELET, MARBLED	BRACHYRAMPHUS MARMORATUS	IR,FF
		PELICAN, BROWN	Pelicanus occidentalis	IR,FF
		PLOVER, WESTERN SNOWY	CHARADRIUS ALEXANDRINUS NIVOSUS.	IR,FF
	FISHES	SALMON, SNAKE RIVER SOCKEYE	ONCORHYNCHUS NERKA	IR,FF
PEND OREILLE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,FF
	MAMMALS	BEAR, GRIZZLY	Ursus arctos (=U.a. horribilis)	IR,FF
PIERCE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,FF
		MURRELET, MARBLED	BRACHYRAMPHUS MARMORATUS	IR,FF
	MAMMALS	BEAR, GRIZZLY	Ursus arctos (=U.a. horribilis)	IR,FF
SAN JUAN	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,FF
SKAGIT	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,FF
		MURRELET, MARBLED	BRACHYRAMPHUS MARMORATUS	IR,FF
	MAMMALS	BEAR, GRIZZLY	Ursus arctos (=U.a. horribilis)	IR,FF
SKAMANIA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,FF
	FISHES	SALMON, SNAKE RIVER SOCKEYE	ONCORHYNCHUS NERKA	IR,FF
SNOHOMISH	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,FF
		MURRELET, MARBLED	BRACHYRAMPHUS MARMORATUS	IR,FF
	MAMMALS	BEAR, GRIZZLY	Ursus arctos (=U.a. horribilis)	IR,FF
SPOKANE	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,FF
	PLANTS	HOWELLIA, WATER	HOWELLIA AQUATILIS	IR,FF
STEVENS	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,FF
	MAMMALS	BEAR, GRIZZLY	Ursus arctos (=U.a. horribilis)	IR,FF
THURSTON	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,FF
		MURRELET, MARBLED	BRACHYRAMPHUS MARMORATUS	IR,FF
	PLANTS	HOWELLIA, WATER	HOWELLIA AQUATILIS	IR,FF
WAHKIAKUM	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,FF
		MURRELET, MARBLED	BRACHYRAMPHUS MARMORATUS	IR,FF
		PELICAN, BROWN	Pelicanus occidentalis	IR,FF
WALLA WALLA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,FF
	FISHES	SALMON, CHINOOK (SNAKE RIVER SPRING/SUMMER.	ONCORHYNCHUS TSHAWYTSCHA	IR,FF
		SALMON, SNAKE RIVER SOCKEYE	ONCORHYNCHUS NERKA	IR,FF
WHATCOM	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,FF
		MURRELET, MARBLED	BRACHYRAMPHUS MARMORATUS	IR,FF
	FISHES	SALMON, SNAKE RIVER SOCKEYE	ONCORHYNCHUS NERKA	IR,FF
	MAMMALS	BEAR, GRIZZLY	Ursus arctos (=U.a. horribilis)	IR,FF
WHITMAN	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,FF
	FISHES	SALMON, CHINOOK (SNAKE RIVER SPRING/SUMMER).	ONCORHYNCHUS TSHAWYTSCHA	IR,FF
		SALMON, SNAKE RIVER SOCKEYE	ONCORHYNCHUS NERKA	IR,FF
YAKIMA	BIRDS	EAGLE, BALD	Haliaeetus leucocephalus	IR,FF
	MAMMALS	BEAR, GRIZZLY	Ursus arctos (=U.a. horribilis)	IR,FF

*Permit is being issued for these areas only: IR=Federal Indian Reservations, FF=Federal Facilities.

[FR Doc. 95–23257 Filed 9–28–95; 8:45 am]

BILLING CODE 4310–55–P

★ U.S. GOVERNMENT PRINTING OFFICE: 1995 – 401 - 862 / 40429

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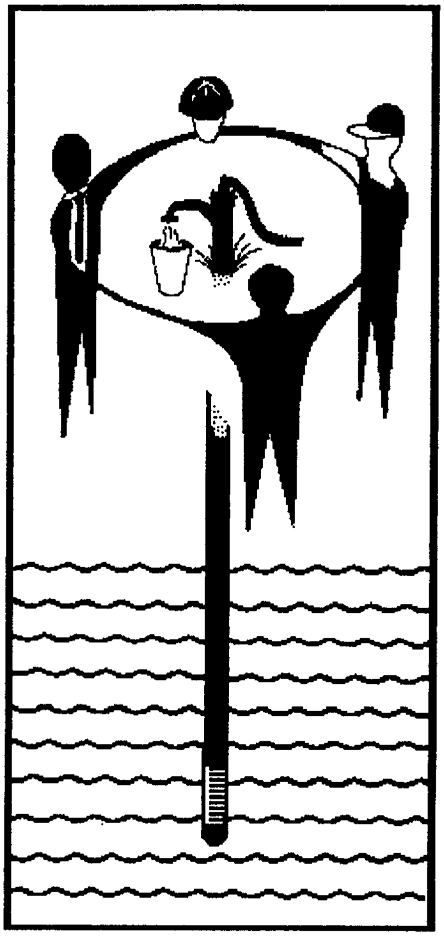

Oregon Wellhead Protection Program Guidance Manual

May 1996

(Second Printing: September)

Department of Environmental Quality
&
Oregon Health Division

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ACCESSIBILITY INFORMATION

R0016598

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"NOTICE"

This guidance applies to the voluntary development of wellhead protection plans in

Oregon. It is intended solely as guidance for local jurisdictions and state officials implementing and certifying individual wellhead protection plans. Compliance with or use of these guidelines does not waive requirements from any other rules or statutes in Oregon.

Provided resources are available, the Oregon Department of Environmental Quality and Oregon Health Division will update this Guidance Manual in approximately two years (or earlier if necessary). We are always open to suggestions for changes or improvements to the document. Feel free to contact us:

Regarding: Oregon's Wellhead Protection Program or this Guidance Manual

Sheree Stewart Oregon DEQ (503-229-5413)

Regarding: Delineation, New Wells

Dennis Nelson Oregon Health Division (503-731-4010)

Regarding: Contingency Plans

Kurt Putman Oregon Health Division (503-731-4010)

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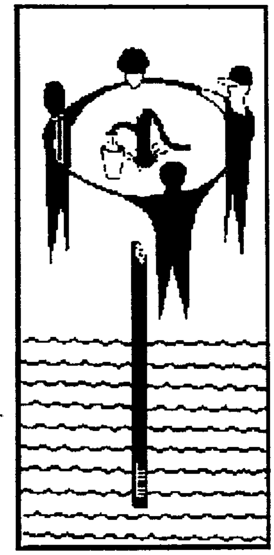

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Table 3-2: Potential Sources of Groundwater Contaminants (Return to: Chapter 3 - Step 1 ; Chapter 3 - Step 4) or Use Your Browser's Back Arrow to Return to Document

Source		Groundwater Contaminants[1,2,3]
Commercial/Industrial		
Automobile	Body Shops/Repair Shops	Waste oils; solvents; acids; paints; automotive wastes[4]; miscellaneous cutting oils.
	Car Washes	Soaps; detergents; waxes; miscellaneous chemicals; hydrocarbons.
	Gas Stations	Oils; solvents; miscellaneous wastes.
Boat Services/Repair/Refinishing		Diesel fuels; oil; septage from boat waste disposal area; wood preservative and treatment chemicals; paints; waxes; varnishes; automotive wastes[4].
Cement/Concrete Plants		Diesel fuels; solvents; oils; miscellaneous wastes.
Chemical/Petroleum Processing/Storage		Hazardous chemicals; solvents; hydrocarbons; heavy metals; asphalt.
Dry Cleaners		Solvents (perchloroethylene, petroleum solvents, Freon); spotting chemicals (trichloroethane, methylchloroform, ammonia, peroxides, hydrochloric acid, rust removers, amyl acetate).
Electrical/Electronic Manufacturing		Cyanides; metal sludges; caustic (chromic acid); solvents; oils; alkalis; acids; paints and paint sludges; calcium fluoride sludges; methylene chloride; perchloroethylene; trichloroethane; acetone; methanol; toluene; PCBs.
Fleet/Trucking/Bus Terminals		Waste oil; solvents; gasoline and diesel fuel from vehicles and storage tanks; fuel oil; other automotive wastes[4].
Food Processing		Nitrates; salts; phosphorus; miscellaneous food wastes; chlorine; ammonia; ethylene glycol.
Funeral Services/Graveyards		Formaldehyde; wetting agents; fumigants; solvents; leachate; lawn and garden maintenance chemicals[5].
Furniture Repair/Manufacturing		Paints; solvents; degreasing and solvent recovery sludges; lacquers; sealants.
Hardware/Lumber/Parts Stores		Hazardous chemical products in inventories; heating oil and fork lift fuel from storage tanks; wood-staining and treating products such as creosote; paints; thinners; lacquers; varnishes.
Home Manufacturing		Solvents; paints; glues and other adhesives; waste insulation; lacquers; tars; sealants; epoxy wastes; miscellaneous chemical wastes.
Junk/Scrap/Salvage Yards		Automotive wastes[4]; PCB contaminated wastes; any wastes from businesses[6] and households[7]; oils; lead.
Machine Shops		Solvents; metals; miscellaneous organics; sludges; oily metal shavings; lubricant and cutting oils; degreasers (tetrachloroethylene); metal marking fluids; mold-release agents.
Medical/Vet Offices		X-ray developers and fixers[8]; infectious wastes; radiological wastes; biological wastes; disinfectants; asbestos; beryllium; dental acids; miscellaneous chemicals.
Metal Plating/Finishing/Fabricating		Sodium and hydrogen cyanide; metallic salts; hydrochloric acid; sulfuric acid; chromic acid; boric acid; paint wastes; heavy metals; plating wastes; oils; solvents.
		Mine spills or tailings that often contain metals; acids; highly corrosive

Mines/Gravel Pits	mineralized waters; metal sulfides; metals; acids; minerals sulfides; other hazardous and nonhazardous chemicals[9].
Office Buildings/Complexes	Building wastes[6]; lawn and garden maintenance chemicals[5]; gasoline; motor oil.
Parking Lots/Malls (> 50 spaces) (H)	Hydrocarbons; heavy metals; building wastes[6].
Photo Processing/Printing	Biosludges; silver sludges; cyanides; miscellaneous sludges; solvents; inks; dyes; oils; photographic chemicals.
Plastics/Synthetics Producers	Solvents; oils; miscellaneous organic and inorganics (phenols, resins); paint wastes; cyanides; acids; alkalis; wastewater treatment sludges; cellulose esters; surfacant; glycols; phenols; formaldehyde; peroxides; etc.
Research Laboratories	X-ray developers and fixers[8]; infectious wastes; radiological wastes; biological wastes, disinfectants; asbestos; beryllium; solvents; infectious materials; drugs; disinfectants; (quaternary ammonia, hexachlorophene, peroxides, chlornexade, bleach); miscellaneous chemicals.
RV/Mini Storage	Automobile wastes[4]; gasoline and diesel fuel from vehicles and storage tanks
Wood Preserving/Treating	Wood preservatives: creosote, pentachlorophenol, arsenic; heavy metals.
Wood/Pulp/Paper Processing and Mills	Metals; acids; minerals; sulfides; other hazardous and nonhazardous chemicals[9]; organic sludges; sodium hydroxide; chlorine; hypochlorite; chlorine dioxide; hydrogen peroxide; treated wood residue (copper quinolate, mercury, sodium bazide); methanol; paint sludges; solvents; creosote; coating and gluing wastes.
Agricultural/Rural	
Auction Lots/Boarding Stables	Livestock sewage wastes; nitrates; phosphates; coliform and noncoliform bacteria; giardia, viruses; total dissolved solids.
Confined Animal Feeding Operations	Livestock sewage wastes; nitrates; phosphates; chloride; chemical sprays and dips for controlling insect, bacterial, viral and fungal pests on livestocks; coliform[10] and noncoliform bacteria; viruses; giardia; total dissolved solids.
Farm Machinery Repair	Automotive wastes[4]; welding wastes.
Crops - Irrigated and Nonirrigated	Pesticides[11]; fertilizers[12]; nitrates; phosphates; potassium (can be worsened by over-watering).
Lagoons/Liquid Wastes	Nitrates; Livestock sewage wastes; salts; pesticides[11]; fertilizers[17]; bacteria.
Pesticide/Fertilizer/Petroleum Storage & Transfer Areas	Pesticides[11]; fertilizers[12]; petroleum residues.
Rural Homesteads - Rural	Machine shops: Automotive wastes[4]; welding wastes; solvents; metals; subricants; sludges.
	Septic systems: Septage; coliform[10] and noncoliform bacteria; viruses; nitrates; heavy metals; synthetic detergents; cooking and motor oils; bleach; pesticides;[5,13] paints; paint thinner; photographic chemicals; swimming pool chemi-cals;[14] septic tank/cesspool cleaner chemicals;[15] elevated levels of chloride, sulfate, calcium, magnesium, potassium, and phosphate.
Residential/Municipal	

Airports (Maintenance/Fueling Areas)	Jet fuels; deicers; diesel fuel; chlorinated solvents; automotive wastes;[4] heating oil; building wastes[6].
Apartments and Condominiums	Swimming pool maintenance chemicals[14] ; pesticides for lawn and garden maintenance and cockroach, termite, ant, rodent, and other pest control[5,13], wastes from on-site sewage treatment plants; household hazardous wastes.
Camp Grounds/RV Parks	Septage; gasoline; diesel fuel from boats; pesticides for controlling mosquitoes, ants, ticks, gypsy moths, and other pests[11,13]; household hazardous wastes from recreational vehicles (RVs)[7].
Drinking Water Treatment Plants	Treatment chemicals; pesticides[11].
Fire Stations	General building wastes[6]; hydrocarbons from test burn areas.
Golf Courses	Fertilizers[12]; herbicides[11]; pesticides for controlling mosquitoes, ticks, ants, gypsy moths, and other pests[5].
Housing	Household hazardous wastes[7]: Household cleaners; oven cleaners; drain cleaners; toilet cleaners; disinfectants; metal polishes; jewelry cleaners; shoe polishes; synthetic detergents; bleach; laundry soil and stain removers; spot removers and dry cleaning fluid; solvents; lye or caustic soda; household pesticides;[13] photo chemical; paints; varnishes; stains; dyes; wood preservatives (creosote); paint and lacquer thinners; paint and varnish removers and deglossers; paint brush cleaners; floor and furniture strippers.
	Mechanical repair and other maintenance products: Automotive wastes;[4] waste oils; diesel fuel; kerosene; #2 heating oil; grease; degreasers for driveways and garages; metal degreasers; asphalt and roofing tar; tar removers; lubricants; rustproofers; car wash detergents; car waxes and polishes; rock salt; refrigerants.
	Lawn/garden care: Fertilizers;[11] herbicides and other pesticides used for lawn and garden maintenance[5] (can be worsened by over-watering).
	Swimming pools: Swimming pool maintenance chemicals[14].
	Urban runoff/storm water[3]: Gasoline; oil; other petroleum products; microbiological contaminants.
Landfills/Dumps	Leachate; organic and inorganic chemical contaminants; waste from households[7] and businesses[6]; nitrates; oils; metals; solvents; sludge.
Motor Pools	Automotive wastes[4]: solvents; waste oils; hydrocarbons from storage tanks.
Parks	Fertilizers[12]; herbicides[5]; insecticides[11,13].
Railroad Yards/Maintenance/Fueling Areas	Diesel fuel; herbicides for rights-of-way[11]; creosote from preserving wood ties; solvents; paints; waste oils.
Schools	Machinery/vehicle serving wastes; gasoline and heating oil from storage tanks; general building wastes[6]; pesticides[11,13].
Septic Systems	Septage; coliform[10] and noncoliform bacteria; viruses; nitrates; heavy metals; synthetic detergents; cooking and motor oils; bleach; pesticides[5,13]; paints; paint thinner; photographic chemicals; swimming pool chemicals[14]; septic tank/cesspool cleaner chemicals[15]; elevated levels of chloride, sulfate, calcium, magnesium, potassium, and phosphate; other household hazardous wastes[7].
	PCBs from transformers and capacitors; oils; solvents; sludges; acid

Utility Stations/Maintenance Areas	solution; metal plating solutions (chromium, nickel, cadmium); herbicides from utility rights-of-way.
Waste Transfer/Recycling Stations	Residential and commercial solid waste residues.
Wastewater	Municipal wastewater; sludge[16]; treatment chemicals[17]; nitrates; heavy metals; coliform[10] and noncoliform bacteria; nonhazardous wastes[16].
Miscellaneous	
Above Ground Storage Tanks	Heating oil; diesel fuel; gasoline; other chemicals.
Construction/Demolition Areas (Plumbing, Heating, and Air Conditioning, Painting, Paper Hanging, Decorating, Drywall and Plastering, Acoustical Insulation, Carpentry, Flooring, Roofing, and Sheet Metal etc.)	Solvents; asbestos; paints; glues and other adhesives; waste insulation; lacquers; tars; sealants; epoxy waste; miscellaneous chemical wastes; explosives.
Historic Gas Stations	Diesel fuel; gasoline; kerosene.
Historic Waste Dumps/Landfills	Leachate; organic and inorganic chemicals; waste from households[7]; and businesses[6]; nitrates; oils; heavy metals; solvents.
Injection Wells/Drywells/Sumps	Storm water runoff[3]; spilled liquids; used oils; antifreeze; gasoline; solvents; other petroleum products; pesticides[11]; and a wide variety of other substances.
Managed Forests	Pesticides; fertilizers; total suspended solids.
Military Installations	Wide variety of hazardous and nonhazardous wastes depending on the nature of the facility and operation[3,9]; diesel fuels; jet fuels; solvents; paints; waste oils; heavy metals; radioactive wastes; explosives.
Surface Water - Stream/Lakes/Rivers	Directly related to surface water quality in the stream, lake, or river which is recharging groundwater.
Transportation Corridors	Herbicides in highway right-of-way[11,5]; road salt (sodium and calcium chloride); road salt, anticaking additives (ferric ferrocyanide, sodium ferrocyanide); road salt anticorrosives (phosphate and chromate); automotive wastes[4]; fertilizers.
Underground Storage Tanks	Diesel fuel; gasoline; heating oil; other chemical and petroleum products.
Wells - Such as Water Supply Wells, Monitoring Wells, Unsealed or Abandoned Wells, and Test Holes	Storm water runoff[3]; solvents; nitrates; septic tanks; hydrocarbons; and a wide variety of other substances.

[1] In general, groundwater contamination stems from the misuse and improper disposal of liquid and solid wastes; the illegal dumping or abandonment of household, commercial, or industrial chemicals; the accidental spilling of chemicals from trucks, railways, aircraft, handling facilities, and storage tanks; or the improper siting, design, construction, operation, or maintenance of agricultural, residential, municipal, commercial, and industrial drinking water wells and liquid and solid waste disposal facilities. Contaminants also can stem from atmospheric pollutants, such as airborne sulfur and nitrogen compounds, which are created by smoke, flue dust, aerosols, and automobile emissions, fall as acid rain, and percolate through the soil. When the sources list in this table are used and managed properly, groundwater contamination is not likely to occur.

[2] Contaminants can reach groundwater from activities occurring on the land surface, such as industrial waste storage; from sources below the land surface but above the water table, such as septic systems; from structures beneath the water table, such as wells; or from contaminated recharge water.

[3] This table lists the most common wastes, but not all potential wastes. For example, it is not possible to list all potential contaminants contained in storm water runoff or from military installations.

[4] Automobile wastes can include gasoline; antifreeze; automatic transmission fluid; battery acid; engine and radiator flushes; engine and metal degreasers; hydraulic (brake) fluid; and motor oils.

[5] Common pesticides used for lawn and garden maintenance (i.e., weed killers, and mite, grub, and aphid controls) include such chemicals as 2,4-D; chlorpyrifos; diazinon; benomyl; captan; dicofol; and methoxychlor.

[6] Common wastes from public and commercial buildings include automotive wastes; and residues from cleaning products that may contain chemicals such a xylenols, glycol esters, isopropanol, 1,1,1,-trichloroethane, sulfonates, chlorinated phenols, and cresols.

[7] Household hazardous wastes are common household products which contain a wide variety of toxic or hazardous components (see also **Appendix F**: Household Waste Fact Sheet).

[8] X-ray developers and fixers may contain reclaimable silver, glutaldehyde, hydroquinone, potassium bromide, sodium sulfite, sodium carbonate, thiosulfates, and potassium alum.

[9] The *Resource Conservation and Recovery Act* (RCRA) defines a hazardous waste as a solid waste that may cause an increase in mortality or serious illness or pose a substantial threat to human health and the environment when improperly treated, stored, transported, disposed of, or otherwise managed. A waste is hazardous if it exhibits characteristics of ignitability, corrosivity, reactivity, and/or toxicity. Not covered by RCRA regulations are domestic sewage; irrigation waters or industrial discharges allowed by the *Clean Water Act*; certain nuclear and mining wastes; household wastes; agricultural wastes (excluding some pesticides); and small quantity hazardous wastes (i.e., less than 220 pounds per month) generated by businesses.

[10] Coliform bacteria can indicate the presence of pathogenic (disease-causing) microorganisms that may be transmitted in human feces. Diseases such as typhoid fever, hepatitis, diarrhea, and dysentery can result from sewage contamination of water supplies.

[11] Pesticides include herbicides, insecticides, rodenticides, fungicides and avicides. EPA has registered approximately 50,000 different pesticide products for use in the United States. Many are highly toxic and quite mobile in the subsurface. An EPA survey found that the most common pesticides found in drinking water wells were DCPA (dacthal) and atrazine, which EPA classifies as moderately toxic (class 3) and slightly toxic (class 4) materials, respectively.

[12] The EPA National Pesticides Survey found that the use of fertilizers correlates to nitrate contamination of groundwater supplies.

[13] Common household pesticides for controlling pests such as ants, termites, bees, wasps, flies, cockroaches, silverfish, mites, ticks, fleas, worms, rates, and mice can contain active ingredients include naphthalene, phosphorus, xylene, chloroform, heavy metals, chlorinated hydrocarbons, arsenic, strychnine, kerosene, nitrosamines, and dioxin.

[14] Swimming pool chemicals can contain free and combined chlorine; bromine; iodine; mercury-based, copper-based, and quaternary algaecides; cyanuric acid; calcium or sodium hypochlorite; muriatic acid; sodium carbonate.

[15] Septic tank/cesspool cleaners include synthetic organic chemicals such as 1,1,1,-trichloroethane, tetrachloroethylene, carbon tetrachlorine, and methylene chloride.

[16] Muncipal wastewater treatment sludge can contain organic matter, nitrates; inorganic salts, heavy metals; coliform and noncoliform bacteria; and viruses.

[17] Municipal wastewater treatment chemicals include calcium oxide; alum; activated alum, cabon, and silics; polymers; ion exhcange resins; sodium hydroxide; chlorine; ozone; and corrosion inhibitors.

Source:

Adapted from EPA (1993); Supplemented with Oregon DEQ database information.

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R0016611

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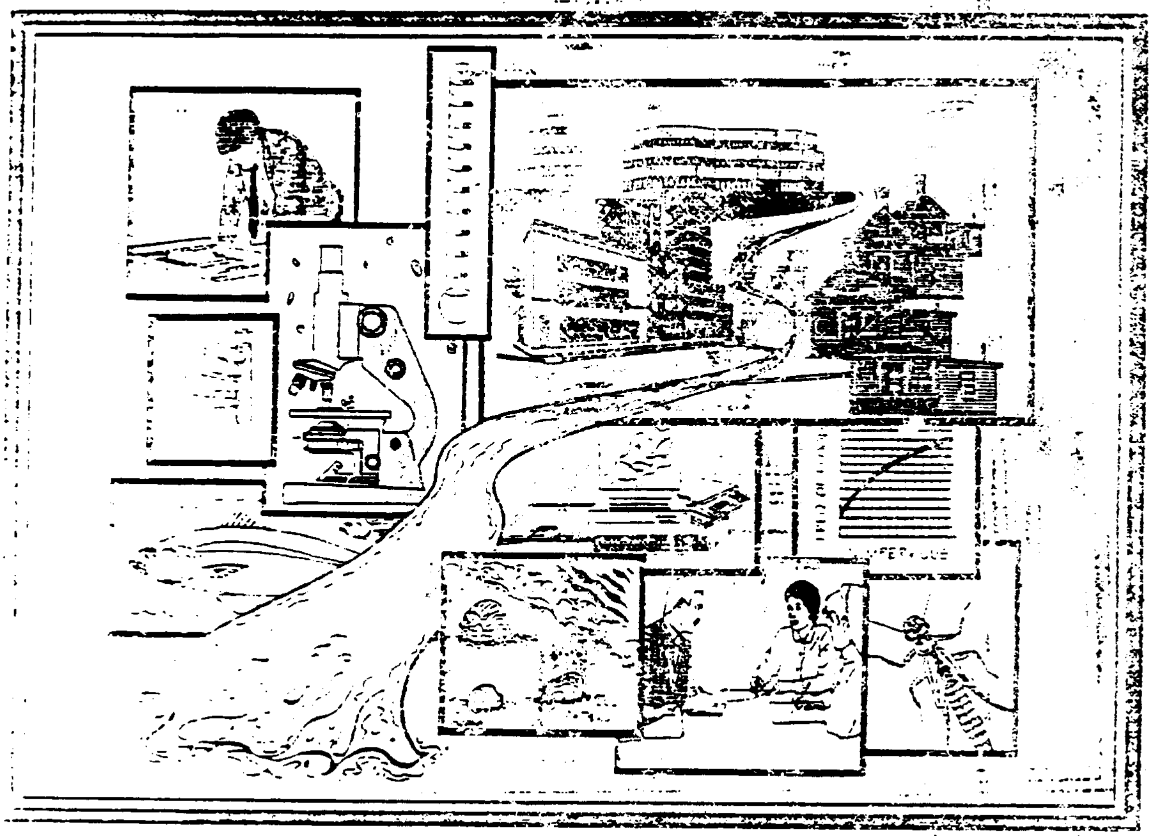

Center for Watershed Protection
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July 1996

CENTER FOR WATERSHED PROTECTION

R0016612

Abstract

Title: Environmental Indicators to Assess Stormwater Control Programs and Practices

Date: July, 1996

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Center for Watershed Protection

Publisher: Published under a cooperative agreement with the U. S. Environmental Protection Agency and the Center for Watershed Protection. The Center for Watershed Protection is a non-profit organization dedicated to the protection, restoration, and stewardship our nations water resources and watersheds through a watershed approach. The Center promotes the advancement of innovative and effective land and water management techniques, and serves as a forum for planners, engineers, landscape architects and municipal officials engaged in watershed protection.

Abstract: The document presents a series of alternate stormwater monitoring techniques which rely on indicators, or surrogates of chemical, biological, physical, social, and programmatic conditions to assess stormwater program and practice success. Twenty-six "environmental indicator" profile, or fact sheets are presented which describe the indicator, explain advantages and disadvantages for use, review indicator utility, present a case example, and cite references for further investigation. A framework for using indicators is presented, along with a potential methodology for crafting an indicator based monitoring program for municipal and industrial site managers. Three theoretical case examples are presented applying the principles of environmental indicator based stormwater monitoring programs.

Cover art by Donna deMars

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IN COOPERATION WITH
THE U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Wastewater Management
under assistance I.D. No.
C X 823668-01-0

R0016614

ACKNOWLEDGMENTS

The preparation of this document was made possible through a Cooperative Agreement with the U.S. Environmental Protection Agency (Assistance ID No. C X 823668-01-0).

We would like to thank a number of individuals whose support and participation were key to the completion of this final environmental indicator document. In particular, we would like to extend our appreciation to Ms. Kimberly Ogden Hankins and Mr. William Swietlik of U.S. EPA for their direction and guidance through the preparation of this document. We would like to thank the numerous people who took time out of their busy schedule to respond to our telephone and mail requests, with specific appreciation to Mr. Roger Bannerman, Mr. Derek Booth, Mr. Gail Boyd, Mr. Charlie Gougeon, Ms. Marcia Guzetta, Dr. Melinda Lalor, Mr. Peter Mangarella, Mr. Keith Van Ness, Mr. Cameron Wiegand, Ms. Kia Whittlesey, and Mr. Chris Yoder.

In addition, we would like to extend our appreciation to Ms. Mary Marsters and Mr. John LaRocca of the Rensselaerville Institute for their facilitation of the stakeholder meetings. Their compilation of comments and remarks from the participants was invaluable in the preparation of this document. Furthermore, we would like to thank Mr. Chuck Noss and Ms. Raye Grant of the Water Environment Research Foundation for their participation and helpful suggestions during the preparation of this document.

Finally, we would like to extend our greatest appreciation to the following list of stormwater management experts who attended and participated in the several stakeholder meetings, held in four cities, and who provided invaluable input on the preparation of this document.

DENVER, CO
Mick Baldys
Vern Berry
Sam Brush
Edwin Herricks
Sarah Johnson
Jonathan Jones
Rick Moser
Jon Sorenson
Scott Tucker
Ben Urbonas

SACRAMENTO, CA
Jackie Bogard
Richard Boon
Gail Boyd
Eugene Bromley
Geoff Brosseau
Bob Fuerstenberg
Nancy Gardiner
Jim Harrington
Doug Harrison
Tom Mumley
Sydney Munger
Jim White
Robert Wilson

PHILADELPHIA, PA
Libby Blank
Jay Brolin
Barry Chalofski
Leo Essenthier
Ed Frankel
Derek Guthrie
Eric Livingston
John Maxted
Drew Mihocko
Jan Oliver
Earl Shaver
Marilyn Shup
Jim Smullen
Cuong Vu

WASHINGTON, DC
Christine Andersen
Roger Bannerman
Laureen Boles
Gail Boyd
Erich Brandstetter
Allen Burton
Brian Clevenger
Wayne Davis
Dennis Dreher
David French
Tom Grizzard
Roger James
William James
Norm LeBlanc
Robert McCleary
Robert Pitt
Channy Soeur
Keith Van Ness
Paul Wotzka
Chris Yoder

EXECUTIVE SUMMARY

In response to National Pollutant Discharge Elimination System (NPDES) stormwater regulations, many municipalities and industrial facilities have invested significant time, money, and manpower towards stormwater monitoring. Traditionally, the focus of these efforts have been end-of-pipe conditions and chemical and physical water quality criteria. However, many stormwater management professionals have begun to question the ability of traditional monitoring to accurately describe existing conditions in receiving waters, evaluate the overall integrity of aquatic communities, and assess the degree of improvement in stream systems. Environmental indicators have become popular as regulators, resource protection managers, and others look to alternative techniques to assess stormwater management efforts and environmental health.

Environmental indicators are select parameters and indices which can be used to characterize overall conditions in the receiving water and provide benchmarks for assessing the success of stormwater management efforts.

This report represents a component of a larger project call the Environmental Indicators/Measures of Success Project, funded by the U.S. Environmental Protection Agency (EPA) under the Clean Water Act, Section 104(B)(3). The first phase of this project, conducted by The Center for Watershed Protection, consisted of a review of approximately 500 research papers and studies. The results of the review were summarized in an annotated bibliography of environmental indicator resources. The second phase, performed by The Rensselaerville Institute, involved soliciting stakeholder input on the selection of appropriate indicators and on development of a flexible methodology for using indicators. The final phase of the project will focus on local and/or state demonstration projects testing the use of indicators. This effort will be performed by the Water Environment Research Federation. Case studies will be prepared on the outcome of the demonstration projects.

This report is intended for municipal stormwater managers, regulatory agencies, and industrial site managers. A framework for identifying appropriate indicators based on reference and baseline conditions, regional considerations, and available resources is provided (Chapter II). The applicability and usefulness of twenty-six environmental indicators for stormwater monitoring are summarized in a series of Profile Sheets (Chapter III). A suggested methodology for development of a comprehensive stormwater monitoring program, based on environmental indicators, is provided (Chapter IV). Lastly, three theoretical scenarios are presented to illustrate the potential application of stormwater indicators in real world situations (Chapter 5). A summary of the key findings in this report is presented below.

STORMWATER ENVIRONMENTAL INDICATORS

Environmental indicators are measurements of environmental conditions or trends in environmental quality which can be used by managers to evaluate resource protection programs and assess the general state of the environment. Environmental indicators can be viewed as analogous to economic indicators such as housing starts, new construction gains, and the Dow Jones index which, although based on diverse measurements, when examined in combination, give a general indication of improvements or downturns in the economy and the success of various economic strategies. Similarly, environmental indicators provide a general assessment of improvements (or downturns) in the environment and of the effectiveness (or success) of resource management strategies.

Environmental indicators are comprehensive and include a vast array of monitoring parameters applicable to a variety of management goals (i.e., water supply, point source) and environmental resources (i.e., forests, wetlands, groundwater). The term "stormwater indicator" applies to the select few environmental indicators which specifically focus on urban stormwater runoff impacts and can be evaluated to assess the success (or failure) of stormwater management efforts. These indicators are designed to be used by municipal stormwater managers, regulatory agencies, or industrial site managers to track general improvements or downturns in overall aquatic health due to implementation of various stormwater management practices and programs.

Twenty-six stormwater indicator categories were compiled through joint work sessions with EPA and Center for Watershed Protection staff and review of comments received from the stakeholders group (Table E.1). The indicators, organized into six categories, represent both traditional and less frequently used assessment methods. The stormwater indicators are described in indicator profile sheets which include descriptions of indicator applications, advantages and disadvantages, brief case studies and method references (Chapter III).

TABLE E.1

STORMWATER INDICATOR PROFILE CATEGORIES

	INDICATOR NAME	PROFILE NO.
Water Quality Indicators	Water quality pollutant constituent monitoring	1
	Toxicity testing	2
	Non-point source loadings	3
	Exceedance frequencies of water quality standards	4
	Sediment contamination	5
	Human health criteria	6
Physical and Hydrological Indicators	Stream widening/downcutting	7
	Physical habitat monitoring	8
	Impacted dry weather flows	9
	Increased flooding frequency	10
	Stream temperature monitoring	11
Biological Indicators	Fish assemblage	12
	Macro-invertebrate assemblage	13
	Single species indicator	14
	Composite indicators	15
	Other biological indicators	16
Social Indicators	Public attitude surveys	17
	Industrial/commercial pollution prevention	18
	Public involvement and monitoring	19
	User perception	20
Programmatic Indicators	No. of illicit connections identified/corrected	21
	No. of BMPs installed, inspected, and maintained	22
	Permitting and compliance	23
	Growth and development	24
Site Indicators	BMP performance monitoring	25
	Industrial site compliance monitoring	26

INDICATOR USEFULNESS AND ADVANTAGES

Potential indicator usefulness and advantages were qualitatively analyzed (Chapter III). To complete this analysis, two lists of questions were developed which provide some insight on the types of questions which should be considered when developing a successful stormwater management program.

The usefulness analysis focused on the ability of each indicator to adequately document stormwater impacts and/or the efficacy of management efforts in the following six areas:

- aquatic integrity of lakes, streams and estuaries;
- land use impacts;
- stormwater management programs;
- whole watershed quality;
- industrial sites; and
- municipal programs.

The analysis of indicator advantages concentrated on the applicability of the indicators with respect to the following nine areas:

- multiple geographic regions;
- establishment of baseline conditions;
- wide range of stormwater applications;
- identification of the health or quality of an aquatic system;
- cost effectiveness;
- varying environmental and geographical conditions over a long time period;
- site, subwatershed, watershed and river basin scales;
- acceptance and familiarity to professionals involved in urban runoff management; and
- inexpensive, rapid and relative easy personnel training.

Comparisons of the overall usefulness of each indicator category and of indicator advantages is presented in Tables E.2 and E.3. An overall effectiveness category is included in both tables. An indicator which receives the highest ranking for overall effectiveness in both the Usefulness and Advantages Matrices, is likely to be a very useful tool for stormwater program managers.

COST ANALYSIS

Cost estimates were developed for each indicator based on data collected through a telephone survey of stormwater practitioners, a literature review, the authors' experience, and general industry information (Chapter III). The cost basis for each indicator is identified in a concise format in a series of tables in Chapter III. Whenever possible, the cost data represents a unit basis of cost per station, per sample.

TABLE E.2
USEFULNESS QUICK REFERENCE GUIDE
OVERALL INDICATOR SUMMARY

Indicators	Lakes	Streams	Estuaries	Land Use Impacts	Stormwater Management Programs	Whole Watershed Quality	Industrial Sites	Municipal Programs	Overall Effectiveness
Water Quality Indicators	●	◖	●	◖	◖	○	●	◖	◖
Physical and Hydrological Indicators	○	●	○	●	●	◖	○	●	◖
Biological Indicators	●	●	◖	●	●	◖	◖	●	●
Social Indicators	○	○	○	○	●	◖	○	◖	○
Programmatic Indicators	◖	◖	◖	◖	◖	◖	◖	●	◖
Site Indicators	◖	◖	○	◖	●	○	●	◖	◖

Key
Yes (Very Useful) ● *Partially (Moderately Useful)* ◖ *No (Not Useful)* ○

TABLE E.2
ADVANTAGES QUICK REFERENCE GUIDE
WATER QUALITY INDICATORS

Indicators	Geographic Range	Baseline Control	Reliable	Accuracy	Low Cost	Repeatable	All Watershed Scale	Familiar to Practitioners	Easy to Use & Low Training	Overall Effectiveness
(1) Water Quality Monitoring	●	◖	○	◖	○	◖	●	◖	○	◖
(2) Toxicity Testing	●	○	◖	◖	○	◖	◖	◖	○	○
(3) Nonpoint Source Loading	●	○	◖	◖	○	●	◖	◖	○	◖
(4) Exceedance Frequencies	●	●	◖	◖	○	●	◖	●	●	●
(5) Sediment Contamination	◖	◖	◖	◖	○	◖	○	●	◖	◖
(6) Human Health Criteria	○	◖	◖	◖	◖	●	○	●	◖	◖

Key
Yes (Very Advantageous) ● *Partially (Moderately Advantageous)* ◖ *No (Not Advantageous)* ○

The indicator costs are planning level estimates and are not all-encompassing. There are many different methodologies that can be used to perform indicator monitoring, and implementation costs can vary significantly in different regions of the country. Program managers should use these estimate for comparison purposes only and verify all costs with other sources, before implementing program monitoring strategies.

FRAMEWORK FOR USING INDICATORS

Identification of appropriate stormwater indicators for monitoring programs should be conducted within a framework based upon regional and site-specific considerations. This framework, which acknowledges the impacts of urbanization on water resources, represents reference and baseline conditions, regional considerations, and available resources.

Reference conditions are used to establish a benchmark for assessing existing conditions or to measure trends in conditions. A reference site should be selected to represent a least or minimally impacted condition. Ecoregions, representing regions of homogeneity in land surface, form, soils, natural vegetation, and general land use, should be utilized in the establishment of reference sites. A variety of reference sites can be established in each ecoregion to represent a variety of gradients, substrates, and water body types.

Regional considerations provide a framework for the selection of appropriate indicators based on specific land use, climate and local geology and geography. Stormwater indicators require regional adaptation to be utilized in different regions of the country.

TOOLS FOR INDICATOR USE

Several "tools" can be used over a broad range of physical, chemical, and biological conditions to measure environmental indicators including:

- Watershed Simulation Modeling
- Geographic Information Systems (GIS)
- Paired Subwatershed Monitoring
- Comparison to Reference Conditions
- Photographic Records

Watershed simulation modeling has been used to assess various land uses and development scenarios to calculate pollutant load wash off Watershed simulation modeling can also be applied to predict changes in stormwater runoff quantity and stream dry weather flow impacts caused by changes in watershed imperviousness. Changes in peak stormwater flows can be related to the potential for stream channel erosion, channel widening and downcutting and related habitat damage.

Geographic Information Systems are used to assemble and compile watershed characteristics and other information into a graphical and/or tabular format for assessment of various conditions. GIS and watershed simulation modeling can be used in combination to calculate various land use/BMP combinations and their impacts on downstream water quality.

Paired subwatershed studies involve comparing the response of two physiographically similar watersheds when subjected to different management practices. A control watershed is established to account for climatic, seasonal, and other natural variations, while a treatment watershed measures the affects of implementation of management practices.

Photographic and video records can be used to document many different indicators, but are perhaps most suited to assessing changes in physical conditions. The use of digital cameras to document conditions can be integrated with GIS watershed mapping to convey this information to a wide range of potential viewers.

Crafting an Indicator Monitoring Program - A Methodology

Stormwater indicator monitoring programs can be tailored to address the specific information needs of individual municipalities and industrial sites. When selected correctly, stormwater indicators can assess the long-term effectiveness of stormwater management programs as well as provide required baseline data. A two-level methodology for development of stormwater monitoring programs was developed based on general considerations common to all monitoring efforts (Chapter IV). This methodology is presented as a flexible tool which can be adapted to a particular jurisdiction's or industrial site situation. The Level I methodology targets assessment of baseline conditions; the Level II methodology is for assessing program management efforts. The two-level methodology for crafting a stormwater indicator monitoring program is outlined in Figures E.1 and E.2.

FIGURE E.1
STORMWATER INDICATOR METHODOLOGY
LEVEL I, PROBLEM IDENTIFICATION

① ESTABLISH MANAGEMENT SPHERE

Who will be responsible for implementation? A government agency (municipality, county, or state) or a site-specific industry? What other programs are being implemented within the watershed? Can this program be developed and implemented on a watershed-wide or basin basis?

⇓

② GATHER/REVIEW HISTORICAL DATA

Identify what programs and studies have already been implemented in the watershed.
Determine what problems associated with stormwater have already been identified.
Assess the effectiveness of earlier efforts and programs.

⇓

③ IDENTIFY POTENTIAL RECEIVING WATER IMPACTS

Identify uses and characteristics which may be impacted by stormwater runoff.
Hydrology and Hydrodynamics (Flooding, Drainage)
Biological Integrity (Fish Diversity, Macro. Community)
Non-contact Recreation (Sports Fishing)
Supply (Potable Water)
Contact Recreation (Swimming)
Aqua-culture (Shellfish Harvesting, Food Fishing)

⇓

④ INVENTORY RESOURCES AND IDENTIFY CONSTRAINTS

Determine manpower and funding limitations.
Identify regulatory-mandated deadlines and programs.

Staffing
Scheduling Constraints
Funding
Regulatory Compliance

⇓

⑤ ASSESS BASELINE CONDITIONS

Use rapid (qualitative) assessment methods versus detailed quantitative techniques to assess baseline conditions.

Indicator Options by Receiving Water Use

Concern:	Hydrology & Hydrodynamics	Biological Integrity	Non-contact Recreation	Water Supply	Contact Recreation	Aqua-culture
Type of Indicator to be Considered:	*Physical* *Social* *Programmatic* *Site*	*Biological* *Water Quality* *Social* *Programmatic* *Site*	*Water Quality* *Physical* *Biological* *Social* *Programmatic* *Site*	*Water Quality* *Biological* *Social* *Programmatic* *Site*	*Biological* *Water Quality* *Physical* *Social* *Programmatic* *Site*	*Biological* *Water Quality* *Physical* *Social* *Programmatic* *Site*

FIGURE E.2
STORMWATER INDICATOR METHODOLOGY
LEVEL II. ASSESSMENT OF MANAGEMENT PROGRAM

① STATE GOALS FOR PROGRAM

Based on baseline conditions, resources, and constraints, articulate goals for stormwater management program in terms of measurable achievements.

Example: We want to increase the level and diversity of the fish population in the next 5 years.

To accomplish this, we must improve biological integrity, water quality, and physical conditions.

② INVENTORY PRIOR AND ONGOING EFFORTS

Identify prior stormwater management efforts and assess success of prior efforts.
Identify current stormwater management efforts both within the municipal boundaries and the larger watershed.
Assess success of ongoing efforts.
Incorporate complementary programs and goals.
Identify potential conflicts.

③ DEVELOP AND IMPLEMENT MANAGEMENT PROGRAM

Identify and implement specific program facets in order to achieve goal.

Example: In order to increase the fish population, we will retrofit BMPs, require stormwater BMPs all new development, remove fish barriers, and re-introduce some aquatic species.

④ DEVELOP AND IMPLEMENT MONITORING PROGRAM

Based on goals, program structure, resources and constraints, select indicators to be used to assess success of stormwater management program. Level II indicators will likely be more quantitative in comparison to Level I techniques. Quantitative analysis is required to identify pollutant sources and assess success of program.

Example: macro-invertebrate assemblage, fish assemblage, public opinion surveys, toxicity testing.

⑤ ASSESS INDICATOR RESULTS

Analyze indicator monitoring results.

What do the monitoring results indicate about the success of the stormwater management program?
Have the indicators accurately reflected the effectiveness of the management program?
What do the indicators suggest about the ability of the stormwater indicator monitoring program to measure of overall watershed health?

⑥ RE-EVALUATE MANAGEMENT PROGRAM

Re-evaluate resources and constraints.
Update (if necessary) assessment of baseline conditions.
Review and revise program goals.
Review and revise indicator monitoring program.
Implement revised management program.

SCENARIOS FOR INDICATOR USE

The potential application of stormwater indicators in real world situations is illustrated in three theoretical scenarios (Chapter V). The scenarios represent different regions of the country, while facing different resource management challenges. Scenario 1 focuses on a moderately sized, rapidly growing suburban municipality in the Southeast United States. The theoretical situation involves development of a watershed management program targeting non-point source control as well as water supply protection. Level I methodology (resource problem identification) and Level II methodology (management efforts assessment) is used to develop the comprehensive monitoring program. The scenario also demonstrates how costs associated with preparation and implementation of the watershed management plan and monitoring program must be weighed against available resources.

Scenario 2 illustrates efforts required to implement a resource restoration and protection management strategy for an older industrial municipality in the Great Lakes region of the county. This theoretical example identifies a five task management strategy, including: industrial runoff controls, residential runoff controls, combined sewer overflow (CSO) reductions, habitat and water quality assessments and public involvement initiatives. A monitoring program is identified and program costs are specified.

Scenario 3 illustrates management strategies for a smaller industrial park located on the Southwest United States. The theoretical situation involves an industrial park which has been identified as a significant source of non-point source pollutants being exported to a tidal estuary. Storm monitoring and toxicity testing have shown that dissolved metals are the principal pollutants leaving the site. A management strategy employing construction of structural BMPs and pollution prevention efforts is proposed. The costs of constructing the BMPs, implementing the pollution prevention efforts, and post-implementation monitoring are compared to the available budget.

All three scenarios demonstrate the impact of urbanization on aquatic quality and the necessity to utilize stormwater indicators within a watershed-wide context. Recent studies throughout North America and elsewhere have shown a consistent relationship between the impacts of urbanization and degraded water resource quality, even with the widespread use of BMPs. The increased frequency and magnitude of runoff and the increased pollutant load associated with urban stormwater, can dramatically degrade critical stream systems by destroying habitat, eroding channel bottoms and banks, and by producing an influx of toxic runoff and sediments. Stormwater managers must recognize this when using stormwater indicators to evaluate how effectively these mitigation measures are working.

It is also important to implement stormwater indicator monitoring strategies on a watershed-wide basis. At this scale, managers will be able to better differentiate between water resource impacts associated with land use changes, as opposed to poor performance of BMPs or poor stormwater management program implementation.

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CHAPTER I INTRODUCTION

OVERVIEW

Stormwater runoff management has traditionally focused on end-of-pipe controls and compliance with chemical and physical criteria, usually set by Environmental Protection Agency (EPA) or state environmental protection agencies. In part, due to EPA stormwater permit requirements, many municipalities and industries have invested significant time, money, and manpower towards characterization of stormwater runoff and collection of chemical and physical data for receiving streams (or water bodies). Recently, however, many stormwater management professionals have questioned the applicability and usefulness of these data to accurately describe existing conditions in the receiving water, evaluate the overall integrity of the aquatic community, and assess the degree of improvement in the stream system (Swietlik et al 1994). EPA is now re-assessing stormwater monitoring parameters and goals with an eye towards development of comprehensive monitoring programs which characterize overall conditions in the receiving water and provide benchmarks for assessing the success of stormwater management efforts.

Many municipalities and industries are required to implement monitoring and management programs in compliance with National Pollutant Discharge Elimination System (NPDES) stormwater regulations. Stormwater indicators can be used by the municipalities and industries as alternatives to traditional end-of-pipe monitoring, to assess the effectiveness of their stormwater management programs and to focus these programs so that generally limited resources are used effectively.

BACKGROUND

EPA identified national environmental goals in the draft report "Proposed Environmental Goals for America with Benchmarks for the Year 2005: Summary (EPA 1995). These goals outline a commitment to continued restoration of the environment (including land, air, and water resources), enhancement of environmental resources, and full usage of the environment in ways that ensure sustainable development.

Following the overall agency lead, the EPA Office of Water (EPA/OW) outlined its commitment to protection and maintenance of healthy and clean waters and designated water uses. In order to measure their success in attainment of this goal, EPA/OW, in conjunction with other EPA, Federal, State, and tribal agencies, developed a list of environmental indicators. Environmental indicators are measurements and indices which can be used to assess existing environmental conditions, provide insight into general environmental trends over time, and measure the effectiveness of existing environmental monitoring and management programs. Environmental indicators are analogous to economic indicators such as housing starts, new construction gains, and the Dow Jones index which, although based on diverse measurements, when examined in combination, give a general indication of improvements or downturns in the economy and the success of various economic strategies. The environmental indicators will provide water resource managers with insight into the state of their aquatic environment and the effectiveness of current resource management strategies.

STORMWATER INDICATORS

The overall thrust of the EPA/OW effort is reduction or prevention of pollutant loadings and other stressors. One of the most significant sources of pollutant loads to receiving waters in this country is stormwater runoff. The significance of stormwater pollutants, especially from urban areas, was examined in the early 1980's as part of the National Urban Runoff Program (NURP). In recognition of the impacts associated with stormwater runoff, Congress required, in the 1987 amendments to the Clean Water Act, that EPA expand the NPDES program to include a stormwater component.

NPDES stormwater regulations focus on reduction of pollutants from large and medium-sized municipalities, as well as select industries. During Phase I of the NPDES stormwater program, participating municipalities and industries conducted "characterization" monitoring of stormwater runoff. The purpose of this monitoring was to characterize the stormwater runoff from separate land uses (industrial, commercial and residential), identify significant pollutant sources (i.e., illicit connections, outside material storage, etc.), and provide a basis for development of future monitoring and stormwater management programs as outlined in permit requirements.

A next step in assessing the effects of urban stormwater runoff on the environment is through the use of comprehensive monitoring practices. The comprehensive approach provides information on the health of receiving waters (as opposed to an end-of-pipe focus) and tracks improvements in overall aquatic integrity as various management programs are implemented. Comprehensive monitoring of all environmental parameters would be required to assess the total aquatic health of a particular waterway, given the vast array of environmental conditions and management practices. Since it is not practical nor cost effective to evaluate all biological, chemical, and physical parameters, a few select environmental indicators, focusing specifically on urban stormwater runoff impacts, can be evaluated to tell the story of the whole system.

"Stormwater indicators" will be used to track general improvements or downturns in the overall aquatic health of the receiving water and to assess the effectiveness of various management practices and programs. These indicators are designed to be used by municipal stormwater managers, regulatory agencies, or industrial site managers. EPA/OW has undertaken an effort to develop a list of stormwater indicators and to assess the usefulness of these indicators as predictors of effective stormwater management practices and programs.

Twenty-six stormwater indicator categories were compiled through joint work sessions with EPA and Center for Watershed Protection staff and review of comments received from the stakeholders group. (The stakeholders represent a cross-section of stormwater management professionals including administrators, scientists, and engineers.) The list of 26 indicator categories has been reduced from an original list of 33. These indicators have been evaluated with respect to the following considerations:

- Do the indicators provide an accurate representation of environmental conditions?
- Are they relatively easy to use and inexpensive?
- Do the indicators work (in a scientific sense) and how?
- What indicator or combination of indicators can be used to evaluate a stormwater management program?
- What aquatic uses do the indicators assess?

- How comparable are the indicators in different geographic locations (are they equally effective throughout the country and equally effective in different water bodies; i.e., lakes, streams, rivers, estuaries)?
- At what watershed scale are the indicators most effective (over the whole watershed, only in headwater streams, or only within the ultimate receiving water)?

Although the indicators are designed to focus on the success (or failure) of individual municipal, jurisdictional, or industrial site efforts, comprehensive monitoring results must also be examined in a watershed-wide context. Urban stormwater runoff represents only one potential impact to water systems. Other potential non-point source impacts include agricultural runoff and atmospheric deposition. Point sources are also of concern. Successful design and implementation of stormwater management programs for a particular catchment, drainage area, or subwatershed can depend upon more than implementation of effective BMPs, pollution prevention measures, aquatic restoration strategies, and public involvement. Land use management in the larger watershed, implementation of complementary stormwater management programs in upstream drainage areas, attention to other non-point sources of pollution, and a general watershed-wide commitment to minimize and alleviate stormwater impacts is required. Thus, a comprehensive monitoring program may reveal that although the selected stormwater management strategies are effective on a subwatershed scale, the overall aquatic environment may continue to degrade due to upstream influences not within the jurisdiction's control. Conversely, monitoring results may indicate that only limited additional measures are required because watershed-wide growth management controls have been implemented.

Report Outline

This report presents the results of the review of stormwater indicators, their applicability, and their usefulness for measuring the success of stormwater management programs. Developed for use by municipal stormwater managers, regulatory agencies, and industrial site managers, this report provides a framework for identifying appropriate indicators based on reference and baseline conditions, regional considerations, and available resources (Chapter II). Profile sheets which describe the various stormwater indicators; summarize application, advantages and disadvantages, and costs; and provide brief case studies and method references are presented in Chapter III. Draft versions of the profile sheets were previously published as <u>Environmental Indicators to Assess the Effectiveness of Municipal and Industrial Stormwater Control Programs</u> (Claytor, R. and R. Ohrel 1995a). The profile sheets have been revised to reflect stakeholder comments. Also presented in this report is a suggested methodology (decision matrix) for development of comprehensive monitoring programs based on stormwater indicators (Chapter IV). Lastly, three scenarios are presented to illustrate and further examine the potential benefits associated with use of stormwater indicators (Chapter V).

This study is part of a larger project called the Storm Water Program-Environmental Indicators/Measures of Success Project. The first phase of this effort, Step I: Research and Information Gathering, focussed on compilation and review of currently used indicators and development of a methodology for applying these indicators. An annotated bibliography of environmental indicators was developed and is presented in the <u>Annotated Bibliography of Environmental Indicators to Assess the Effectiveness of Municipal and Industrial Stormwater Control Programs</u> (Claytor, R. and R. Ohrel 1995b). This report presents the stormwater indicators and describes a methodology implementation.

During the second phase of the project, Step II: Stakeholder Input, stakeholders were convened to provide input on selection of appropriate indicators and development of a flexible methodology for use of the indicators. Step II was conducted by the Rennselaerville Institute and is summarized in Appendix A.

Appendix B presents an example of a recently issued NPDES municipal stormwater discharge permit. The permit is included as an example because it incorporates many of the environmental indicators presented in this document as part of a watershed based monitoring and management program.

During the final phase of the study, a series of grants will be awarded for development of comprehensive monitoring programs using stormwater indicators to assess stormwater management program effectiveness. The results of these demonstration projects will be reported under separate cover by the grantees.

REFERENCES

Claytor, R. and R. Ohrel. 1995a. Environmental Indicators to Assess the Effectiveness of Municipal and Industrial Stormwater Control Programs. Prepared by the Center for Watershed Protection for the United States Environmental Protection Agency, Office of Wastewater Management. March 1995.

Claytor, R. and R. Ohrel. 1995b. Annotated Bibliography of Environmental Indicators to Assess the Effectiveness of Municipal and Industrial Stormwater Control Programs. Prepared by the Center for Watershed Protection for the United States Environmental Protection Agency, Office of Wastewater Management. April 1995.

EPA. 1995. Proposed Environmental Goals for America with Benchmarks for the Year 2005: Summary. EPA 230-D-95-001. February 1995.

Swietlik, William F. et al. 1994. Strategies for Using Storm Water Monitoring Data. Paper presented at: *Stormwater NPDES Related Monitoring Needs*. Mount Crest Butte, Colorado. August 7-12, 1994.

URBANIZATION AND WATER RESOURCE QUALITY

Water resource quality is influenced by many different parameters, however, human induced alterations are probably the single biggest contributor to degraded conditions. The ability of streams, lakes, rivers, and estuaries to sustain healthy ecosystems is often a function of how much or how little humans have altered the natural conditions.

One primary way aquatic ecosystems are altered by human influences is through physical, chemical, and biological impacts associated with urban stormwater runoff. The increased frequency and magnitude of runoff and the increased pollutant load associated with urban stormwater, can dramatically degrade critical stream systems by destroying habitat, eroding channel bottoms and banks, and by producing an influx of toxic runoff and sediments. Stormwater management programs and practices are designed to mitigate these adverse impacts. Stormwater monitoring allows managers to evaluate how effectively these mitigation measures are working. Environmental indicators can provide managers with alternative monitoring tools to evaluate program success.

Environmental indicators have the utility and applicability to be extremely versatile tools for analyzing stormwater program and best management practice (BMP) effectiveness. However, before reviewing these tools in detail, a cautionary note is worth emphasizing. Too often local officials, planners, engineers, landscape architects, and others involved in urban stormwater management utilize best available technologies to attempt to solve complex ecological alterations of the natural environment. These professionals may mistakenly assume that the impacts of urbanization can be prevented through the use of BMPs. However, recent studies throughout North America and elsewhere have shown a consistent relationship between the impacts of urbanization and degraded water resource quality, even with the widespread use of BMPs (Schueler 1994).

Urbanization is often measured in terms of impervious area, population, or number of building permits issued. Water resource quality can be measured in terms of physical, chemical, and biological parameters, using many of the indicators examined in this document. One conclusion appears consistently throughout the several studies referenced above, which is, as the amount of urbanization surpasses certain thresholds, water resource quality and aquatic life diversity shows increasing signs of degradation. Even at relatively low levels of imperviousness, the most sensitive aquatic species tend to disappear from examined systems (Schueler 1995).

This presents a challenge for urban watershed managers attempting to evaluate the effectiveness of their stormwater management programs and practices. Officials must realize that even the most successful programs may have indicators which show partially degraded conditions. One benefit of utilizing a comprehensive monitoring program, relying on multiple indicators, is that managers are likely to be able to assess those components of a program which work, and those that may need further development. For these reasons, it is important to utilize environmental indicator monitoring strategies on a watershed-wide basis. At this scale, managers will be able to better differentiate between water resource impacts associated with land use changes, as opposed to poor performance of BMPs or poor stormwater management program implementation.

Another significant hurdle for program managers will be to identify, or more accurately, to eliminate confounding sources influencing water body health. This is necessary to be able to target control strategies for particular sources of pollutants. While some indicators will be useful for documenting that there are problems with water body health, a more significant value should be in the identification of pollutant sources and assessing whether or not management practices are working. It is important to recognize that indicators will be of limited value if there are multiple sources of pollutants influencing water body health. Non-point source pollution, by definition, is coming from locations and activities which are not easily identifiable.

In order to establish environmental indicators as effective tools to address this difficult problem, it is first useful to understand the typical pollution sources and pathways affecting water quality. Several non-point sources affecting water quality in urban areas are identified in Table 2.1, below:

TABLE 2.1

TYPICAL NON-POINT SOURCE PATHWAYS AND POLLUTANTS

ACTIVITY	POLLUTANT PATHWAY	PRINCIPLE POLLUTANTS
Agricultural runoff	Runoff and leachate	Nutrients Sediment Pesticides/herbicides
Atmospheric deposition	Fallout of pollutants in rainfall and dry deposition	Nutrients Metals
Combined sewage overflows and sanitary sewage overflows	Piped directly in drainage system	Pathogens (bacteria) Metals
Urban stormwater runoff	Drainage network	Whole host of "conventional pollutants"
Forestry	Overland runoff	Sediment
Septic discharges	Leachate through ground water	Bacteria
Boating activities	Direct discharge	Hydrocarbons Oil/grease Metals
Resuspension of previously settled solids	Thermal turn-over Bottom feeding fish activity Microbial activity	Phosphorus release Metals Other pollutants bound to sediments

To be effective, a monitoring program must be set up to isolate these confounding sources. For example, it is difficult to evaluate and analyze the confounding sources of larger rivers which flow through urban areas, if they first flow through large agricultural areas and/or other varied land uses. Similarly, it is difficult to assess the contribution of urban runoff for large drainage areas to larger lakes and estuaries which receive input from several sources. Therefore, a monitoring program should specify a drainage area which can be realistically identified and quantified. For example, stormwater runoff, draining a mostly residential and commercial subwatershed, is most likely to be the primary source of pollutants and hydrologic impacts to first or second order streams (commonly referred to as headwater streams).

Management strategies concentrating on reducing urban stormwater pollutants and hydrologic impacts can be evaluated by measuring changes within these smaller headwater streams. Once the drainage area gets significantly larger and industrial, agricultural, and other inputs are included in the non-point source load, it is more and more difficult to measure the effectiveness of stormwater management programs on water body health. Municipalities and industrial sites which concentrate on managing the smaller headwater streams, and which focus their urban stormwater monitoring efforts at this level, are more likely to be able to assess program and practice success and corresponding improvements in water resource quality.

IMPORTANCE OF REFERENCE CONDITIONS AND ESTABLISHMENT OF ECOREGIONS

Successful water resource management programs have traditionally focussed on efforts which reduce chemical or microbial pollutant loads or concentrations below a pre-determined numerical limit (Hughes and Larsen, 1988). These standards and criteria, developed under the auspices of the Federal Water Pollution Control Act, are intended to restore, protect, and maintain the biological, chemical, and physical quality of the Nation's aquatic environments. This management approach has resulted in significant reductions in point source discharges of conventional and toxic pollutants. However, the resultant benefits to the biological aquatic community have fallen below expectations. Chemical and physical criteria are often either under protective or inappropriate (e.g., the acceptable mercury standard is toxic to the resident fish population). In addition, quantitative biological criteria and standards have generally not been developed to the same degree as chemical and physical standards.

Comprehensive stormwater monitoring programs must focus on indicators which provide a realistic assessment of the total aquatic health of the system. Compliance with national standards will not necessarily ensure attainment of the best possible or most realistic level of aquatic protection which can be obtained in a specific watershed or water body. Traditional water quality and biological standards are generally not applicable across the broad range of diverse geological, ecological, and water quality conditions to which they are applied. These standards, therefore, have limited usefulness as benchmarks for success.

In order to realistically assess present conditions (including biological diversity and aquatic habitat), set achievable stormwater management goals, and accommodate diverse geology and ecology, reference conditions must be identified. Reference conditions are established through identification of watersheds (or water bodies) where human impacts are minimal. Existing conditions in the reference watershed are then determined through review of existing records or monitoring results. Stormwater management goals based on these reference conditions, (with consideration accorded for existing anthropogenetic influences) are then used as a benchmark for assessing the success of the stormwater management effort.

It is not always possible nor desirable to identify reference conditions which represent all possible geologic, habitat, and water quality conditions for each water body of concern. In order to minimize the number of reference watersheds required, a geographically based ecological region (ecoregion) approach may be used. Ecoregions are mapped regions of homogeneity in land surface form, soil, potential natural vegetation, and general land use (Hughes and Larsen 1988). They group water bodies together that would be naturally similar in the absence of human influences. Based on the work of Omernik, Hughes, and Griffith, and others, ecoregions are now considered a more appropriate framework for assessment of aquatic health. Seventy-six ecoregions in the United States were defined in 1987 by Omernik using regional patterns in climate, geology, and land use (Omernik 1987).

A variety of reference sites can be identified within each ecoregion to represent the variety of gradients, substrates, water quality, and body types in each ecoregion. The ecoregion approach allows stormwater managers to develop estimates of water quality conditions or organisms likely to be observed in a body of water. Stormwater mangers can then assess the success of their program in context of both the potential for restoration as represented by the reference watershed and the relative condition of the watershed as compared to other watersheds in the ecoregion.

REGIONAL CONSIDERATIONS

Ecoregions provide a framework for assessment of stormwater indicator results. Similarly, regional considerations provide a framework for selection of appropriate indicators based on specific land usage, climate, and local geology and geography. Selection of an indicator such as number of illicit connections detected would be more appropriate for an industrialized watershed versus an agricultural watershed. Similarly, selection of an indicator assessing changes in dry weather flows would be more appropriate for a perennial stream system in the semi-humid mid-Atlantic coastal plain than for an ephemeral stream system in the semi-arid high plains of Colorado.

Regional considerations also provide a framework for modification of stormwater indicators to more accurately represent local conditions. Biological and physical stormwater indicators can be used to assess stormwater management programs throughout the country. However, in order to establish realistic restoration goals, these indicators will need to be modified to more appropriately represent regional conditions. For example, Miller and others reported that the Index of Biotic Integrity (an indicator of biological diversity) has been modified in various states to reflect native species, thus providing an indicator of greater utility and applicability (Miller et al. 1988).

Upfront consideration of regional differences is required to ensure selection of appropriate stormwater indicators which accurately represent local conditions. Development of an appropriate framework for selection of stormwater indicators and establishment of restoration goals can only be achieved by taking into account regional considerations as well as reference conditions and ecoregional concerns.

TOOLS FOR INDICATOR USE

As has been discussed, one goal of this environmental indicator project is to recommend and analyze a group of indirect measurements of environmental conditions to assess water body health and stormwater management practice and program effectiveness. During the course of this project, the "indicators" used to measure environmental conditions have evolved. Several topics were originally categorized as Whole Watershed Indicators which were initially envisioned as measurements of "whole watershed" health. These included watershed simulation modeling, watershed geographic information systems (GIS), comparison to reference watersheds, paired watershed analysis, and watershed imperviousness studies. What became apparent through the Stakeholder meetings and through various comments received, was that these "indicators" were really "tools" used to measure other indicators. With the exception of watershed impervious studies, which has been renamed and incorporated into a the indicator topic called "Growth and Development," these other tools can all be applied over a broad range of physical, chemical, and biological indicators as identified in Chapter III.

Although the tools discussed here can be used to estimate specific water resource impacts, the emphasis for monitoring programs to be structured on a watershed-wide basis cannot be overstated. For it is at the watershed or subwatershed scale, that it is most obvious to differentiate between land use management strategies and other BMP implementation strategies.

The following discussion identifies some of the common "tools" watershed managers and stormwater practitioners can use to measure a range of environmental indicators, specifically:

- Watershed Simulation Modeling
- Geographic Information Systems
- Paired Subwatershed Monitoring
- Comparison to Reference Conditions
- Photographic Records

Not discussed are tools used to measure specific indicators, such as the Index of Biotic Integrity to measure fish assemblages (Karr et al. 1986). These specific tools are reviewed and discussed for each relevant indicator topic, in Chapter III - "Environmental Indicator Profile Sheets."

Watershed Simulation Modeling and Geographic Information Systems (GIS)

Watershed simulation modeling is a tool that can be used to characterize pollutant constituent load wash-off from various land surfaces, or to estimate the hydrologic and hydraulic affects upon receiving waters. Several computer models have been developed to assess the quality and quantity of stormwater runoff. These models must usually be calibrated to properly estimate watershed responses to various land use development patterns. Geographic information systems (GIS) are tools that can be used to compile watershed characteristics in a graphic and tabular format for use in examining the effects of various land use/land cover conditions.

Recent efforts to combine the capabilities of water quality/quantity simulation models with GIS have yielded powerful new tools for watershed analysis. The pollutant load estimation, transport, and flow rate computational capabilities of simulation models complement the database and spatial graphic capabilities of GIS. Combined, these tools provide a quick and efficient method to assess different watershed development scenarios and their impacts on receiving water quality. GIS is used to compile watershed parameters such as land use/land cover, soils, vegetative cover, drainage networks, topography, hydrologic data, watershed, and political boundaries. This data is linked spatially using the graphic capabilities of the software, and/or tabularly using database capabilities. In addition, GIS can compile data on pollutant sources such as on-site sewage disposal systems (OSDS), nutrient contributions for agricultural land uses, BMP effectiveness, and sediment loading.

The GIS/simulation model combination can be used to calculate pollutant loads and flow rates for various locations within the watershed. Different management strategies or land use scenarios can be evaluated for their impact on downstream water quality. Physical conditions can also be modeled. For example, streambank erosion and depositional areas can be estimated based on land use, channel geometry, and soil particle size characteristics. Flooding potential and frequency has traditionally been modeled using several computer models. These models are now being combined with GIS databases to quickly assess the physical flooding potential of alternative management efforts or land development patterns.

GIS to can also be used to assemble biological monitoring data into a spatial database. This information can then be used to compare biological integrity across various land use/land cover situations and locations to evaluate and assess conditions leading to biological degradation. Although little literature is available on this application, utilization of the GIS tool in this area is likely to be expanded in the future.

Kasi (1993) reported on the use of GIS to compute pollution potential indices. This approach compiles pollution load estimates for different land uses and then combines this data into a single quantifiable number. Watersheds, subwatersheds, or portions of watersheds can be prioritized for management based on the potential pollutant contributions of the respective areas. This program can then be used to target resources for protection and/or remediation.

GIS and simulation models are extremely versatile for evaluating different watershed development and restoration alternatives. By using these combined tools, stormwater runoff problems and alternative control measures can be rapidly evaluated. Analysis of watershed scenarios can be evaluated at a variety of scales including analysis of different structural BMPs at the micro-scale; evaluation of comprehensive planning and growth management options at the macro-scale; and assessment of alternative land use "location" (as opposed to just type and quantity).

Watershed simulation models and GIS are limited by the input data and require calibration to be truly effective. Calibration can be very costly and time consuming. Actual monitoring data is necessary to compare simulation modeling results against actual field measurements. Furthermore, the results of simulation modeling are dependent on the resolution of the database input. The source and precision of the data must be matched with the anticipated results. Databases must be continually updated to remain current with changing development activity and other watershed changes.

Perhaps the biggest complaint made by stormwater managers regarding GIS development is the cost and resources required to input the raw data into digital format. Much of this data may be less than desirable. For example, one watershed study, in Delaware, utilized zoning maps for inputting land use data, only to find that the agricultural zone had available more than half a dozen different land development options. In addition, the data storage requirements for topography alone required a completely new computer system to accommodate the millions of bytes of data (Shaver 1995). Data from digital sources is rapidly becoming the preferred data format for most GIS because input is quicker and usually cheaper (Griffin 1995). As national, state, and local databases become more common, the data input problem will likely become more manageable.

The following references can be used to obtain additional information for a few widely used simulation models and GIS software packages:

HSPF:	Hydrologic Simulation Program-Fortran. Barnwell, T.O. and R. Johanson. 1981.
	HSPF: A Comprehensive Package for Simulation of Water Hydrology and Water Quality, Nonpoint Pollution Control: Tools and Techniques for the Future. Interstate Commission on the Potomac River Basin.
ANSWERS	Areal Nonpoint Source Watershed Environmental Response Simulation. Beasley, D. and Huggins, L. 1982.
	ANSWERS: Users Manual (EPA-905/9-82-001). Environmental Protection Agency Great Lakes National Program Office.
SLAMM	Source Loading and Management Model (SLAMM), A Water Quality Management Planning Model for Urban Stormwater Runoff, Volume 1: Model Development and Summary. Pitt, R. 1991.
SWMM:	Storm Water Management Model, Version 4: User's Manual (EPA/600/3-88/001, NTIS PB88-236641/AS. Environmental Protection Agency. 1988.
ARC/INFO	Understanding GIS, The Arc/Info Method. Environmental Systems Research Institute, Inc. 1990.

Paired Subwatershed Monitoring and Comparison to Reference Conditions

The use of paired watershed studies and comparison to reference conditions is becoming an increasingly important tool for watershed research and monitoring. The paired watershed study approach involves comparing the response of two watersheds when subjected to different management practices (Clausen and Spooner 1993). The approach requires two physiographically similar watersheds which are treated identically over a calibration period to establish a quantifiable relationship between the paired data. Then one watershed, the "treatment watershed," is actively subjected to management strategies. The other (control) watershed continues to be exposed to the same conditions as during the calibration period. The control watershed accounts for climatic, seasonal, and other natural variations, while the treatment watershed measures the affects of implementation of the management programs. The same process can also be used to measure impacts associated with the lack of management or to reflect the impacts of developing watersheds.

The comparison to reference conditions involves the same approach, except a reference watershed or water body, judged to be in a natural or a "least impacted" condition, serves as the control area. Responses to management strategies or impacts from land use changes are compared with the best attainable condition (as represented by the reference condition). The reference condition may be an isolated site or may encompass an entire subwatershed. This minimally impacted site should be selected to be as typical of the natural ecoregion condition as possible. Hughes (1989) recommends the following selection criteria for ecoregional reference sites:

- Minimal impacts from stressors, common elsewhere in the ecoregion
- Within close proximity to biological refuge areas

- Few natural or man made barriers to migration
- Water body, channel type, and basin size typical of ecoregion
- Contains data of historical conditions

The reference site may be hard to initially select, since the habitat and biological characteristics should be based on the aquatic life uses to be analyzed in the study watershed or site. This reference site may be representative of the best attainable conditions of a particular watershed or may be part of a regional reference station system to evaluate conditions on a larger scale (Plafkin et al. 1989).

Comparison between paired watersheds can be used as an assessment tool to estimate a wide range of biological, physical, and chemical environmental conditions. An example might include comparing flooding frequencies between two watersheds. As one watershed experiences development, growth in the control watershed remains reasonably constant. The frequency of flood events can be documented for each watershed over a period of time and then compared to assess the impact of urbanization. An important component to this analysis is establishing the control condition through a calibration process. A variation of this type of study was reported by Weiss, in a paper entitled "Effects of Urbanization on Peak Streamflows in Four Connecticut Communities, 1980-84" (Weiss 1990).

Photographic Records

Another tool which is not technical in nature, but may provide valuable information, is a simple photographic or video record. Photographs can be used to document many types of indicators, but perhaps most effectively, they can be used to record physical conditions. Examples include: flood damage, channel erosion and sediment deposition, trash and debris accumulation, visible water clarity impairment, and habitat loss (both instream and riparian cover).

Photographic or video records are easy to do, require little special training, are inexpensive, and are easily understood by a wide audience. Photographs are particularly useful in documenting changing conditions over time. Application of digital camera technology can be particularly effective in linking photographic evidence of aquatic conditions at specific sites directly to a GIS watershed map. Photographs can be combined with other tools, such as watershed models, to document the complete conditions of a waterbody.

Photographs can sometimes be misleading, usually implying an un-impacted status. For instance, a water body can appear very clean, have plentiful habitat cover and other appearances of physical quality, but contain a degraded biological community due to severe water chemistry contamination. It should be emphasized that this tool is most valuable as a supporting role, and not as a stand alone measurement of a particular indicator topic.

REFERENCES

Clausen, J.C., and J. Spooner. 1993. Paired Watershed Study Design. Environmental Protection Agency, Office of Wetlands, Oceans and Watersheds. EPA/841/F-93/009.

Griffin, C.B. 1995. Introduction to GIS for Public Agencies. Conservation Technology Information Center. State University of New York, College of Environmental Science and Forestry, Syracuse, NY.

Hughes. R.M. 1989. What Can Biological Monitoring Tell Us About the Environmental Health of Aquatic Ecosystems. In *Design of Water Quality Information Systems. Proceedings of an International Symposium*, June 7-9 1989.

Hughes and Larsen. 1988. Ecoregions: An Approach to Surface Water Protection. *Journal of the Water Pollution Control Federation*. Volume 60, No. 4. April 1988. pp 486-493.

Karr et al. 1986. Assessing Biological Integrity in Running Waters: A Method and its Rationale. *Illinois Natural History Survey Special Publications 5.*

Kasi, V. 1993 Using a Geographic Information System as a Targeting Tool for Pennsylvania's Chesapeake Bay Program. In proceedings from *Watershed '93, A National Conference on Watershed Management.*

Miller et al. 1988. Regional Applications of an Index of Biotic Integrity for Use in Water Resource Management. *Fisheries*. Volume 13, No. 5. September - October 1988. pp. 12 - 20.

Omernik, J.M. 1987. Ecoregions of the Conterminous United States. *Annals of the Association of American Geographers*. No. 77. pp. 118-125.

Plafkin, J.L.et al. 1989 Rapid Bioassessment Protocols for use in Streams and Rivers: Benthic Macroinvertebrates and Fish. Environmental Protection Agency, Office of Water. EPA/444(440)/4-39-001.

Schueler, T. 1994. The Importance of Imperviousness. *Watershed Protection Techniques*. Volume 1, No 3. Center for Watershed Protection, Silver Spring, MD.

Shaver, E. 1995. Personal Communication. Environmental Engineer, Division of Soil and Water Conservation, Delaware Department of Natural Resources and Environmental Control.

Weiss, L.A. 1990. Effects of Urbanization on Peak Streamflows in Four Connecticut Communities, 1980-84. Books and Open File Report Section, USGS Water Resources Investigations Report 89-4167.

OVERVIEW

The twenty-six environmental indicators for stormwater monitoring are organized into six categories representing both traditional monitoring practices such as water quality monitoring, and less frequently used methods such as programmatic analyses. The indicator categories include:

- Water Quality Indicators;
- Physical and Hydrological Indicators;
- Biological Indicators;
- Social Indicators;
- Programmatic Indicators; and
- Site Indicators.

An Environmental Indicator Profile Sheet has been prepared for each indicator. The Profile Sheets provide a concise and analytical compilation of information gathered during a literature review (published separately as an Annotated Bibliography of Environmental Indicators). Each Profile Sheet contains a description of the indicator; a list of applications, advantages and disadvantages; a brief case study; and method references. The Profile Sheets are intended to function as a quick reference and provide stormwater program managers with a general introduction to various monitoring techniques. The Profile Sheets are designed to function as a guide for obtaining more information on specific indicator protocols and implementation. The Profile Sheets are only short guidance "fact sheets," therefore, they will likely best serve program managers when used to compare the applicability and utility of the various indicators.

A qualitative analysis of indicator usefulness and advantages, as well as a cost analysis, has been completed for each stormwater indicator. The analysis methodology and results are described below. The individual Profile Sheets are presented later in this chapter.

INDICATOR USEFULNESS AND ADVANTAGES

The results of a qualitative analysis of potential indicator usefulness and advantages are presented as a concise visual guide in the Profile Sheets. This guide can be used to ascertain the usefulness of an indicator for a particular application and to determine what advantages one indicator might have over another method. To complete this analysis, two lists of questions were developed which are intended to provide some insight on the types of questions which should be considered when developing a successful stormwater management program. The questions can be answered either yes, no, or partially. The key identified below corresponds with the characters used in the Profile Sheets.

Usefulness Matrix: Questions for Usefulness Assessors

1. Aquatic Integrity of Lakes, Streams and Estuaries: Can the indicator assist in adequately documenting changes in overall aquatic health for lakes, streams and/or estuaries?

2. Land Use Impacts: Can the indicator be useful for identifying impacts of different urban and suburban land uses on aquatic systems?

3. Stormwater Management Programs: Does the indicator measure the overall effectiveness of a stormwater management program or a component of a stormwater management program?

4. Whole Watershed Quality: Can the indicator assess the complete range of long term change/impacts in aquatic health or quality over an entire watershed?

5. Industrial Sites: Is the indicator applicable for assessing industrial site stormwater management practices and programs?

6. Municipal Programs: Is the indicator applicable for assessing municipal stormwater management practices and programs?

Key: Yes (Very Useful) ●
Partially (Moderately Useful) ◖
No (Not Useful) ○

Advantages Matrix Questions for Advantages Assessors

1. Geographic Range: Can the indicator be applied over multiple geographic regions, assuming moderate changes are made in measuring techniques?

2. Baseline Control: Can the indicator be applied to various conditions (including geographic locations) without requiring re-establishment of baseline conditions against which change is measured?

3. Reliable: Can the indicator be considered a dependable measure of aquatic system health over a wide range of stormwater applications?

4. Accuracy: Can the indicator identify the health or quality of an aquatic system with reasonable confidence?

5. Low Cost: Is the indicator cost effective in obtaining the useful and meaningful results?

6. Repeatable: Can different investigators use the same indicator and get consistently similar results under varying environmental and geographical conditions, and over a long time period?

7. All Watershed Scale: Does the indicator provide useful information across site, subwatershed, watershed and river basin scales?

8. Familiar to Practitioners: Is the indicator commonly accepted and familiar to professionals involved in urban runoff management?

9. Easy to Use and Low Training: Can personnel be trained to apply the indicator inexpensively, rapidly and with relative ease?

Key: Yes (Very Advantageous) ●
Partially (Moderately Advantageous) ◖
No (Not Advantageous) ○

The results of the indicator usefulness analysis are presented in Tables 3.1A through 3.1G (Usefulness Quick Reference Guide). The first six tables correspond to the six indicator categories. The seventh table presents a comparison of the overall usefulness of each indicator category. Similarly, the results of the analysis of indicator advantages (Tables 3.2A through 3.2G, Advantages Quick Reference Guide) are presented in six tables organized by category and one table for the overall comparison.

An overall effectiveness category has been included in both the Usefulness Guides and the Advantages Guides. Overall effectiveness was estimated based on the cumulative responses to the questions identified above. An indicator which receives a solid circle (●) for both the Usefulness and Advantages Matrices and is reasonably cost efficient, is likely to be a very useful tool for stormwater program managers.

TABLE 3.1A
USEFULNESS-QUICK REFERENCE GUIDE
WATER QUALITY INDICATORS

Indicators	Lakes	Streams	Estuaries	Land Use Impacts	Stormwater Management Programs	Whole Watershed Quality	Industrial Sites	Municipal Programs	Overall Effectiveness
(1) Water Quality Monitoring	●	●	◖	◖	◖	◖	●	◖	◖
(2) Toxicity Testing	◖	◖	◖	◖	◖	◖	●	●	◖
(3) Nonpoint Source Loading	◖	◖	◖	◖	◖	◖	◖	◖	◖
(4) Exceedance Frequencies	●	●	●	◖	◖	◖	●	◖	◖
(5) Sediment Contamination	●	◖	●	◖	◖	◖	◖	◖	◖
(6) Human Health Criteria	●	○	●	◖	◖	○	○	◖	○

Key	
Yes (Very Useful)	●
Partially (Moderately Useful)	◖
No (Not Useful)	○

TABLE 3.1B
USEFULNESS QUICK REFERENCE GUIDE
PHYSICAL AND HYDROLOGICAL INDICATORS

Indicators	Lakes	Streams	Estuaries	Land Use Impacts	Stormwater Management Programs	Whole Watershed Quality	Industrial Sites	Municipal Programs	Overall Effectiveness
(7) Stream Widening/Downcutting	○	●	○	●	◐	●	◐	●	◐
(8) Physical Habitat Monitoring	◐	●	◐	●	◐	●	○	◐	◐
(9) Impacted Dry Weather Flows	○	●	○	◐	◐	◐	○	◐	○
(10) Increased Flooding Frequency	○	●	○	●	●	◐	◐	●	◐
(11) Stream Temperature Monitoring	○	●	○	●	●	◐	◐	●	◐

TABLE 3.1C
USEFULNESS QUICK REFERENCE GUIDE
BIOLOGICAL INDICATORS

Indicators	Lakes	Streams	Estuaries	Land Use Impacts	Stormwater Management Programs	Whole Watershed Quality	Industrial Sites	Municipal Programs	Overall Effectiveness
(12) Fish Assemblage Analyses	◐	●	◐	●	●	●	◐	●	●
(13) Macro-invert. Assemblages	●	●	◐	●	●	●	◐	●	●
(14) Single Species Indicator	◐	◐	◐	◐	◐	◐	◐	◐	◐
(15) Composite Indicators	●	●	●	●	●	●	◐	●	●
(16) Other Biological Indicators	●	◐	●	◐	◐	○	◐	◐	◐

Key	
Yes (Very Useful)	●
Partially (Moderately Useful)	◐
No (Not Useful)	○

TABLE 3.1D
USEFULNESS QUICK REFERENCE GUIDE
SOCIAL INDICATORS

Indicators	Lakes	Streams	Estuaries	Land Use Impacts	Stormwater Management Programs	Whole Watershed Quality	Industrial Sites	Municipal Programs	Overall Effectiveness
(17) Public Attitude Surveys	○	○	○	○	●	◖	○	◖	○
(18) Industrial/commercial Pollution Prevention	○	○	○	○	●	○	●	○	○
(19) Public Involvement and Monitoring	◖	◖	◖	◖	◖	◖	○	◖	◖
(20) User Perception	◖	◖	◖	○	◖	◖	○	◖	○

TABLE 3.1E
USEFULNESS QUICK REFERENCE GUIDE
PROGRAMMATIC INDICATORS

Indicators	Lakes	Streams	Estuaries	Land Use Impacts	Stormwater Management Programs	Whole Watershed Quality	Industrial Sites	Municipal Programs	Overall Effectiveness
(21) No. of Illicit Connections Identified/Corrected	●	●	●	◖	◖	◖	●	●	●
(22) No. of BMPs Installed, Inspected, & Maintained	○	○	○	◖	◖	◖	◖	●	○
(23) Permitting and Compliance	○	○	○	◖	◖	◖	◖	●	○
(24) Growth and Development	◖	●	◖	●	◖	●	◖	●	◖

Key	
Yes (Very Useful)	●
Partially (Moderately Useful)	◖
No (Not Useful)	○

TABLE 3.1F
USEFULNESS QUICK REFERENCE GUIDE
SITE INDICATORS

Indicators	Lakes	Streams	Estuaries	Land Use Impacts	Stormwater Management Programs	Whole Watershed Quality	Industrial Sites	Municipal Programs	Overall Effectiveness
(25) BMP Performance Monitoring	●	●	◖	◖	●	◖	●	●	●
(26) Industrial Site Compliance Monitoring	○	○	○	◖	●	○	●	○	○

TABLE 3.1G
USEFULNESS QUICK REFERENCE GUIDE
OVERALL INDICATOR SUMMARY

Indicators	Lakes	Streams	Estuaries	Land Use Impacts	Stormwater Management Programs	Whole Watershed Quality	Industrial Sites	Municipal Programs	Overall Effectiveness
Water Quality Indicators	●	◖	●	◖	◖	○	●	◖	◖
Physical and Hydrological Indicators	○	●	○	●	●	◖	○	●	◖
Biological Indicators	●	●	◖	●	●	◖	◖	●	●
Social Indicators	○	○	○	○	●	◖	○	◖	○
Programmatic Indicators	◖	◖	◖	◖	◖	◖	◖	●	◖
Site Indicators	◖	◖	○	◖	●	○	●	◖	◖

Key	
Yes (Very Useful)	●
Partially (Moderately Useful)	◖
No (Not Useful)	○

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TABLE 3.2A
ADVANTAGES QUICK REFERENCE GUIDE
WATER QUALITY INDICATORS

Indicators	Geographic Range	Baseline Control	Reliable	Accuracy	Low Cost	Repeatable	All Watershed Scale	Familiar to Practitioners	Easy to Use & Low Training	Overall Effectiveness
(1) Water Quality Monitoring	●	◖	○	◖	○	◖	●	◖	○	◖
(2) Toxicity Testing	●	○	◖	◖	○	◖	◖	◖	○	○
(3) Nonpoint Source Loading	●	○	◖	◖	○	●	◖	◖	○	◖
(4) Exceedance Frequencies	●	●	◖	◖	○	●	◖	●	●	●
(5) Sediment Contamination	◖	◖	◖	◖	○	◖	○	●	◖	◖
(6) Human Health Criteria	○	◖	◖	◖	◖	●	○	●	◖	◖

TABLE 3.2B
ADVANTAGES QUICK REFERENCE GUIDE
PHYSICAL AND HYDROLOGICAL INDICATORS

Indicators	Geographic Range	Baseline Control	Reliable	Accuracy	Low Cost	Repeatable	All Watershed Scale	Familiar to Practitioners	Easy to Use & Low Training	Overall Effectiveness
(7) Stream Widening/ Downcutting	●	●	●	●	●	●	◖	●	●	●
(8) Physical Habitat Quality	●	●	●	◖	●	●	●	●	●	●
(9) Impacted Dry Weather Flows	◖	◖	◖	○	◖	◖	●	◖	●	◖
(10) Increased Flooding Frequency	●	◖	●	◖	◖	◖	●	●	◖	●
(11) Stream Temperature Monitoring	●	●	◖	◖	◖	●	●	●	●	●

Key	
Yes (Very Advantageous)	●
Partially (Moderately Advantageous)	◖
No (Not Advantageous)	○

TABLE 3.2C
ADVANTAGES QUICK REFERENCE GUIDE
BIOLOGICAL INDICATORS

Indicators	Geographic Range	Baseline Control	Reliable	Accuracy	Low Cost	Repeatable	All Watershed Scale	Familiar to Practitioners	Easy to Use & Low Training	Overall Effectiveness
(12) Fish Assemblage Analyses	●	◖	●	●	◖	●	◖	●	◖	●
(13) Macro-invert. Assemblages	●	◖	●	●	●	●	●	●	◖	●
(14) Single Species Indicator	●	◖	○	◖	●	◖	◖	◖	●	◖
(15) Composite Indicators	●	◖	●	●	○	●	●	●	◖	●
(16) Other Biological Indicators	●	◖	○	◖	◖	●	◖	○	○	◖

TABLE 3.2D
ADVANTAGES QUICK REFERENCE GUIDE
SOCIAL INDICATORS

Indicators	Geographic Range	Baseline Control	Reliable	Accuracy	Low Cost	Repeatable	All Watershed Scale	Familiar to Practitioners	Easy to Use & Low Training	Overall Effectiveness
(17) Public Attitude Surveys	●	◖	◖	◖	◖	●	●	◖	◖	◖
(18) Indust./comm. Pollution Prevention	●	◖	◖	◖	◖	●	●	◖	◖	◖
(19) Public Involvement & Monitoring	●	○	◖	◖	●	○	●	●	●	◖
(20) User Perception	●	◖	◖	◖	◖	●	●	◖	◖	◖

Key	
Yes (Very Advantageous)	●
Partially (Moderately Advantageous)	◖
No (Not Advantageous)	○

TABLE 3.2E
ADVANTAGES QUICK REFERENCE GUIDE
PROGRAMMATIC INDICATORS

Indicators	Geographic Range	Baseline Control	Reliable	Accuracy	Low Cost	Repeatable	All Watershed Scale	Familiar to Practitioners	Easy to Use & Low Training	Overall Effectiveness
(21) # Illicit Connections	●	○	◖	◖	◖	◖	◖	●	◖	◖
(22) #BMPs Installed	●	●	◖	◖	○	●	◖	◖	○	◖
(23) Permitting and Compliance	●	●	◖	◖	●	●	◖	◖	◖	●
(24) Growth and Development	◖	◖	◖	◖	◖	●	●	◖	●	◖

TABLE 3.2F
ADVANTAGES QUICK REFERENCE GUIDE
SITE INDICATORS

Indicators	Geographic Range	Baseline Control	Reliable	Accuracy	Low Cost	Repeatable	All Watershed Scale	Familiar to Practitioners	Easy to Use & Low Training	Overall Effectiveness
(25) BMP Performance Monitoring	◖	◖	◖	◖	○	●	◖	◖	○	◖
(26) Industrial Site Compliance Monitoring	●	●	◖	◖	●	◖	○	◖	●	◖

Key	
Yes (Very Advantageous)	●
Partially (Moderately Advantageous)	◖
No (Not Advantageous)	○

TABLE 3.2G
ADVANTAGES QUICK REFERENCE GUIDE
OVERALL INDICATOR SUMMARY

Indicators	Geographic Range	Baseline Control	Reliable	Accuracy	Low Cost	Repeatable	All Watershed Scale	Familiar to Practitioners	Easy to Use & Low Training	Overall Effectiveness
Water Quality Indicators	●	○	○	◖	○	●	○	◖	○	◖
Physical & Hydrological Indicators	●	●	●	◖	◖	●	●	●	●	●
Biological Indicators	●	◖	◖	●	◖	●	◖	◖	◖	●
Social Indicators	●	◖	◖	◖	◖	●	●	◖	◖	◖
Programmatic Indicators	●	◖	◖	◖	◖	●	◖	◖	◖	◖
Site Indicators	●	●	◖	◖	◖	●	○	◖	◖	◖

Key	
Yes (Very Advantageous)	●
Partially (Moderately Advantageous)	◖
No (Not Advantageous)	○

COST ANALYSIS

Costs for each indicator are presented by category in Tables 3.3A through 3.3F. The costs are based on a review of available data collected through a telephone survey of stormwater practitioners, a literature review, the authors' experience, and general industry information. For example, the cost for Indicator No. 20, User Perception, is based on development and implementation of a telephone survey. According to the results of the data review, this is a common method for conducting user perception surveys.

The indicator costs should only be considered planning level estimates, and should not be relied upon as all encompassing. There are many different methodologies that can be used to perform the indicator monitoring and implementation costs can vary significantly in different regions of the country. (Examples which demonstrate how these costs comparisons may be used are presented in three case study scenarios in Chapter IV.) Program managers should verify all costs with other sources, before implementing program monitoring strategies.

TABLE 3.3A
WATER QUALITY INDICATORS
COST COMPARISON

INDICATOR/ BASIS FOR COST	IMPLEMENTATION COSTS	NOTES
(1) *Water Quality Constituent Pollutant Monitoring* • Per site, one person at each site • Sampling site accessible from land • Conventional pollutants* and physical parameters (pH, temperature, conductivity) only • Four hour sampling event • Single composited sample provided for laboratory analysis • Weir or flume used to establish stage-discharge relationship • Stage recorded during monitoring event to determine flow • Grabs sample collected manually • Composite aliquots collected using automated sampler • Compositing based on constant time-volume proportional to flow increment or rate relationship • Cost includes analysis to compile and arrange data	$700 - $850 per station, per storm event	Cost to set-up station (installation and calibration of weir or flume; development of stage discharge relationship; acquisition of automated samplers and DO, temperature, conductivity, and pH meters; aquisition of reagents, sampling buckets, etc.) not included in cost estimate. Set up costs (based on the above-listed assumptions) will be on the average of $7,000 - $9,000 dollars per station. Cost may be reduced by using same sampler at different stations during different storm events and/or by using alternative methods to determine flow (i.e., USGS data). *Conventional pollutants include those typically reported as pollutants of concern in "normal urban runoff"--(e.g., TKN, nitrate + nitrite, ammonia nitrogen, TP, ortho-phosphate, cadmium, copper, lead, zinc (both total and dissolved), TSS, BOD_5, COD)(Strecker 1995)
(2) *Toxicity Testing* • Per sampling event test, assumes 10 replicate samples collected and analyized • Short term, chronic 7 day toxicity test using *Ceriodaphnia dubia* or *Pimephales promelas*	$2,500 - $3,750 per sampling event	Cost estimate does not include sampling/collection costs. Cost is based on laboratory analysis only. In-situ and/or flow through testing involves sophisticated equipment and station set-up which can dramatically add to cost.

TABLE 3.3A
WATER QUALITY INDICATORS
COST COMPARISON

INDICATOR/ BASIS FOR COST	IMPLEMENTATION COSTS	NOTES
(3) *Nonpoint Source Loadings* Method #1: Sub-watershed assessment with computer modeling • Water quality data collection not included • Land use/imperviousness data collection not included Method #2: Simple method, EMC based on land use • Land use/imperviousness data collection not included	Method #1: $70,000 - $84,000 per sub-watershed Method #2: $500 - $1,000 per sub-watershed	Estimates for water quality data collection costs can be based on Water Quality Constituent Pollutant Monitoring costs. In Sub-watershed assumed to be approximately 5 square miles.
(4) *Exceedance Frequencies of Water Quality Standards*	N/A	Costs associated with implementation of this indicator are assumed to be minimal. The most significant portion of the cost would be associated with data collection. The data required to implement this indicator is most likely collected as part of an ongoing baseflow and/or wet weather water quality monitoring program.
(5) *Sediment Contamination* • Per site • Conventional pollutants only* • Single sample collected and laboratory analysis • Interpretation of results not included	$450 - $550 per sample	Cost estimate does not include sampling collection costs. *Conventional pollutants include those typically reported as pollutants of concern in "normal urban runoff"--(e.g., TKN, nitrate + nitrite, ammonia nitrogen, TP, ortho-phosphate, cadmium, copper, lead, zinc (both total and dissolved), TSS, BOD_5, COD)(Strecker 1995)
(6) *Human Health Criteria* • Annual cost • Based on shellfish bed or beach closures • Per growing area or beach, average 5 samples per year • Fifteen to twenty locations within each growing area • Two people monitoring, 8 hours per monitoring event	$5,250 - $6,500 per area (beach)	Cost based on analysis of f. coli or E. coli samples.

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TABLE 3.3B
PHYSICAL AND HYDROLOGICAL INDICATORS
COST COMPARISON

INDICATOR/ BASIS FOR COST	IMPLEMENTATION COST	NOTES
(7) ***Stream Widening/Downcutting*** • Per reach cost • Reach defined as approximately 2000', 10 measurements per reach • Two staff members required per site • Stream cross-sections measured with taped surveys, not traditional field survey equipment • Field cross-sections established and recorded with flagged steel reinforcing bar • Includes overhead expenses (supplies, vehicles, travel, utilities, maintenance, rent, printing, and equipment) • Includes data analysis and preparation of summary report	\$575 to \$700 per 2000 foot reach	Cost is based on surveying first and second order headwater streams, in semi-humid to humid climates. For start-up add: steel reinforcing bars, flagging, hip chain, 50' tape, wading rod, notebooks, clinometer, and computer(s).
(8) ***Physical Habitat Quality*** • Per reach cost • Reach defined as approximately 275' (75 meters), 10 observations per reach. • Quantitative assessments of natural habitat structures (such as fallen trees, large rocks, etc.), channel alterations, recently deposited sediments, riffle/pool sequences, and length of erosional areas. • Qualitative assessment of presence of trash and debris, and stream character (morphology, dominate substrate, etc.). • Substrate composition measured at 3 stations per reach using modified Wolman pebble count. Percent embeddedness, wetted width, bank height, gradient, and canopy coverage measured at all stations. • Two staff members required per site • Includes overhead expenses (supplies, vehicles, travel, utilities, maintenance, rent, printing, and equipment) • Includes data analysis and preparation of summary report	\$400 to \$490 per 275 foot reach	Cost is based on a series of discrete measurements using quantitative and semi-quantitative descriptive parameters. For start-up costs add: 50' tape (or walktax), clinometer, notebooks, and computer(s).

TABLE 3.3B
PHYSICAL AND HYDROLOGICAL INDICATORS
COST COMPARISON

INDICATOR/ BASIS FOR COST	IMPLEMENTATION COST	NOTES
(9) *Impacted Dry Weather Flows* • Per study cost • Study cost assumes long term (≥ 10 years) stream flow gaging data is available • Study involves comparing data from one or more gaging station(s) undergoing changed land use with gaging station data from an unchanged (control) area • Includes overhead expenses (supplies, vehicles, travel, utilities, maintenance, rent, printing, and equipment) • Includes data analysis and preparation of summary report	$4,500 to $5,500 per study area	Based on long term data (≥ 10 years) availability. For start-up costs add: Long term stream flow monitoring data and computer(s). Study area assumed to include data from five stations or less.
(10) *Increased Flooding Frequency* • Per study cost • Study cost assumes long term (≥ 10 years) stream flow gaging data is available • Study involves comparing data from one or more gaging station(s) undergoing changed land use with gaging station data from an unchanged (control) area • Includes overhead expenses (supplies, vehicles, travel, utilities, maintenance, rent, printing, and equipment) • Includes data analysis and preparation of summary report	$4,500 to $5,500 per study area	Based on long term data (≥ 10 years) availability. For start-up costs add: Long term stream flow monitoring data and computer(s). Study area assumed to include data from five stations or less.
(11) *Stream Temperature Monitoring* • Per monitoring station cost, per year • Cost includes automated samplers, recording temperature hourly, requiring downloading every six months • Automated samplers are downloaded in office (laboratory), not at site • Analysis of data includes computing daily mean, maximum and minimum temperature • Includes overhead expenses (supplies, vehicles, travel, utilities, maintenance, rent, printing, and equipment)	$400 to $500 per station per year	Based on yearly monitoring costs, temperature meters deployed once, data downloaded twice per year. Data is automatically downloaded into a desktop computer, additional data analysis required to compute daily mean, maximum and minimum temperatures.

TABLE 3.3C
BIOLOGICAL INDICATORS
COST COMPARISON

INDICATOR/ BASIS FOR COST	IMPLEMENTATION COST	NOTES
(12) *Fish Assemblage Analyses* • Per sample, per site cost • Three staff members per site (one intern) • Includes overhead expenses (supplies, vehicles, travel, utilities, maintenance, rent, computers, printing, and equipment) • Includes data analysis and preparation of summary report	$400 to $475 per sample, per site	Based on methodology of Karr's IBI (1986). Cost for first or second order stream (only one electofishing shocker required) For start-up costs add: electrofishing equipment, computer(s), and basic field gear (e.g., hip waders, fish holding buckets, etc.).
(13) *Macro-Invertebrate Assemblage* • Per sample, per site cost • Two staff members required per site • Includes overhead expenses (supplies, vehicles, travel, utilities, maintenance, rent, computers, printing, and equipment) • Includes sub-sample analysis, identification to genus level, and preparation of summary report	$500 to $600 per sample, per site	Based on RBP protocol III, and sampling to genus level. Cost for 200 individual sub-sample count For start-up costs add: Microscope, kick-screen sampler(s), glassware, preservative, and computer(s).
(14) *Single Species Indicator* • Per sample, per site cost • Two field staff members required per site • Includes overhead expenses (supplies, vehicles, travel, utilities, maintenance, rent, computers, printing, and equipment) • Includes data analysis and preparation of summary report	$375 to $425 per sample, per site	Based on fish electro-shocking surveys of trout or salmon. For start-up costs add: Electrofishing equipment, computer(s) and basic field gear.
(15) *Composite Indicators* • Per sample, per site cost • Two field staff members required per site • assumes at least two biological indicators investigated per site • Includes overhead expenses (supplies, vehicles, travel, utilities, maintenance, rent, computers, printing, and equipment) • Includes data analysis and preparation of summary report	$900 to $1,075 per sample, per site.	Based on combining fish and macro-invertebrate sampling at one site. For start-up costs add: Equipment referenced under fish and macro-invertebrates.

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TABLE 3.3C
BIOLOGICAL INDICATORS
COST COMPARISON

INDICATOR/ BASIS FOR COST	IMPLEMENTATION COST	NOTES
(16) *Other Biological Indicators* • Per sample cost, lake site • Two staff members required per sample • Phytoplankton community sampling costs • Incudes overhead expenses (supplies, vehicles, travel, utilities, maintenance, rent, printing, and equipment) • Includes data analysis and preparation of summary report	$340 - $420 per sample, per lake	Based on single index sampling for phytoplnkton only. Multi-metric protocols, incorporating habitat assessments (requiring at least two trips per sample and two or more sample locations) cost between $1,800 to $2,200 per assessment (excluding start-up costs).

TABLE 3.3D
SOCIAL INDICATORS
COST COMPARISON

INDICATOR/ BASIS FOR COST	IMPLEMENTATION COSTS	NOTES
(17) ***Public Attitude Surveys*** • Per survey cost per 1,000 households contacted (implementation costs) • Interviews conducted over telephone • Includes survey implementation, data analysis, and summary of findings	$14,500 - $17,750 per 1,000 households	Generally, 50% of those households contacted respond to survey.
(18) ***Industrial/Commercial Pollution Prevention*** • Per survey cost per 1,000 industrial facilities contacted (implementation costs) • Interviews conducted over telephone • Includes survey implementation, data analysis, and summary of findings	$14,500 - $17,750 per 1,000 facilities	Generally, 50% of those industrial facilities contacted respond to survey.
(19) ***Public Involvement and Monitoring*** • Per 100,000 people • Substantial in-kind support required from citizens' groups such as Save Our Streams, Trout Unlimited, Izaak Walton League • Major costs associated with development and printing of educational materials training of volunteer monitors	$8,000 - $10,000 per 100,000 persons	No additional comments
(20) ***User Perception*** • Per survey cost per 1,000 households contacted (implementation costs) • Interviews conducted over telephone • Includes survey implementation, data analysis, and summary of findings	$14,500 - $17,750 per 1,000 households	Generally, 50% of those households contacted respond to survey.

TABLE 3.3E
PROGRAMMATIC INDICATORS
COST COMPARISON

INDICATOR/BASIS FOR COST	IMPLEMENTATION COSTS	NOTES
(21) *No. of Illicit Connections Identified/Corrected* • Per illicit connection identification survey • Assumes survey will be conducted visually; smoke, dye, or other methods will not be used • Illicitness of dry-weather flows will be determined by tracing source upstream in system and through use of field test kits	\$1,250 - \$1,750 per mi^2	Cost does not include costs associated with correction of illicit connections. Nationally, approximately 15 to 20 percent of storm drain outfalls carry illicit discharges (Lalor, 1995).
(22) *No. of BMPs Installed, Inspected, and Maintained* • Per survey cost • Includes data reporting and summary report of findings • Assumes telephone survey and on-site visit to records office will be required • Assumes municipalities maintain records of BMP installation and inspection • No field inspections performed	\$15,000 - \$20,000 per survey	Cost does not include field inspecton of each facility. For file inspection program, add \$80 to \$100 per BMP inspected (assumes one trip per year)
(23) *Permitting and Compliance*	N/A	No cost data provided since methods and procedures to conduct surveys of permits and compliance will vary depending on the type of permit, whether or not a jurisdiction already has existing data, the means with which data is recorded, and the capability to retrieve data.
(24) *Growth and Development* • Annual cost • Based on use of GIS database for multiple sub-watersheds • Assumes growth will be tracked through imperviousness or other land use variable	\$26,000 - \$21,250 per sub-watershed	Initial capital expense not included in cost estimate. Costs for collection of data not included. Instead, cost is based on updating GIS system using already digitized land use or imperviousness data. Sub-watershed assumed to be approximately 5 square miles.

TABLE 3.3F
SITE INDICATORS
COST COMPARISON

INDICATOR/ BASIS FOR COST	IMPLEMENTATION COST	NOTES
(25) *BMP Performance Monitoring* • Per site, annual cost • Two automated samplers collecting composite aliquots, one inflow, and one outflow • Flow/stage relationship established using hydraulic capacity of inflow pipe • Conventional pollutants* and physical parameters only (PH, temperature, and conductivity) • 10 storms per station collected, and analyzed per year • Compositing based on constant time-volume proportional to flow increment or rate relationship • Includes overhead expenses • Includes bi-weekly equipment maintenance and inspections • Includes data analysis and preparation of summary report	$22,000 to $26,000 per site, per year	Cost to set-up stations not included in cost estimate. For set-up costs add: $14,000 to $18,000 per site (two stations) *Conventional pollutants include those typically reported as pollutants of concern in "normal urban runoff"--(e.g., TKN, nitrate + nitrite, ammonia nitrogen, TP, ortho-phosphate, cadmium, copper, lead, zinc (both total and dissolved), TSS, BOD_5, COD)
(26) *Industrial Site Compliance Monitoring* • Per Industrial site (based on 5 acre site) • Light industrial land use • Visual inspections of compliance with pollution prevention plans • One technical inspector per site • Includes overhead expenses (supplies, vehicles, travel, utilities, maintenance, rent printing, and equipment) • Includes preparation of summary report	$290 to $350 per 5 acre site	Based on visual inspections only, for pollutant constituent monitoring refer to Table 3.3A. For start-up costs add: Notepads, computer(s), camera.

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Water Quality Indicators

The costs comparison for the water quality indicators is presented in Table 3.3A. Costs for Water Quality Constituent Pollutant Monitoring, Toxicity Testing, Sediment Contamination, and Human Health Criteria are based on sampling considerations and/or laboratory analyses. The cost comparison for Nonpoint Source Loadings, however, does not include sampling or analytical costs. Instead, the cost comparison for Nonpoint Source Loadings focuses on costs associated with model development and data manipulation.

No cost comparison is provided for Exceedance Frequencies of Water Quality Standards. Labor and capital costs associated with this indicator are most likely already incorporated into existing monitoring efforts.

Physical and Hydrological Indicators

The cost comparison for physical indicators are computed on the basis of reach length for stream assessment techniques (e.g., physical habitat quality), study area for watershed-wide assessment techniques (e.g., increased flooding frequency), and station-year for time based monitoring techniques (e.g., stream temperature monitoring). The assumptions for the cost comparison are included in Table 3.3B. Since the costs are closely tied to the assessment methodologies, and since these methodologies can vary from study to study, the specific assessment methodology is depicted for each indicator. Other alternative methodologies may be used, but the cost assumptions will need to be verified.

Biological Indicators

The cost comparison for biological indicators are, in general, computed on a per sample, per site basis. The assumptions for the cost comparison are included in Table 3.3C. These include the number of staff required, overhead expenses, the methodology used to conduct the monitoring, and items needed to compute start-up costs. The cost data was obtained from a brief survey of stormwater practitioners, the authors' experience and general industry information.

The data is reported on unit cost to aid stormwater program managers in planning monitoring programs. For implementation of a state-wide or large municipality program, add administrative and management staff costs. The cost is reported as a range, which encompasses the average of costs obtained from the survey results. Programs which have a large number of monitoring stations will undoubtably receive the rewards of economy of scale, whereas programs with a small number of stations can expect to pay more per station.

Social Indicators

The costs comparison for the social indicators is presented in Table 3.3D. Costs for Public Attitude Surveys, Industrial/Commercial Pollution Prevention, and User Perception are based on the same assumptions regarding development costs, implementation costs (via telephone), and analysis costs. Although these indicators represent different methods for assessing the social aspect of stormwater management, the tools used to measure the indicators are similar. The costs for these indicators are presented on a per 1,000 households (or industrial facilities) contacted basis.

Costs for Public Involvement and Monitoring are based on a survey of various citizen groups and local watershed protection and nonpoint source government agencies. These costs are presented on a per 100,000 person basis.

Programmatic Indicators

Table 3.3E presents the costs comparison for the programmatic indicators. The major portion of the costs for Permitting and Compliance; Number of BMPs Installed, Inspected, and Maintained; and Number of Illicit Connections Identified/Corrected are labor costs. Implementation of these indicators will probably require a significant man-hour investment. However, little, if any, capital costs will be expended.

Growth and Development costs, on the other hand, include significant capital costs for computers and workstations, as well as labor costs associated with development, maintenance, and updating of a GIS database.

Site Indicators

The cost comparison for site indicators are computed on the basis of each BMP monitored for BMP performance monitoring and each site for industrial site compliance monitoring. The assumptions for the cost comparison are included in Table 3.3F. The specific assessment methodology is depicted for each indicator. Other alternative methodologies may be used, but the cost assumptions will need to be verified.

INDICATOR PROFILE SHEETS

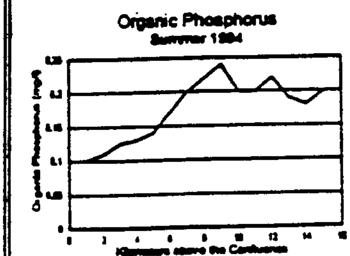
The twenty-six Environmental Indicator Profile Sheet are listed by category in Table 3.4. Each Profile Sheet contains a brief description of the indicator; a discussion of indicator utility; a review of indicator advantages and disadvantages; a case study; and method references. In addition, the results of the analysis of indicator usefulness and advantages are presented in the sidebar on the right side of each Profile Sheet.

TABLE 3.4

ENVIRONMENTAL INDICATOR PROFILE SHEETS

	INDICATOR NAME	PROFILE NO.
Water Quality Indicators	Water quality pollutant constituent monitoring	1
	Toxicity testing	2
	Non-point source loadings	3
	Exceedance frequencies of water quality standards	4
	Sediment contamination	5
	Human health criteria	6
Physical and Hydrological Indicators	Stream widening/downcutting	7
	Physical habitat monitoring	8
	Impacted dry weather flows	9
	Increased flooding frequency	10
	Stream temperature monitoring	11
Biological Indicators	Fish assemblage	12
	Macro-invertebrate assemblage	13
	Single species indicator	14
	Composite indicators	15
	Other biological indicators	16
Social Indicators	Public attitude surveys	17
	Industrial/commercial pollution prevention	18
	Public involvement and monitoring	19
	User perception	20
Programmatic Indicators	No. of illicit connections identified/corrected	21
	No. of BMPs installed, inspected, and maintained	22
	Permitting and compliance	23
	Growth and development	24
Site Indicators	BMP performance monitoring	25
	Industrial site compliance monitoring	26

Environmental Indicator Profile Sheet



Indicator Profile No. 1

Water Quality Pollutant Constituent Monitoring

Category: **Water Quality**

Tools Used to Measure Indicator:

- Pollutant Concentrations
- Event Mean Concentrations
- Spatial and Temporal Trend Analysis

Description:
Water quality monitoring has traditionally focussed on examination of chemical parameters such as oxygen demand, nutrients, and metals, and physical parameters such as pH and temperature. Stormwater monitoring usually requires collection of water samples from stormwater detention and retention facilities, structural and non-structural conveyance channels, stormwater outfalls, and receiving waters during storm events. Evaluation of the parameters may be conducted in the laboratory (e.g. for chemical parameters) or in the field (e.g. pH).

Depending upon the geographic and temporal scope of the monitoring effort, monitoring results may be used to assess current water quality conditions at a specific location; evaluate changes in water quality throughout different seasons or over a period of years; or identify longitudinal or spatial trends in water quality along a river or within a lake. The monitoring results may also be used to identify significant sources of pollution or times of the year when water quality noticeably worsens.

Utility of Indicator to Assess Stormwater Impacts:

- Monitoring results from long-term efforts (five years or more) can be examined to identify trends in water quality conditions over time.
- Monitoring results from urban stormwater studies can be compared to pollutant concentrations in reference rural or "least impacted" watersheds to assess the relative degree of impairment.
- Trends may correlate with land use changes or watershed restoration efforts, helping watershed managers determine priorities for problem sources and pollutants.
- Monitoring results can be used to identify pollution problems and identify potential sources of degradation.
- Monitoring can be implemented on both a regional and local level.

Indicator Useful for Assessing:

* Aquatic Integrity of:	
Lakes	●
Streams	●
Estuaries	◖
* Land Use Impacts	◖
* Stormwater Mgmt Programs	◖
* Whole Watershed Quality	◖
* Industrial Sites	●
* Municipal Programs	◖

Key:	
Very Useful	●
Mod. Useful	◖
Not Useful	○

Indicator Advantages

* Geographic Range	●
* Baseline Control	◖
* Reliable	○
* Accuracy	◖
* Low cost	○
* Repeatable	◖
* All Watershed Scale	●
* Familiar to Practitioners	◖
* Easy to use & Low training	○

Key	
Very Advantageous	●
Mod. Advantageous	◖
Not Advantageous	○

Cost

See Table 3.3A

Advantages of Method:

- Reasonably well standardized, generally accepted sampling methods and protocols are already established in many jurisdictions.
- Many jurisdictions have an extensive historical database which may be examined to determine whether water quality degradation has occurred over a specified period of time.
- Monitoring results are easily presented in graphic form.
- Violations of regulatory standards may be quantified and, therefore; are more likely to be legally defensible.
- Large existing databases on urban and highway stormwater runoff quality allows comparison between local and national concentrations.

Disadvantages of Method:

- Generally, samples must be collected during representative storm event (i.e., volume and duration of rain varies by less than 50 percent from average) to provide accurate characterization of event mean concentrations.
- Multiple sampling events over an extensive period of time are usually required to identify statistically defensible trends in water quality due to the tremendous variability seen in urban runoff data.
- This method is essentially a derivation of traditional, baseflow water quality monitoring using primarily chemical parameters. The applicability of this method to stormwater characterization has been questioned by many municipal stormwater managers.
- Requires accurate measurement of storm flow and automated sampling

Case Study: Wright, R.M.; Roy Chaudhury, R.; Makam, S. 1995
Experiences from the Blackstone River Wet Weather Initiative
In: Stormwater NPDES-Related Monitoring Needs. Conference Proceedings. American Society of Civil Engineers. Mt. Crested Butte, CO. Aug. 7-12, 1994

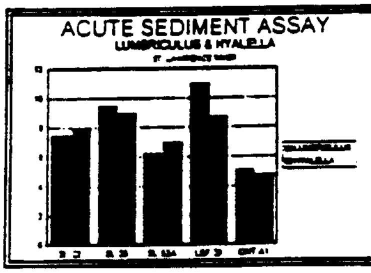
A program, initiated by the U.S. EPA, to study the Blackstone River under dry and wet weather conditions was conducted to pinpoint and rank major sources degrading water quality. The river was monitored at 13 locations along 48 miles, in addition to, six tributaries and five point sources. Three storms were monitored for 23 constituents with at least ten samples at each of the stations. Methods of interpreting the water quality data and isolating the sources into dry and wet weather sources are presented. The wet weather component is studied to establish loadings from point sources, new materials (runoff related) and old materials (bottom sediment re-suspension). A procedure to estimate annual loading rates is presented.

Total suspended soils and lead concentrations in the river generally increased during wet weather conditions. Copper concentrations also increased. This is attributed to re-suspension of copper from the sediments on the bottom. The original source of the copper is probably dry weather discharges from a wastewater treatment plant. Calcium and magnesium concentrations decreased during wet weather due to dilution. Overall, fluctuations in wet weather concentrations are attributable to pollutant loadings from runoff and re-suspension of pollutants in the sediment.

Method References:

- Chemical Monitoring: Taylor, G.F. 1990. *Quantity and Quality of Stormwater Runoff from Western Daytona Beach, Florida, and Adjacent Areas.* USGS Water-Resources Investigations Report 90-4002.
- Stormwater Sampling: EPA. 1992. *NPDES Storm Water Sampling Guidance Document.* EPA/833/B-92-001.
- Toxicity testing: Peltier, W.H.; C.I. Weber. 1985. *Methods for Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms.* EPA/600/4-85/013. Environmental Monitoring Laboratory, Cincinnati, OH.

Environmental Indicator Profile Sheet



Indicator Profile No. 2

Toxicity Testing

Category: **Water Quality**

Tools Used to: Measure Indicator:

- Acute, Chronic, and In-Situ Toxicity Testing
- Microtox
- Toxicity Identification Evaluation (TIE)

Description:

Toxicity testing is used to assess the impact of stormwater pollutants on the overall quality of aquatic systems. Toxicity testing is usually conducted in a laboratory setting using sample water (e.g. stormwater runoff) and test organisms such as *Ceriodaphnia dubia* or *Pimephales promelas*. A single species or microcosm is exposed to collected stormwater runoff for a period of time. The organisms are analyzed for evidence indicating that exposure to pollutants in the stormwater produced lethal or sublethal effects such as mortality, limited reproduction, or stunted growth. Negative physiological and behavioral changes in response to stormwater exposure may also indicate the presence of pollutants in toxic concentrations.

Acute toxicity testing focuses on effects which become apparent over a relatively short interval (i.e., usually 24 to 96 hours). Chronic toxicity tests are used to identify effects which become apparent only after long periods of exposure, usually ten percent of the test organism's life span or longer. Chronic toxicity tests are commonly conducted over a seven-day period; longer periods of exposure are also used.

In-situ or flow through toxicity testing may also be conducted. Test organisms are transported to the site and placed in submerged exposure chambers designed to allow water flow in and out of the chamber. After the exposure period, the organisms are collected and analyzed in the laboratory for evidence of lethal or sublethal effects. Both acute (short-term) and chronic (long-term) toxicity testing can be conducted in-situ.

In order to identify the probable agent of the observed toxicity, toxic identification evaluation (TIEs) procedures may be performed. TIE is a step-wise procedure which first identifies the probable class of toxicant (e.g., metals, nonpolar organics) and then the specific toxicant (e.g., mercury, creosote). Once the probable toxicant has been identified, control measures may be developed and implemented.

Indicator Useful for Assessing:

- Aquatic Integrity of:
  - Lakes ◐
  - Streams ◐
  - Estuaries ◐
- Land Use Impacts ◐
- Stormwater Mgmt Programs ◐
- Whole Watershed Quality ◐
- Industrial Sites ●
- Municipal Programs ●

Key:
Very Useful ●
Mod. Useful ◐
Not Useful ○

Indicator Advantages

- Geographic Range ●
- Baseline Control ○
- Reliable ◐
- Accuracy ◐
- Low cost ○
- Repeatable ◐
- All Watershed Scale ◐
- Familiar to Practitioners ◐
- Easy to use & Low training ○

Key
Very Advantageous ●
Mod. Advantageous ◐
Not Advantageous ○

Cost

See Table 3.3A

Utility of Indicator to Assess Stormwater Impacts:

- Various species with specific levels of sensitivity can be used to evaluate the severity and identify the potential causes of degradation (i.e., pollutants).
- Toxicity testing can be used to evaluate the effectiveness of stormwater BMPs and other stormwater pollution reduction measures.
- Species-specific toxicity testing can be used as a rallying point for aquatic system restoration, especially if a particularly sensitive, well-known, and economically significant species is used.
- Applicable on both local and regional levels.
- Results of toxicity testing can be used by watershed managers to identify areas of high concern and to establish restoration priorities.
- Phase I, II, and III TIE procedures can be used to help identify specifc pollutant sources.

Advantages of Method:

- A great deal of data is available describing acute and chronic toxicity limits for various species.
- Toxicity testing can easily be incorporated into tiered stormwater monitoring programs. First tier indicators such as fish and macroinvertebrates assemblages and water quality monitoring can be examined to determine if the system is degraded. Toxicity testing, a second tier indicator, can then be used to identify the probable cause and source of the degradation.
- Watershed managers can identify potential severity of water quality degradation by using species with differing levels of sensitivity to environmental parameters.
- Different species sensitivity assists watershed managers' ability to distinguish between potential causes of existing water quality problems.
- The obvious visual impacts on species (e.g., tumors, stunted growth, and discoloration) can generate public concern and motivate involvement with restoration efforts.

Disadvantages of Method:

- Several possible factors influence toxicity for a given species, including concentration of the contaminant, concentrations of other substances, temperature, the organism's environmental conditioning and acclimation, toxicant interactions, and duration of exposure.
- Toxicity testing has historically focused on short term and lethal effects. Sublethal effects, which may not become apparent for years and which can include impacts to reproductive behavior, migration patterns, and predator avoidance, have not been as thoroughly studied.
- The same species may exhibit varying tolerance levels for different pollutants or combination of pollutants.
- Toxicity testing often occurs in a laboratory setting where conditions may not simulate exactly those found in the natural environment.
- There is some disagreement among practitioners about what constitutes acceptable and unacceptable aquatic impacts.
- Organisms' actual exposure to pollutants in stormwater is generally limited. Many toxicants in runoff are usually in biologically less available forms. Standard toxicity limits (generally developed under simulated baseflow conditions) are therefore, not wholly representative of stormwater toxicity response.
- A large quantity of the test organisms must be available quickly and the health of these organisms must be established through reference or control conditions.
- Reliance on single species tests or using only one species may not provide an accurate assessment of ambient toxicity.

Case Study: Hall, K.J.; B.C. Anderson. 1988
The Toxicity and Chemical Composition of Urban Stormwater Runoff
Canadian Journal of Civil Engineering, Vol. 15, pp. 98-106 (1988)

The authors studied the effects of land use on the chemical composition of urban stormwater runoff and its subsequent acute toxicity to the aquatic invertebrate *Daphnia pulex* in a drainage basin in British Columbia. It was determined that both land use and interval between rainfall events influenced the chemical composition and toxicity of the stormwater. Six of the twelve sites studied produced stormwater that was toxic to some degree. Stormwater from all open and/or green space areas was nontoxic to *Daphnia* in static 96-h tests. The frequency of occurrence of toxicity in stormwater, in relation to land use, appeared to be commercial > industrial > residential > open space.

An examination of the pattern of toxicity in the watershed showed higher toxicity in the upper and lower reaches of the basin; those sites in the middle of the basin all had runoff that was nontoxic. In general, these middle reaches of the basin are at the lower, gently sloping elevations, close to the main water bodies and have been predominantly used for residential and open and/or green space land uses.

In laboratory bioassays with *Daphnia*, toxicity of iron was low and it reduced the toxicity of other metals. Lead increased the toxicity of copper and zinc. There was an increase in metal toxicity as pH decreased and suspended solids concentrations increased. The laboratory experiments begin to explain the variable nature of stormwater toxicity and provide an understanding of why field measurements of toxicity in stormwater can change rapidly, as a storm flushes particulate and soluble materials from the watershed.

Method References:

- Acute and chronic toxicity testing: Sayre, P.G.; D.M. Spoon, D.G. Loveland. 1986. Use of Heliophrya sp., a Sessile Suctorian Protozoan, as a Biomonitor of Urban Runoff. In: *Aquatic Toxicology and Environmental Fate: Ninth Volume*. Philadelphia, April 14-16, 1985. ASTM Special Technical Publication 921.
- Microtox: Morrison, G.M. et al. 1993. Variations of Environmental Parameters and Ecological Response in an Urban River. *Water Science and Technology,* 27(12):191-194.
- Long-term in-situ testing: Day. K.E. et al. 1990. Changes in Intracellular Free Amino Acids in Tissues of the Caged Mussel, *Elliptio complanata*, Exposed to Contaminated Environments. In: *Archives of Environmental Contamination and Toxicology.* New York. Vol 19, No. 6, pp 816-827.
- Toxicity identification evaluation (TIE) procedures: S.R. Hansen and Associates. 1994. *Identification and Control of Toxicity in Storm Water Discharges to Urban Areas: Final Report.*
- Marsh, J.M. 1993. Assessment of Nonpoint Source Pollution in Louisville, (Jefferson County), Kentucky. In: *Archives of Environmental Contamination and Toxicology.* New York. Vol 25, No. 4, pp. 446-455.
- U.S. Environmental Protection Agency. 1992. A Pilot Study for Ambient Toxicity Testing in Chesapeake Bay. Annapolis, MD. U.S. EPA Contract No. 68-WQ-00-43.
- Weber, C. I. (ed). 1991. Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms (Fourth Edition). EPA/600/4-90/027 Environmental Monitoring Systems Laboratory, Cincinnati, OH.

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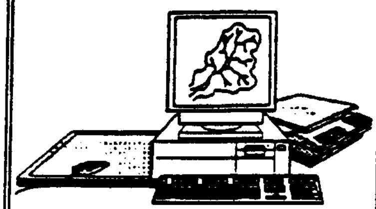

Indicator Profile No. 3

Nonpoint Source Loadings

Category: **Water Quality**

Tools Used to Measure Indicators:

- Computer Simulation Models (HSPF, SWMM, SLAMM, ILLUDAS, WASP)

Description:

Nonpoint source (NPS) pollutant loadings represent the amount of pollutant in stormwater runoff from various land uses. NPS loadings are not directly measured, but instead are estimated based on empirical monitoring data, land use imperviousness and cover, area, and rainfall volume. NPS loadings can be used to estimate baseline water quality or to determine the relative decrease or increase in NPS pollutant loads due to changes in land use or implementation of restoration efforts.

NPS loading estimates can be calculated using the simple method or simulation models. The simple method is appropriate for small-scale studies. Comprehensive NPS loading estimates may be obtained with simulation models such as HSPF, SLAMM, or SWMM. Changes in NPS pollutant loadings in response to changes in watershed land use (typically pre-developed, existing, and anticipated future conditions) can be estimated using simulation models. Estimates may be reported on an average annual or seasonal mass basis or for a single storm event.

Utility of Indicator to Assess Stormwater Impacts:

- Trends in NPS pollutant loadings can be compared with land use changes or implementation of BMPs to assess potential increases or reduction in NPS pollution.
- Can be used to help identify major land uses which are significant sources of NPS pollution.
- Can be used as a planning tool to evaluate loads associated with different development options.
- Can be used to help identify portions of a watershed where loadings may be concentrated and pollutant accumulation is likely.

Indicator Useful for Assessing:

• Aquatic Integrity of:	
Lakes	◐
Streams	◐
Estuaries	◐
• Land Use Impacts	◐
• Stormwater Mgmt Programs	◐
• Whole Watershed Quality	◐
• Industrial Sites	◐
• Municipal Programs	◐

Key:	
Very Useful	●
Mod. Useful	◐
Not Useful	○

Indicator Advantages

• Geographic Range	●
• Baseline Control	○
• Reliable	◐
• Accuracy	◐
• Low cost	○
• Repeatable	●
• All Watershed Scale	◐
• Familiar to Practitioners	◐
• Easy to use & Low training	○

Key	
Very Advantageous	●
Mod. Advantageous	◐
Not Advantageous	○

Cost

See Table 3.3A

Advantages of Method:

- Calibrated NPS loading models can quickly and efficiently evaluate many different land use development options.
- Good method for evaluating pollutant load distribution throughout a watershed with respect to various land uses and restoration strategies.
- Allows for geographic analysis of watersheds and priority ranking of possible nonpoint sources.
- Identifies which NPS pollutants are most prevalent, allowing for programs targeted at reducing those specific pollutants.
- Calibrated NPS loading models partially alleviate the need for additional water quality monitoring.

Disadvantages of Method:

- Accuracy in estimating NPS pollutant load may vary from method to method and model to model.
- Development and calibration of watershed NPS loading models can be relatively expensive and time consuming. It may take several years to accurately evaluate trends in NPS loads.
- Accurate modeling requires fairly sophisticated data collection conducted over several years and a reasonably in-depth personnel training program.
- BMP pollutant removal efficiencies used in modeling may substantially differ from actual removal rates.
- Focus on urban stormwater loading and in-stream pollutant concentrations can be misleading in assessing land use impacts since these indicators do not address critical hydrological impacts and effects.

Case Study: Wulliman, J.T., 1994

Application of Nonpoint Source Loading Relationships to Lake Protection Studies in Denver, Colorado

Pawlukiewicz, J.; et. al. (eds.), 1994. Proceedings from Watershed '93: A National Conference on Watershed Management., Alexandria, VA., Mar 21-24, 1993., USEPA No. 840-R-94-002

The paper evaluates various approaches to estimate nonpoint source loads from watershed areas to help assist watershed managers in selecting alternative options. Ten loading estimation options, consisting of 4 basic methods are presented. They consist of various levels of analysis ranging from simple calculations to complex approaches which require hydrologic modeling and site-specific monitoring. The four methods are: the Unit Load Method, where loads are calculated based on a unit loading rate multiplied by the upstream drainage area; the EMC Method, where loads are expressed as the product of the constituent concentration and the runoff volume; the Regression Method, where watershed loads are estimated using regression relationships developed from local, regional, or national stormwater monitoring data; the Sediment Method, where loads are expressed as the product of the constituent concentration and the sediment volume. A number of these options have been used effectively in lake protection studies in the Denver area. In selecting which option to use, it is important to keep in mind the accuracy required and the budgetary limits. In general, there is a direct relationship between the accuracy and the level of complexity of the method. The Unit Load Method, for example is relatively quick and simple to calculate loads but does not incorporate physical hydrologic processes or site specific data and therefore may yield highly uncertain results. The other methods may be much more accurate but require a more sophisticated approach and are more difficult and costly to perform.

Method References:

- Simulation models (HSPF): Dinicola, R.S., 1990. *Characterization and Simulation of Rainfall-Runoff Relations for Headwater Basins in Western King and Snohomish Counties, Washington State.* 55 pp.
- Simulation models (HSPF, ILLUDAS, SWMM): Dendrou, S.A., 1982. Overview of Urban Stormwater Models., *In: Urban Stormwater Hydrology*, American Geophysical Union, Washington, DC. Water Resources Monograph 7, 1982. p. 219-247
- Simulation models (WASP): DiToro, D.M.; J.J. Fitzpatrick; R.V. Thomann, 1983. *Documentation for Water Quality Analysis Simulation Program (WASP) and Model Verification Program (MVP).* Westwood, New Jersey. Hydroscience, Inc. EPA600381044.
- Simulation models (SLAMM): Pitt, R.; J. McLean, 1986. *Toronto Area Watershed Management Strategy Study - Humber River Pilot Watershed Project.* Toronto, Canada. Ontario Ministry of the Environment, June 1986.
- Simulation models (general): Hoos, A.B.; J.K. Sisolak, 1993. *Procedures for Adjusting Regional Regression Models of Urban-Runoff Quality using Local Data.* USGS, Open File Report 93-39, 1993, 39p.
- Simple method: Schueler, T.R., 1987. *Controlling Urban Runoff: A Practical Manual for Planning and Designing Urban BMP's.* Metropolitan Washington Council of Governments, Publication No. 87703

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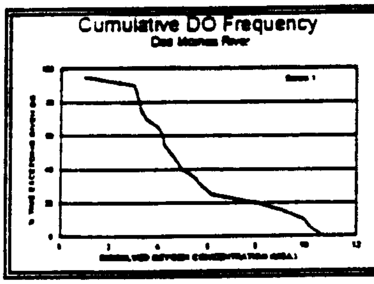

Indicator Profile No. 4

Exceedance Frequencies of Water Quality Standards

Category: **Water Quality**

Tools Used to Measure Indicator:

- Chemical Monitoring
- Trend Analysis

Description:

Water quality standards have been established by federal, state, and local governments for various pollutants and receiving water classifications. The frequency with which a particular standard is exceeded or the percentage of water bodies, river-miles, or lake-acres failing to meet designated uses may be indicative of the relative success or failure of stormwater management efforts.

While physical characteristics (e.g., downcutting, flooding) and biological parameters (e.g., assemblage or diversity) could be evaluated by this method, few jurisdictions have standards for such parameters. Consequently, current use of this indicator is based primarily on chemical standards.

The frequency analysis can incorporate data already collected by local and State agencies as part of the 305(b) reporting process. Section 305(b) of the Federal Water Pollution Control Act requires States to prepare a biennial report including analyses of the extent to which pollution reduction; maintenance of specified levels of water quality; and protection of aquatic habitat, wildlife, and recreational usage has been achieved.

Utility of Indicator to Assess Stormwater Impacts:

- Can be used to evaluate the performance of stormwater BMPs with respect to various storm frequencies.
- Can be used to identify long-term and seasonal trends in regional water quality.
- Can be used to characterize water quality impacts due to urban runoff with respect to various storm categories (frequent storms, flood events).
- Can be used to document periods of poor water quality (e.g., following large storm events, during low-flow summer months).

Indicator Useful for Assessing:

- Aquatic Integrity of:
  - Lakes ●
  - Streams ●
  - Estuaries ●
- Land Use Impacts ◖
- Stormwater Mgmt Programs ◖
- Whole Watershed Quality ◖
- Industrial Sites ●
- Municipal Programs ◖

Key:	
Very Useful	●
Mod. Useful	◖
Not Useful	○

Indicator Advantages

- Geographic Range ●
- Baseline Control ●
- Reliable ◖
- Accuracy ◖
- Low cost ○
- Repeatable ●
- All Watershed Scale ◖
- Familiar to Practitioners ●
- Easy to use & Low training ●

Key	
Very Advantageous	●
Mod. Advantageous	◖
Not Advantageous	○

Cost

See Table 3.3A

Advantages of Method:

- Many jurisdictions already have long-term databases which may be examined to determine if standard exceedances are increasing in frequency (trend analysis).
- Required sampling and parameter determination for this indicator are already incorporated into regular monitoring programs and the 305(b) reporting process in many jurisdictions.
- Results are easy to interpret, making the method a good tool for initiating policy actions, securing funding sources, etc.
- Provides a reliable and legally defensible benchmark for enforcement actions.

Disadvantages of Method:

Exceedance frequencies are developed on a constituent by constituent basis. Comprehensive assessment of a particular water body or stormwater management effort requires identification and evaluation of several parameters and standards.

- Several sample locations are required within a relatively small area to determine the actual cause or source of the standard exceedance.
- Exceedance frequencies alone may not identify the causes and sources of observed degradation. Additional long-term and/or longitudinal monitoring may be required, especially if in-stream samples are used.
- Most criteria and standards are based on a few chemical water quality parameters that present indirect measure of the presence or absence of aquatic life.
- There are almost none that are based on physical or biological parameters that reflect the actual versus inferred presence or absence or aquatic species.
- Exceedance frequency may be an artifact of monitoring effort as much as water quality degradation. The more frequently monitoring is conducted, the more likely exceedances will be detected.
- Exceedance of a water quality standard or criteria may only occur briefly during storm events. Exceedance of the standard may not be reflected in the sample collected, and actual long-term impacts on the aquatic community are difficult to predict.

Case Study: Cooke, T.; Drury, D.; Katznelson, R.; Lee, C.; Mangarella, P.; Whitman, K. 1995
Storm Water NPDES Monitoring in Santa Clara Valley
Stormwater NPDES-Related Monitoring Needs. Conference Proceedings. 1995.

The authors compared metals monitoring data from four years of sampling with water quality objectives contained in the April 1991 California Inland Surface Waters Plan. Dissolved concentrations seldom exceeded objectives, whereas total metal concentrations exceeded the objectives with greater frequency. Most exceedances occurred at stations whose watersheds were smaller and more highly urbanized. Exceedances of objectives by dissolved metal concentrations were considered better indicators of potential toxicity problems than exceedances by total metals concentrations because dissolved metals are more bioavailable.

The duration of exceedance was also measured at one station. The duration of exceedance of acute water quality objectives for total copper, lead and zinc was always less than the duration of the storm runoff event. The frequency of exceedance varied depending on the metal, and was greatest for copper, followed by zinc and lead. For those cases where an exceedance was measured, the average duration of exceedances, expressed as a percent of the storm duration, was approximately 60% for copper, 40% for zinc, and about 20% for lead.

Method References:

- Frequency Exceedances: Yamane, C.M.; M.G. Lum, 1985. *Quality of Storm-Water Runoff, Mililani, Oahu, Hawaii, 1980-1984.* USGS Water-Resources Investigations Report 85-4265.

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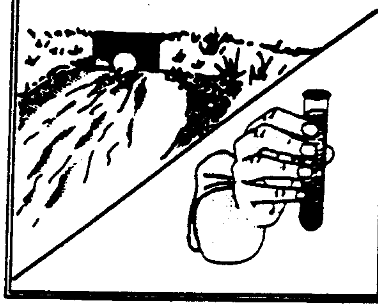

Indicator Profile No. 5

Sediment Contamination

(Constitutent/toxicity analysis)

Category: **Water Quality**

Tools Used to Measure Indicator:

- Constituent Concentrations
- Sediment Quality Assessment Guidelines
- Spectrophotometry
- Chromatography

Description:

Many pollutants found in stormwater runoff, such as metals, organic toxins, and aromatic compounds, become attached to sediments and settle to the bottom in slower receiving waters, wetlands, and stormwater retention and detention basins. The presence and mass concentration of pollutants can be determined through spectrometric and chromatographic analyses of sediment samples.

Sampling may be conducted in natural water bodies (e.g. streams, lakes, estuaries) or artificial basins (e.g. detention ponds). To determine whether sediments are contaminated by anthropogenic sources, samples are often compared to a reference water body where human impacts are minimal or nonexistent. The mass of contaminant is often cross-referenced with the distance from the suspected pollutant discharge location (e.g., stormwater outfall) or source (e.g., urban area).

Sediment may adversely impact the aquatic community. Benthic organisms feed and dwell in the bottom sediments. Nonbenthic organisms are potentially exposed to sediment contaminants through re-suspension, ingested benthic organisms, and exposure to the sediment as it settles to the bottom.

In order to identify potential ecological effects, contaminant concentrations may be compared to sediment quality assessment guidelines. Ecological impacts may also be assessed through analysis of the associated interstitial (pore) water and water immediately overlying the sediment. This water can be collected and analyzed for conventional pollutants. Acute and chronic toxicity testing of the water immediately overlying the sediment may be conducted either in the field or in the laboratory. Toxicity testing of the interstitial water and the sediment elutriates (recreated sediment suspensions) are performed in the laboratory.

Indicator Useful for Assessing:

* Aquatic Integrity of:	
Lakes	●
Streams	◖
Estuaries	●
* Land Use Impacts	◖
* Stormwater Mgmt Programs	◖
* Whole Watershed Quality	◖
* Industrial Sites	◖
* Municipal Programs	◖

Key:

Very Useful	●
Mod. Useful	◖
Not Useful	○

Indicator Advantages

* Geographic Range	◖
* Baseline Control	◖
* Reliable	◖
* Accuracy	◖
* Low cost	○
* Repeatable	◖
* All Watershed Scale	○
* Familiar to Practitioners	●
* Easy to use & Low training	◖

Key

Very Advantageous	●
Mod. Advantageous	◖
Not Advantageous	○

Cost

See Table 3.3A

Utility of Indicator to Assess Stormwater Impacts:

- Analysis of the sediment within urban embayments can provide an indication of the level of contamination and, by proximity, the probable source of contamination in the drainage area.
- Analysis of samples taken within and/or immediately upstream and downstream of stormwater management facilities can be used to evaluate the performance of BMPs.
- Trends in sediment pollutant levels over time can reveal long-term changes in pollutant loadings.
- Can be used to evaluate local stormwater management efforts for the control of particular pollutant sources over the long term.

Advantages of Method:

- The relatively static nature of this indicator may increase public interest and involvement in stormwater issues.
- The likelihood that sediment pollutants come from nearby sources promotes local accountability thereby reducing the potential for jurisdictions to blame problems on others and instead encouraging them to assume responsibility for restoration.

Disadvantages of Method:

- There are few criteria or standards against which ambient sediment pollutant concentrations may be compared.
- Levels of concern and the long-term impact of sediment pollutant concentrations with respect to ecological impacts are still being studied and are not clearly defined.
- The method requires numerous samples (both spatially and at various depths) to determine whether pollutants come from anthropogenic sources.
- The method is useful only for pollutants that become adsorbed to dense particulates.
- Since sedimentation occurs primarily in low-energy embayments, the indicator is less appropriate for use in free-flowing channels.
- The usefulness of this indicator for "real-time" assessment of current pollutant reduction measures is limited due to resuspension of sediments, dredging, and other activities which inhibit the short-term settlement of pollutants.
- Several decades may be necessary to accumulate sufficient data for trend analysis.
- Industrial spills, wastewater discharges, illicit connections, atmospheric deposition and runoff from agricultural and industry sources can all deliver pollutants to sediments, making it very difficult to trace the actual source.
- While suspended in the water column, pollutants may undergo differential chemical behavior, microbial degradation, and photo-degradation. Correlation of the original pollutant source to pollutants identified in the sediment may, therefore, be difficult.

Case Study: Byrne, C.J.; DeLeon, I.R. 1987
Contributions of Heavy Metals from Municipal Runoff to the Sediments of Lake Pontchartrain, Louisiana
Chemosphere, Vol. 16, Nos. 10-12: 2579-2583, 1987.

The authors analyzed sediment samples from eight stations along the northern and southern shorelines of Lake Pontchartrain to determine the distribution and sources of heavy metal pollutants. Sampling sites were at stormwater runoff canals, the mouth of a highly industrialized canal, and the mouths of two lake tributaries. The authors used atomic absorption spectrometry to determine sediment concentrations of barium, copper, nickel, lead, and zinc. Metal concentrations tended to increase with increasing population densities, with the most highly impacted areas being adjacent to the metropolitan area of New Orleans. Lower metal concentrations were found in suburban/residential areas, with the lowest levels observed at the rural, low-density station.

Method References:

- Chemical Monitoring: Taylor, G.F. 1990. *Quantity and Quality of Stormwater Runoff from Western Daytona Beach, Florida, and Adjacent Areas*. USGS Water-Resources Investigations Report 90-4002.
- Toxicity testing: ASTM. 1995. Standard Guide for Collection, Storage, Characterization and Manipulation of (Freshwater/Saltwater) Sediments for Toxicological Testing. in Annual Book of ASTM Standards, Section II. Water and Environmental Technology. Vol 11.05.
- Biological monitoring/bioassays: Dermott, R.; M. Munawar. 1992. A Simple and Sensitive Assay for Evaluation of Sediment Toxicity Using *Lumbriculus variegatus* (Mueller). In: Hart, B.T.; Sly, P.G. (eds). *Sediment-Water Interactions*. Vol. 235-6, pp. 407-414.
- Contaminated sediment: U.S. EPA. 1994. EPA's Contminated Sediment Management Strategy-Reinventing Bovernment to Streamline Dicision-making. Washington, DC 151p. EPA/823/R-94/001

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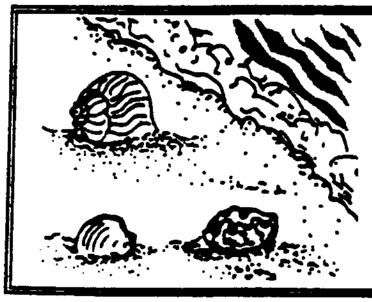


Indicator Profile No. 6

Human Health Criteria

Category: **Water Quality**

Tools Used to Measure Indicator:

- Bacteria concentrations
- Shellfish Bed Closures
- Fishing Restrictions
- Beach Closures

Description:

Bacteria (usually fecal coliform, *Escherichia coli*, or *enterococci)* are often used as indicators of human pathogens in the water column. Large bacterial concentrations are assumed to be indicative of harmful levels of pathogens. Pathogens are of special concern in shellfish harvesting and recreational contact waters. Water quality criteria for these uses are among the strictest of all water use classifications.

Contact recreation such as water-skiing and swimming potentially expose humans to harmful pathogens; when bacterial levels exceed established standards, beaches may be closed. Since shellfish are filter feeders, they tend to accumulate pathogens in their tissues. When bacteria concentrations exceed the acceptable standard, it is assumed that shellfish taken from the area are unfit for human consumption. Consequently, the shellfish beds are closed to recreational and commercial harvesting.

Because bacteria concentrations tend to sharply increase following storm events, it is strongly suspected that stormwater runoff contributes significantly to elevated bacteria levels. A change in the frequency of shellfish bed closures or beach restrictions, therefore, can provide an early indication of degradation and may be used to assess the effectiveness of stormwater management programs.

Increases in fishing restrictions may also indicate degradation due to urban runoff. Similar to shellfish, fish tend to accumulate pathogens in their tissue. It should be noted that not all fishing restrictions are due to elevated bacterial concentrations. Restrictions may also be implemented in response to high toxic metal, or other pollutant concentrations.

Utility of Indicator to Assess Stormwater Impacts:

- The tendency for many shellfish beds to be closed immediately following a storm event suggests that it can be used as an indicator of short term stormwater impacts.
- Consistent, long-term shellfish bed closures and beach restrictions can be used to detect early stages of water quality degradation.
- Can be used to assess the relative effectiveness of stormwater BMPs or watershed restoration efforts.
- Can be used as a motivational tool for initiating public support for stormwater management efforts.

Indicator Useful for Assessing:

* Aquatic Integrity of:	
Lakes	●
Streams	○
Estuaries	●
* Land Use Impacts	◖
* Stormwater Mgmt Programs	◖
* Whole Watershed Quality	○
* Industrial Sites	○
* Municipal Programs	◖

Key:	
Very Useful	●
Mod. Useful	◖
Not Useful	○

Indicator Advantages

* Geographic Range	○
* Baseline Control	◖
* Reliable	◖
* Accuracy	◖
* Low cost	◖
* Repeatable	●
* All Watershed Scale	○
* Familiar to Practitioners	●
* Easy to use & Low training	◖

Key	
Very Advantageous	●
Mod. Advantageous	◖
Not Advantageous	○

Cost

See Table 3.3A

Advantages of Method:

- Provides an early indication of water quality degradation and allows managers to address the problem before it becomes substantial.
- Since no shellfish may be harvested near areas with wastewater treatment plants, bed closures located away from such areas are more likely to indicate problems resulting from stormwater runoff.
- Long-term data is usually available for trend determination.
- The public is generally knowledgeable about this issue; consequently, this indicator may generate public pressure on officials to initiate cleanup efforts.
- Beach closures and shellfish bed closures impact the local economy which increases the likelihood that government officials and the business community will support pollution reduction efforts.

Disadvantages of Method:

- Many of the bacterial species used in human health criteria are common in soil, in other warm-blooded animals, and on the surface of plants, making it difficult to ascertain whether water quality problems are human-induced.
- There is some debate about which bacteria best correlates with presence of human pathogens.
- There are several anthropogenic sources of indicator bacteria (e.g. industrial wastewater, septic systems, agricultural and stormwater runoff), making it somewhat difficult to determine which specific source or sources require management measures.
- Application is limited only to areas where bacteria is regularly monitored, usually shellfish harvesting areas and recreational waters.
- Coliform dies off rapidly when introduced to surface waters and high concentrations can return to normal levels in a matter of days. This makes it difficult to determine whether stormwater runoff causes a chronic water quality problem.
- Relatively little is known about the capability of stormwater BMP's to actually remove bacteria from urban runoff.

Case Study: Barber, R; Ohrel, R.; Fowler, P.; Gilbert, G.
Why We Are Convinced That Traditional Strategies for Wastewater Management Are Not Working
Symposium Proceedings: Integrated Coastal Wastewater Management in North Carolina. 1994.

In the North Carolina coastal region from Cedar Island to the South Carolina border, there have been increases and decreases in the acreage of shellfish beds closed to harvesting during the period 1980-1992. A large net annual decrease in prohibited area occurred once (1983/1984) in the Cape Fear River and the New River. This decrease in prohibited area resulted from both improvements in and elimination of point source discharges. When Cape Fear River and New River areas are excluded from the analysis, the remaining coastal region is shown to have increases in prohibited areas which have been steady and small, but numerous and widespread. The pattern of steady, widespread, and small annual increases in prohibited area does not match the pattern of agricultural or forestry activities; instead, the observed pattern suggests that expanding coastal development, with its associated increase in land disturbance, drainage, and urban runoff, is responsible for the observed pattern of degradation.

North Carolina's anti-degradation policy that protects existing uses of public trust waters. The evidence of shellfish bed closures indicates that State procedures for permitting development adjacent to shellfish waters do not protect the existing uses in those waters; that is, the permit process consistently violates North Carolina's anti-degradation policy.

Method References:

- Closure trends: North Carolina Division of Health Services, Shellfish Sanitation Program. 1988. *An Overview of Shellfish Growing Areas Since 1980.*
- Bacterial measurements: American Public Health Association, American Water Works Association, and Water Pollution Control Federation. 1989. *Standard Methods for the Examination of Water and Wastewater, 17th ed.* American Public Health Association, Washington, D.C.
- Bacterial measurements: Water Environment Federation. 1992. *The Detection of Pathogens in Storm-Generated Flows.* Alexandria, Virginia.

Environmental Indicator Profile Sheet

Indicator Profile No. 7

Stream Widening/Downcutting

Category: **Physical and Hydrological**

Tools Used to Measure Indicator:

- Stream cross-sectional geometry measurements
- Prevalence of stream bank erosion
- Sediment embeddedness

Description:
The change in stream geometry is measured over time to determine the extent of channel widening/downcutting in response to changes in the magnitude and frequency of stormflows. Stream channel and bank erosion can be documented by measuring channel cross-sections at monumented locations, by measuring channel bankfull width and depth of representative reaches or by measuring the percent of channel-bank scour within specified channel reach lengths. Measurements should be conducted over a period of time in response to upstream land use changes.

Utility of Indicator to Assess Stormwater Impacts:

- Can be used to help document stream segments which are susceptible to channel erosion (by comparison to other stream systems with similar channel slopes and geologic materials).
- Can help provide documentation regarding the rate of stream channel erosion as a function of increased urbanization.
- Can be useful to estimate BMP quantity effectiveness, and in documenting locations where additional controls are needed to protect the stream.
- Can be useful in estimating habitat quality and therefore provide information regarding whether water quality or excessive flow discharges are limiting factors in a stream with respect to overall aquatic health.
- Can help a municipality develop better storm event management criteria to reduce streambank erosion.

Advantages of Method:

- Reasonably easy to measure. Requires little specialized equipment and only minor training.
- Can provide similar results regardless of the experience or preferences of the investigator, very repeatable.
- Inexpensive and conducive to rapid assessment techniques.
- Valuable in assessing impacts over time as a result of upstream land use changes.
- Can help relate post-development changes in stream hydrology to changes in stream habitat.

Indicator Useful for Assessing:

* Aquatic Integrity of:	
Lakes	○
Streams	●
Estuaries	○
* Land Use Impacts	●
* Stormwater Mgmt Programs	◖
* Whole Watershed Quality	●
* Industrial Sites	◖
* Municipal Programs	●

Key:	
Very Useful	●
Mod. Useful	◖
Not Useful	○

Indicator Advantages

* Geographic Range	●
* Baseline Control	●
* Reliable	●
* Accuracy	●
* Low cost	●
* Repeatable	●
* All Watershed Scale	◖
* Familiar to Practitioners	●
* Easy to use & Low training	●

Key	
Very Advantageous	●
Mod. Advantageous	◖
Not Advantageous	○

Cost

See Table 3.3B

Disadvantages of Method:

- Many stream networks may have already been substantially modified by channelization or storm drain enclosure.
- May not accurately assess aquatic habitat impacts in the absence of stream channel erosion.
- Is not by itself a predictive indicator. Once stream widening and downcutting are observed, degradation associated with upstream land uses is already occurring. The absence of erosive conditions may lead to false conclusions regarding future disturbances.
- May not adequately evaluate current land use impacts where past erosion and sedimentation has modified natural stream morphological processes (e.g., in urbanizing areas with past intensive agricultural land uses).
- May not be applicable for larger streams and rivers.

Case Study: Krug, W.R.; G.L. Goddard, 1986
Effect of Urbanization on Streamflow, Sediment Loads, and Channel Morphology in Pheasant Branch Basin Near Middleton, Wisconsin
USGS Water-Resources Investigations Report 85-4068

A five year monitoring and modeling study was conducted on Pheasant Branch basin near Middleton, WI. The study analyzed the effects of urbanization on streamflow characteristics, sediment loads and channel morphology and took steps to predict the future effects associated with urbanization. The results of the study showed significant increases in sedimentation downstream from highly urbanized areas. Stream beds were lowered an average of two feet and significant stream widening occurred over the five year period downstream from the fully urbanized portion of the basin. Storm runoff modeling of full urban buildout revealed that simulated mean annual flood peaks would increase by more than a factor of 2 and stream widening would increase another 40 to 50% over current conditions.

Method References:

- Stream cross-sectional area measurements: Booth, D.B. 1994. *A Protocol for Rapid Channel Assessment*, Unpublished Report, Available from King County, Washington, Surface Water Management Division, Water Resources Section.

- Prevalence of stream bank erosion: MacRae, C.R.; A.C. Rowney, 1992. The Role of Moderate Flow Events and Bank Structure in the Determination of Channel Response to Urbanization. In: *Proceedings: Canadian Water Resources Association, Kingston, Ontario., 45th Annual Conference Resolving Conflict and Uncertainty in Water Management, June 1992.*

- Sediment embeddedness: Plafkin, J.L.; M.T. Barbour, K.D. Porter, S.K. Gross, R.M. Hughes, 1989. *Rapid Bioassessment Protocols for use in Streams and Rivers Benthic Macroinvertebrates and Fish.* Report No. EPA/440/4-89/001.

Environmental Indicator Profile Sheet

Indicator Profile No. 8

Physical Habitat Quality

Category: **Physical and Hydrological**

Tools Used to Measure Indicator:

- Rapid Bioassessment Protocols (Habitat Assess.)
- Rapid Stream Assess. Technique (RSAT)
- Lake Habitat Quality Index

Description:
Physical habitat evaluations are conducted to determine the potential of waterbodies to sustain aquatically healthy systems. Degradation is evaluated to assess whether or not habitat or water quality is the limiting factor to aquatic biodiversity. Specific measurements of streams include channel stability, channel cover, instream sediment embeddedness and substrate condition, riffle, run, pool structure, and riparian habitat. Lake and estuary measurements include: prevalence of submerged aquatic vegetation, percent littoral dominance, depth variation, substrate condition, shoreline development, and submerged structure.

Utility of Indicator to Assess Stormwater Impacts:
- Can help isolate and assess whether water quality or habitat is the limiting factor for aquatic biological health by evaluating what aquatic community might be expected to be present based on habitat alone.
- Can evaluate restoration potential based on the presence or absence of habitat characteristics.
- Can be used as the basis to enhance physical structure of a stream system to increase or maintain available habitat.
- Can help identify causes of degraded habitat (e.g., uncontrolled stormwater runoff).

Advantages of Method:
- Reasonably inexpensive and conducive to rapid assessment techniques.
- Reasonably easy to measure. Requires little specialized equipment and moderate training.
- Provides information on past, present, and potential future channel morphology when conducted over time.
- Useful in detecting the impacts of relatively low levels of development on stream habitat (e.g., trout streams).

Disadvantages of Method:
- May not accurately assess water quality impacts where habitat is in good condition but biological integrity is impaired.
- May be difficult to identify the sources of degraded habitat.
- Results may vary depending on the preferences and experience of the investigator.

Indicator Useful for Assessing:

* Aquatic Integrity of:	
Lakes	◐
Streams	●
Estuaries	◐
* Land Use Impacts	●
* Stormwater Mgmt Programs	◐
* Whole Watershed Quality	●
* Industrial Sites	○
* Municipal Programs	◐

Key:	
Very Useful	●
Mod. Useful	◐
Not Useful	○

Indicator Advantages

* Geographic Range	●
* Baseline Control	●
* Reliable	●
* Accuracy	◐
* Low cost	●
* Repeatable	●
* All Watershed Scale	●
* Familiar to Practitioners	●
* Easy to use & Low training	●

Key	
Very Advantageous	●
Mod. Advantageous	◐
Not Advantageous	○

Cost

See Table 3.3B

Case Study: Maxted, J.R.; E.L. Dickey, G.M. Mitchell, 1994
Habitat Quality of Delaware Nontidal Streams
From Delaware Section 305(b) Report, 1994, Appendix D

Habitat assessments were conducted at 189 sites throughout the state of Delaware during the fall of 1991 and 1993. Sampling stations were selected randomly to provide results which could be statistically extrapolated to the entire state. 87% of all nontidal streams in Kent and New Castle Counties and 78% of all perennial streams throughout the state were found to have degraded physical habitat. The majority of the degraded sites were severely degraded compared to reference conditions. In the Northern Piedmont region, the habitat degradation was caused primarily by urbanization and stormwater. Peak stormwater flows with erosive velocities have caused stream bank failure and channel substrate sedimentation. Management implications are presented. They include the need for aggressive compliance with the state's Sediment and Stormwater Control Regulations.

Method References:

- Rapid Bioassessment Protocols (Habitat Assessment): Plafkin, J.L.; M.T. Barbour, K.D. Porter, S.K. Gross, R.M Hughes., *1989. Rapid Bioassessment Protocols for use in Streams and Rivers Benthic Macroinvertebrates and Fish*. Report No. EPA/440/4--89/001.

- Rapid Stream Assessment Technique (RSAT): Galli, J. Unpublished Notes, Available through the Metropolitan Washington Council of Governments. 777 North Capitol Street, NE, Washington, D.C. 20002.

- Qualitative Habitat Quality Index (QHEI): Rankin, E. 1989. The Qualitative Habitat Evaluation Index (QHEI): Rationale, Methods, and Application. State of Ohio, Environmental Protection Agency. Columbus Ohio.

Environmental Indicator Profile Sheet

Indicator Profile No. 9

Impacted Dry Weather Flows

Category: **Physical and Hydrological**

Tools Used to Measure Indicator:
- Monitoring stream low flow data over time as land use changes.
- Comparing urban stream low flows with nearby rural stream low flows.

Description:
Dry weather flows are measured over a period of time to assess the effects of urbanization on stream base flow. An alternative approach is to analyze streamflow data for various urban streams and compare this data with streamflow data from nearby rural areas (within the same physiographic ecoregion). This alternative approach may require further partitioning for valid comparisons (e.g., within the same physiographic/geologic regime).

In more humid climates, the indicator is reduced dry weather flows (as urbanization increases) as a result of decreased groundwater recharge. In more arid climates, the indicator is increased dry weather flows (as urbanization increases) as a result of increased irrigation/domestic water use.

Dry weather water chemistry, as a result of illicit connections or other discharges, may degrade with increasing urbanization (reviewed as part of pollutant constituent monitoring, Indicator Profile No. 1).

Utility of Indicator to Assess Stormwater Impacts:
- Can assess the low flow quantity effects of increased urbanization.
- Can help assess the causes of reduced low flows in streams by evaluating effects associated with sanitary sewer and storm drainage pipe installation and by evaluating effects of increased impervious surfaces (humid climates).
- Can be used to help watershed managers to institute practices which encourage groundwater recharge and minimize impervious areas.
- Can help assess the causes of increased low flows in streams by evaluating domestic water usage and behavior patterns (arid climates).
- Degraded water chemistry, during low flow conditions can help identify pollutant causes and sources.
- Extremely useful when done in conjunction with stream widening/downcutting studies.

Indicator Useful for Assessing:

* Aquatic Integrity of:	
Lakes	○
Streams	●
Estuaries	○
* Land Use Impacts	◖
* Stormwater Mgmt Programs	◖
* Whole Watershed Quality	◖
* Industrial Sites	○
* Municipal Programs	◖

Key:
Very Useful ●
Mod. Useful ◖
Not Useful ○

Indicator Advantages

* Geographic Range	◖
* Baseline Control	◖
* Reliable	◖
* Accuracy	○
* Low cost	◖
* Repeatable	◖
* All Watershed Scale	●
* Familiar to Practitioners	◖
* Easy to use & Low training	●

Key
Very Advantageous ●
Mod. Advantageous ◖
Not Advantageous ○

Cost

See Table 3.3B

Advantages of Method:

- Provides a direct indicator of low flow quantity as related to watershed urbanization.
- Relatively easy to monitor flows and report results.
- Reduced stream low flow is easily understood by the general public who can apply pressure on decision makers to make appropriate land use decisions (humid climates).
- Most useful in assessing the impact of development on headwater streams.

Disadvantages of Method:

- May take several years to obtain statistically valid results showing trends in flow data with increasing urbanization.
- May not adequately address varying geologic or climatic conditions where other influences (such as irrigation, well drawdown, public water supply use, sea water intrusion, long term drought, etc.) can affect results, unless method is partitioned to account for this variability.
- Areas with excessively poor natural infiltration rates may show inconclusive trends with changing land use.
- The handful of studies conducted have not shown consistent trends.
- Trends are hard to detect in larger streams or where long term hydrology records are not available.
- In arid climates, where low flow tends to increase with increasing urbanization, resultant condition may be perceived by some as more beneficial than natural conditions.

Case Study: Ferguson, B.K.; P.W. Suckling, 1990
Changing Rainfall-Runoff Relationships in the Urbanizing Peachtree Creek Watershed, Atlanta, Georgia
Water Resources Bulletin, American Water Resources Association, Vol. 26, No. 2

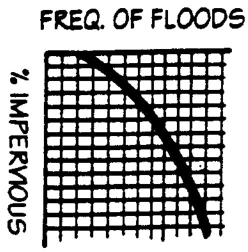
Peachtree Creek is a gaged watershed located in a rapidly urbanizing area. The relationships of runoff to rainfall were studied for total annual flow, low flows and peak flows. Flows were compared between a later, more urbanized condition and an earlier, less urbanized condition. An increase in total runoff in wet years was observed as urbanization increased, but a decrease occurred during dry years. A decrease in low flow was also observed during dry years.

Increasing peak flows and declining low flows can be adequately explained by urban hydrologic theory. A decline in total runoff in dry years can be explained only by taking into account evapotranspiration. The concept of advectively assisted urban evapotranspiration is presented. Urban hydrologic theory must take into account vegetation and evapotranspiration, as well as impervious surfaces and their direct runoff, to explain the magnitude of total annual flows and low flows.

Method References:

- Low flow monitoring over time: Spinnello, A.F.; D.L. Simmons, 1992. *Base Flow of 10 South-Shore Streams, Long Island, New York, 1976-85, and the Effects of Urbanization on Base Flow and Flow Duration.* USGS Water-Resources Investigations Report 90-4205
- Comparing urban and rural low flow: Evett, J.B., 1994. *Effects of Urbanization and Land-Use Changes on Low Stream Flow.* Dept. of Civil Engineering, College of Engineering Univ. of North Carolina, UNC-WRRI-94-284

Environmental Indicator Profile Sheet



Indicator Profile No. 10

Increased Flooding Frequency

Category: **Physical and Hydrological**

Tools Used to Measure Indicator:

- Stream gaging data
- Computer modeling
- Stream channel obstruction assessments

Description:

Flooding frequency (or flowrate magnitude change) is measured over time to determine the response to changing levels of urbanization. The number and magnitude of flooding events (in response to rainfall or snowmelt) for a particular location or specific stream segment is documented and compared with the relative changes in land use. Another method is to compare peak flows for different frequency events in urban watersheds and in rural watersheds with similar physiographic characteristics.

The amount of debris and obstructions identified and documented for a given stream reach also provides an indirect measure of flooding potential. Obstructions are identified through stream channel reconnaissance assessments.

The frequency of bankful storm events (in streams) and the corresponding amount of rainfall are essential in understanding stormwater impacts and planning restoration efforts.

Utility of Indicator to Assess Stormwater Impacts:

- Can be used to assess the frequency, duration, and quantity of flooding with increasing urbanization.
- Can be used to evaluate the effectiveness of structural BMPs in reducing flooding and streambank erosion potential.
- Can be used to evaluate flooding potential associated with different land use development patterns.
- Can help identify specific flood prone areas.
- Can indirectly predict potential for streambank erosion and habitat degradation.
- Frequently identified debris and obstructions can be an indicator of increased flooding potential which can underline the need for corrective actions.

Indicator Useful for Assessing:

* Aquatic Integrity of:	
Lakes	○
Streams	●
Estuaries	○
* Land Use Impacts	●
* Stormwater Mgmt Programs	●
* Whole Watershed Quality	◐
* Industrial Sites	◐
* Municipal Programs	●

Key:	
Very Useful	●
Mod. Useful	◐
Not Useful	○

Indicator Advantages

* Geographic Range	●
* Baseline Control	◐
* Reliable	●
* Accuracy	◐
* Low cost	◐
* Repeatable	◐
* All Watershed Scale	●
* Familiar to Practitioners	●
* Easy to use & Low training	◐

Key	
Very Advantageous	●
Mod. Advantageous	◐
Not Advantageous	○

Cost

See Table 3.3B

Advantages of Method:

- Flooding is a well-known occurrence and is understood by the general public. Corrective measures are more readily addressed than less tangible water quality issues.
- Increased flooding is fairly easily documented and can be reasonably accurately modeled using several computer models.
- Can help focus public attention and support for urban stormwater programs. Can act as a catalyst in developing other watershed restoration initiatives.

Disadvantages of Method:

- May focus too much attention on structural solutions (such as levees, flood control channels, etc.) rather than more natural, biologically based alternatives.
- Increased flooding frequency may encourage jurisdictions to institute more stringent onsite stormwater regulations without evaluating the hydrologic/hydraulic implications within the watershed.
- Does not provide any data on changes in water quality.

Case Study: Weiss, L.A., 1990
Effects of Urbanization on Peak Streamflows in Four Connecticut Communities, 1980-84
USGS Water-Resources Investigations Report 89-4167

Peak stormwater flows for six urban streams in Connecticut were determined from rainfall and runoff data collected from 1981 to 1984 and from a computer rainfall-runoff model that simulated storm runoff for a period from 1951 to 1980. Recurrence intervals for these six streams and three other urban streams were estimated using the log-Pearson Type III method. These results were compared with peak flows for rural streams that were computed from regression equations.

Ratios of peak flows in urban basins to peak flows in rural basins are about 1.5 to 6.1 for the 2 year frequency event and 1.1 to 4.3 for the 100 year frequency event. The lower ratios, for each case, apply to areas where 30% of the basin is served by storm sewers. The higher ratios apply to areas where 90% of the basin is served by storm sewers.

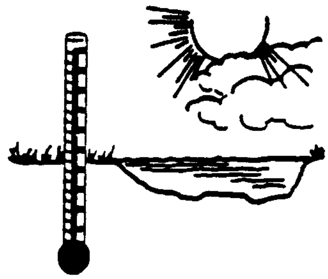
Method References:

- Stream gaging data: Bailey, J.F.; W.O. Thomas, K.L. Wetzel, T.J. Ross, 1989. Estimation of Flood-Frequency Characteristics and the Effects of Urbanization for Streams in the Philadelphia, Pennsylvania Area., In: *USGS Water-Resources Investigations* Report 87-4194, March 1989. 71p.

- Computer modeling: Richter, K.G.; G.A. Schultz, 1988. Aggravation of Flood Conditions Due to Increased Industrialization and Urbanization., In: *Hydrological Processes and Water Management in Urban Areas.* Proceedings of the International Symposium 24-29 April 1988, Duisburg, West Germany.

- Change in Flood Peaks: Kibler, D.F.; D.C. Froelich; G. Aron, 1981. Analyzing Urbanization Impacts on Pennsylvania Flood Peaks., In: *Water Resources Bulletin,* American Water Resources Association. Vol. 17, No. 2, April 1981.

Environmental Indicator Profile Sheet



Indicator Profile No. 11

Stream Temperature Monitoring

Category: **Physical and Hydrological**

Tool Used to Measure Indicator:

- Stream Temperature Monitoring

Description:
Stream temperature is monitored over time to assess changes in response to increasing urbanization. Alternatively, stream temperatures in urban areas may be compared with stream temperatures in nearby rural areas. Monitoring includes both storm events and low flow conditions. For a comparative analysis, streams should be located in close proximity and in the same physiographic province (subject to similar weather events or weather related stressors).

Utility of Indicator to Assess Stormwater Impacts:
- Can be used to assess the effects of urbanization on stream temperature base flows and storm flows.
- Can be used to assess the effects of BMPs on stream temperatures and help in promoting practices which have less impacts.
- Can help identify stream reach lengths which may benefit from riparian buffer enhancement.
- Can be used as a watershed land use planning tool in protecting cool water stream systems.

Advantages of Method:
- Provides a direct indicator of temperature impacts as related to watershed urbanization.
- Since stream temperature changes will likely affect the most sensitive organisms, can provide an early warning indicator of environmental stress which may make remediation easier.
- Reasonably easy to monitor temperatures and report results.
- Stream thermal pollution is easily understood by the general public, public officials, and decision makers who can use the information to make appropriate land use decisions.

Indicator Useful for Assessing:

* Aquatic Integrity of:	
Lakes	○
Streams	●
Estuaries	○
* Land Use Impacts	●
* Stormwater Mgmt Programs	●
* Whole Watershed Quality	◖
* Industrial Sites	◖
* Municipal Programs	●

Key:

Very Useful	●
Mod. Useful	◖
Not Useful	○

Indicator Advantages

* Geographic Range	●
* Baseline Control	●
* Reliable	◖
* Accuracy	◖
* Low cost	◖
* Repeatable	●
* All Watershed Scale	●
* Familiar to Practitioners	●
* Easy to use & Low training	●

Key

Very Advantageous	●
Mod. Advantageous	◖
Not Advantageous	○

Cost

See Table 3.3B

Disadvantages of Method:

- May be of limited value in warm water systems.
- Results may be skewed due to natural conditions such as a prevalence of springs and seeps within a watershed or unusually hot summers.
- Changing climatic conditions could have more effect on stream temperatures than urbanization, over the long term.
- Provides only a single measure of the impact of urbanization on water quality.
- Once temperature increases are detected, few management measures are available to decrease them.

Case Study: Galli, J.; R. Dubose, 1990 -
Thermal Impacts Associated with Urbanization and Stormwater Management Best Management Practices
Produced by the Metropolitan Washington Council of Governments for The Maryland Department of the Environment.

The study consisted of a two part approach to evaluate thermal and dissolved oxygen impacts to aquatic life associated with urbanization and various stormwater management BMPs. Part one of the study involved water temperature monitoring and water quality grab sampling at six headwater streams and four stormwater management BMPs located in the Piedmont portion of the Anacostia River basin. The urban streams studied spanned the entire spectrum of watershed imperviousness from undeveloped to approximately 60% impervious cover.

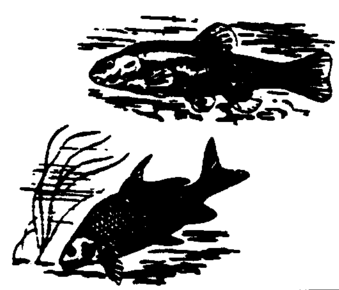
The four representative BMPs monitored in the study included: an infiltration facility, an artificial wetland, an extended detention dry pond and a wet pond. The second part of the study consisted of a comprehensive literature review to evaluate potential temperature and dissolved oxygen impacts at major levels of the aquatic food chain.

The major findings of the study are as follows: (1) Air temperature and other local meteorological conditions had a greater influence on stream temperature than stormflow for 90-95% of the time. Rainfall amount and intensity was second in importance. (2) Watershed imperviousness together with local meteorological conditions had the largest influence on urban streams. (3) Riparian canopy coverage played a key role in insulating small streams from warming. (4) Stream temperature increased with increasing order in a downstream direction. (5) All four BMPs had a positive average effect in increasing stream temperatures. Temperature increases were the most severe in the wet pond and the extended detention dry pond. The artificial wetland was next and the infiltration facility had the least effects on both stormflow and baseflow.

Method Reference:

- Stream Temperature Monitoring: Pluhowski, E.J., 1970. *Urbanization and its Effect on the Temperature of the Streams on Long Island, New York*. U.S. Geological Survey, Professional Paper 627-D, 110p.

Environmental Indicator Profile Sheet



Indicator Profile No. 12

Fish Assemblage Analyses

Category: **Biological**

Tools Used to Measure Indicator:

- Index. of Biotic Integ., (IBI)
- Index. of Well Being, (I_{WB})
- Rapid Bio. Assess., (RBP)
- Species Extinct./Reduction.
- Presence of fish with disease, tumors, fin damage, etc.

Description:

Fish diversity, species richness, species pollutant tolerance, disease prevalence, and other metrics are used to evaluate the aquatic health of waterbodies as compared to a regional reference condition. This indicator, used by state and local governments, volunteer monitoring groups, and environmental organizations for measuring in-stream water resource quality, is widely regarded as one of the more reliable methods for assessing human-caused ecological impacts.

Fish are collected (usually by electrofishing or seining) and a biosurvey of the resident fish community is conducted. Stations for collection must be representative of the entire reach system in terms of habitat. Wherever possible, multiple habitats (i.e., riffle, run and pool) are sampled for each site.

Fish pathology, indicated by the presence of tumors, fin damage, parasite infestations, and discoloration, among other anomalies is also used in the designation of water body health.

Utility of Indicator to Assess Stormwater Impacts:

- Can characterize the existence and severity of degradation and help identify causes and sources of degradation.
- Can be used to evaluate the effectiveness of restoration programs and help prioritize sites for future evaluation.
- Can be used to help evaluate the effectiveness of BMP controls (both structural and non-structural).
- Can be used on both a regional and local level.
- Can help identify barriers to fish migration.
- Can be used to mobilize public support when popular species are impacted.

Indicator Useful for Assessing:

* Aquatic Integrity of:	
Lakes	◐
Streams	●
Estuaries	◐
* Land Use Impacts	●
* Stormwater Mgmt Programs	●
* Whole Watershed Quality	●
* Industrial Sites	◐
* Municipal Programs	●

Key:	
Very Useful	●
Mod. Useful	◐
Not Useful	○

Indicator Advantages

* Geographic Range	●
* Baseline Control	◐
* Reliable	●
* Accuracy	●
* Low cost	◐
* Repeatable	●
* All Watershed Scale	◐
* Familiar to Practitioners	●
* Easy to use & Low training	◐

Key	
Very Advantageous	●
Mod. Advantageous	◐
Not Advantageous	○

Cost

See Table 3.3C

Advantages of Method:

- Because of a longer lifespan (3 to 4 years), fish exposed to years of impacts, provide a good assessment of long-term impacts.
- The fish assemblage represents a broad range of trophic levels and may be strongly influenced by lower trophic levels (i.e., algae, macroinvertebrates, etc.). Therefore, the fish assemblage provides an integrated view of the entire environmental system.
- Fish are relatively easy to collect and identify. The environmental requirements and life history of fish are fairly well documented.
- The general public is familiar with fishing for sport and food.
- Waterbody aquatic life uses are depicted in terms of fish.

Disadvantages of Method:

- Careful regional analysis is required to ensure that metrics and data are representative of ecoregion. This can require substantial calibration of metrics prior to application monitoring.
- Seasonal changes in fish populations and distribution are natural occurrences. Therefore, multiple sampling sessions are required to obtain representative results.
- Data collected after major flow events may not be representative of normal conditions.
- The relative health of a selected reference condition can skew the results of the system being evaluated.
- Monitoring must account for stream size and order as a factor in natural biological diversity and species density. Fish that spawn elsewhere may be impacted by degraded spawning grounds. Reduced richness in the study area may not be a true indicator of its water quality conditions.
- Lack of fish diversity can be due to confounding problems (poor habitat, low flow, channelization, fish barriers, fishing pressures, etc.), making impact source identification difficult.

Case Study: Schueler,T.R. 1994
The Importance of Imperviousness
Watershed Protection Techniques, Vol.1, No. 3 Fall 1994

Four streams in the Maryland Piedmont were monitored to identify the number of fish and number of sensitive fish present as related to watershed imperviousness. As the level of imperviousness increased the total number of fish species present decreased. For a watershed of less than 10% imperviousness, a total of 12 species were present (7 of which were sensitive). At a percent impervious between 10 and 12, two sensitive species (brown trout and sculpin) were no longer present. As the percent imperviousness rose to above 25, four more species were no longer identified. At 55% imperviousness only two, pollutant tolerant species existed.

This relatively simple study shows that as the intensity of development increases (as measured in terms of impervious area, the total number of fish species decreases. Those fish species which are the most sensitive are adversely affected in watersheds of relatively low impervious area.

Method References:

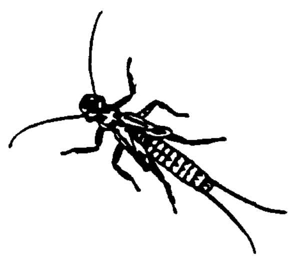
- Index of Biotic Integrity (IBI): Karr, J.R.; K.D. Fausch, P.L. Angermeier, P.R. Yant, and I.J. Schlosser., 1986. Assessing Biological Integrity in Running Waters: A Method and Its Rationale. *Special Publication 5. Illinois Natural History Survey*

- Index of Well Being (I_{wb}): Gammon, J.R. 1980. The use of community parameters derived for electrofishing catches of river fish as indicators of environmental quality,. In: *Seminar on Water Quality Management Tradeoffs.* Report No. EPA-905/9-80-009. U.S. EPA, Washington, D.C.

- Rapid Bioassessment Protocols (RBP): Plafkin, J.L.; M.T. Barbour, K.D. Porter, S.K. Gross, R.M. Hughes., 1989. *Rapid Bioassessment Protocols for use in Streams and Rivers Benthic Macroinvertebrates and Fish.* Report No. EPA/440/4-89/001. U.S. EPA, Office of Water

- Extinction/Reduction in Species: Klein, R.D. 1979. Urbanization and Stream Quality Impairment., In: *Water Resources Bulletin.* Vol. 15, No. 4, pp 948-963

Environmental Indicator Profile Sheet



Indicator Profile No. 13

Macro-Invertebrate Assemblage

Category: **Biological**

Tools Used to Measure Indicator:

- Hilsenhoff Biotic Index
- Rapid. Bioassess. (RBP)
- EPT Index
- Invertebrate Community Index (ICI)

Description:

Benthic macro-invertebrates are used to evaluate the aquatic health of waterbodies. Several metrics (e.g. taxa richness, ratio of scrapers to filterers, ratio of sensitive to tolerant species, abundance, etc.) are used to assess the relative health of a given system. Aquatic systems are usually compared to a reference condition which is defined as the natural or "least impacted" habitat of a particular region. The maximum expectations for macro-invertebrate community structure and function are determined by monitoring the set of streams selected to establish reference conditions.

Utility of Indicator to Assess Stormwater Impacts:

- Can be used to depict the existence and severity of degradation.
- Can be used to help screen possible sources and causes of degradation.
- Can be used to help assess the performance of watershed restoration measures (particularly in-stream habitat restoration projects).
- Can be used to help evaluate the performance of stormwater BMPs (both structural and non-structural)
- Provides short term responses to changes in aquatic systems and therefore is a valuable tool to measure short term impacts (such as effects from construction projects).

Advantages of Method:

- Macro-invertebrates have limited mobility, and therefore are good assessors of site specific impacts (mobility, however, may be affected by storm flows and drift).
- Aquatic insects have relatively short lifespans and respond quickly to stress. Therefore, they provide good short term monitoring results.
- Macro-invertebrates are relatively easy to identify, sampling is reasonably easy and does not effect the resident biota. It is relatively easy to identify degraded systems through casual observations.
- Macro-invertebrates are usually abundant in most small streams where few fish are present.
- Citizen volunteers can quickly learn insects to family level, more comprehensive training is required for other metrics.

Indicator Useful for Assessing:

* Aquatic Integrity of:	
Lakes	●
Streams	●
Estuaries	◖
* Land Use Impacts	●
* Stormwater Mgmt Programs	●
* Whole Watershed Quality	●
* Industrial Sites	◖
* Municipal Programs	●

Key:

Very Useful	●
Mod. Useful	◖
Not Useful	○

Indicator Advantages

* Geographic Range	●
* Baseline Control	◖
* Reliable	●
* Accuracy	●
* Low cost	●
* Repeatable	●
* All Watershed Scale	●
* Familiar to Practitioners	●
* Easy to use & Low training	◖

Key

Very Advantageous	●
Mod. Advantageous	◖
Not Advantageous	○

Cost

See Table 3.3C

Disadvantages of Method:

- Some regional modifications of metrics are required to ensure that data is representative of ecoregion.
- Seasonal changes in species composition and populations requires strict adherence to consistent sampling frequency.
- Data collected after major flow events is likely not to be representative of normal conditions due to habitat disruptions.
- The relative health of a selected reference condition can skew the results of the system being evaluated.
- Species identification may be time consuming and complex.
- Sensitive macro-invertebrate species seem to decline significantly at relatively low watershed imperviousness (≤ 15%) and therefore are less effective as predictive tools for more densely urbanized areas.
- Paired sampling sites must have comparable habitat to produce valid results. Macro-invertebrate prevalence may be as much a function of habitat type as quality.

Case Study: Jones, R.C.; Clark, C.C. 1987
Impact of Watershed Urbanization on Stream Insect Communities
Water Resources Bulletin, American Water Resources Association, Vol 23, No. 6

The effects of urbanization on aquatic insects were analyzed for 22 sites in five watersheds in northern Virginia. The amount of urbanization was measured in terms of human population. Population densities ranged from near 0 in one watershed to nearly 20 individuals per hectare at one sampling site. Sampling sites were located so as to only collect data for non point source discharges. Three samples were obtained for each stream reach, each for a separate riffle. Organisms were collected using a modified circular Hess sampler. During sample collection other physio-chemical parameters were also measured: temperature, dissolved oxygen, conductivity, pH, alkalinity and hardness, and canopy coverage. Organisms were identified to genus using the method of Merrit and Cummins (1984).

Results of the study showed that abundance of Diptera was strongly correlated with increasing urbanization. The relative abundance of other groups was negatively correlated with urbanization. Trichoptera and Ephemeroptera as a percent of total organisms, each decreased with increasing urbanization. Coleoptera, Megaloptera, Plecoptera and Odonata were found almost exclusively at low to moderately urbanized stations. The 22 sites were placed into two groups; 9 sites were in watersheds that had population densities less than 10 per hectare and 13 sites were in watersheds with human populations greater than 10 per hectare. The less urbanized watersheds had significantly less Diptera and significantly more Ephemeroptera, Coleoptera, Megaloptera, Plecoptera and Odonata. The total number of insects was not significantly affected by urbanization. Trichoptera was the only group which did not vary significantly with increasing urbanization. Genus richness and diversity was also significantly higher in the less urbanized group. The result of the study indicates that the relative urbanization has a significant effect on aquatic insect community.

Method References:

- Hilsenhoff Biotic Index: Hilsenhoff, W.L. 1982. Using a Biotic Index to Evaluate Water Quality in Streams., In: *Technical Bulletin No. 132*. Department of Natural Resources, Madison, Wisconsin.

- Hilsenhoff Improved Biotic Index: Hilsenhoff, W.L. 1987. An improved biotic index of organic stream pollution., *Great Lakes Entomology*. 20:31-39

- Rapid Bioassessment Protocols (RBP): Plafkin, J.L.; M.T. Barbour, K.D. Porter, S.K. Gross, R.M. Hughes., 1989. *Rapid Bioassessment Protocols for Use in Streams and Rivers Benthic Macroinvertebrates and Fish*. Report No. EPA/440/4-89/001. U.S. EPA, Office of Water

- Invertebrate Community Index (ICI): Ohio Environmental Protection Agency, 1987. *Users Manual for Biological Field Assessment of Ohio Surface Waters. Vol. II of Biological Criteria for the Protection of Aquatic Life*. Div. Water Quality Monitor. and Assess. Surface Water Section, Columbus, OH0

Environmental Indicator Profile Sheet

Indicator Profile No. 14

Single Species Indicator

Category: **Biological**

Tools Used to Measure Indicator:

- Electrofishing Surveys
- Physical Habitat Assessments
- Bioassays

Description:
The biological status of a carefully chosen single species is used as an assessment tool for representing the environmental health of an aquatic system. The presence, absence and/or trend in population of a particular environmentally sensitive species (such as trout, salmon or freshwater mussels) in a waterbody provides a measure of aquatic health. Single species reproduction rates and mortality rates are compiled to evaluate trends in aquatic system integrity. Species pathology, indicated by the presence of tumors, fin damage, parasite infestations, and discoloration, among other anomalies is also used to assess water body health.

Utility of Indicator to Assess Stormwater Impacts:

- Useful in identifying degradation associated with land use for the single species and/or trophic level.
- Potential to act as a focal point for aquatic system protection and restoration. Can induce public education, support and activism.
- Can solicit political pressure and support regarding planning issues.

Advantages of Method:

- Usually on a higher trophic level and therefore potentially representative of broader range of environmental quality.
- Easy to identify, sample and has low training costs.
- Single species monitoring is conducted relatively quickly.
- The general public is usually very familiar with the species being monitored (such as trout and salmon).
- The use of sensitive species as an indicator species identifies degradation in its early stages which may make remediation easier.

Indicator Useful for Assessing:

* Aquatic Integrity of:	
Lakes	◖
Streams	◖
Estuaries	◖
* Land Use Impacts	◖
* Stormwater Mgmt Programs	◖
* Whole Watershed Quality	◖
* Industrial Sites	◖
* Municipal Programs	◖

Key:	
Very Useful	●
Mod. Useful	◖
Not Useful	○

Indicator Advantages

* Geographic Range	●
* Baseline Control	◖
* Reliable	○
* Accuracy	◖
* Low cost	●
* Repeatable	◖
All Watershed Scale	◖
* Familiar to Practitioners	◖
* Easy to use & Low training	●

Key	
Very Advantageous	●
Mod. Advantageous	◖
Not Advantageous	○

Cost

See Table 3.3C

Disadvantages of Method:

- Management activities, such as fish stocking, can distort monitoring results.
- Habitat protection/restoration measures (based only on single species) may not adequately address other aquatic species needs.
- The natural variability and population fluctuations of the single species being measured may skew results. The advantage of multiple metrics to account for aberrations is not present.
- Species that migrate make it difficult to isolate whether the effect is occurring in the study area or somewhere else.
- If the species is not currently or historically present in the aquatic system, the method provides little useful data.

Case Study: Scott, J.B.; Steward, C.R.; Stober, Q.J.
Effects of Urban Development on Fish Population Dynamics in Kelsey Creek, Washington
Transactions of the American Fisheries Society 115:555-567, 1986

The authors presented a paper from a 30 month study comparing the relative fish dynamics for two small streams in Washington, one located within a predominately urban area and one located in a predominately rural area. Kelsey Creek is located in the City of Bellevue, Washington and has land uses consisting of mainly single-family and multi-family residential, but also has a significant commercial and industrial land use component. Nearby Bear Creek is in a predominantly rural area with only 15% of the land use occupied by single-family residential and the remaining land cover is in forest and pastureland.

According to historic studies Coho salmon *Oncorhynchus kisutch* and cutthroat trout *Salmo clarki* were the most abundant salmonids present in the early 1940's in both streams. Although there were no detailed lists of the other species inhabiting the study streams at that time, more recent investigations indicate that sculpins *Cottus* sp. were originally widely distributed in the area.

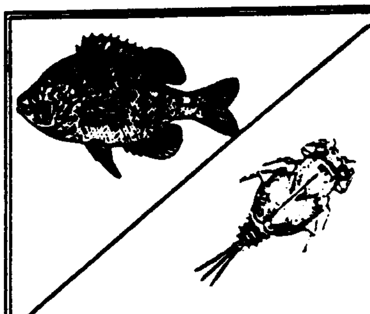
Study methods included conducting outmigrant netting and resident fish sampling. Netting of downstream migrants was conducted at the mouth of Kelsey Creek. Resident fish were sampled at five sites on Kelsey Creek and three sites on Bear Creek. Fish were sampled using a backpack electrofisher. Fork lengths of all salmonids were measured, scale samples were obtained and wet weights were determined. Nonsalmonid fish species were recorded as present or absent except for one sampling session when numbers and weights were recorded. Ages of the fish were determined, population of each species-age group at each study site was estimated by the removal method and the Seber-Jolly mark-recapture method. Population growth rates were calculated.

Impacts from urbanization appeared to have a greater affect on coho salmon and nonsalmonid fish species than on cutthroat trout. The total biomass of fish in each stream was determined to be about the same, but the composition of the fish assemblage differed substantially. The majority of fish in Kelsey Creek were cutthroat trout between age 0 and 1 year. Bear Creek had a much more diverse salmonid community of various ages and numerous non-salmonids were present.

Method References:

- Electrofishing surveys: Tennessee Valley Authority, 1993. *Survey of Brook Trout (Salvelinus Fontinalis) Population in the Upper Little Tennessee River Watershed, Macon and Swain Counties, North Carolina.* TVAWM9320.
- Physical habitat assessments: Platts, W.S.; et. al., 1989. Changes in Salmon Spawning and Rearing Habitat from Increased Delivery of Fine Sediment to the South Fork Salmon River, Idaho. In: *Trans. Am. Fish. Soc.* Vol. 118, No. 3, pp. 274-283.
- Bioassays: Dermott, R.; M. Munawar. 1992. A Simple and Sensitive Assay for Evaluation of Sediment Toxicity Using Lumbriculus Variegatus (Mueller). In: Hart, B.T.; Sly, P.G. (eds). *Sediment-Water Interactions.* Vol. 235-6, pp. 407-414.

Environmental Indicator Profile Sheet



Indicator Profile 15

Composite Indicators

Biological Indicators

Tools Used to Measure Indicator:
Two or more of the following:

- Ind. of Bio. Integrity (IBI)
- Rapid Bioass. Pro. (RBP)
- Index of Well Being (I_{wb})
- Invertebrate Community
- Index (ICI)

Description:

Multiple groups of organisms and/or taxa (e.g., macroinvertebrates, fish, plankton, amphibians) are used to comprehensively portray the health of aquatic systems. A series of biological metrics, ranging from fish diversity indices, macro-invertebrate indices, algal communities, and/or other communities are evaluated to assess the effects of urban runoff on aquatic biota. Composite indicators require comparison to reference conditions as a measure of use attainability.

Utility of Indicator to Assess Stormwater Impacts:

- Provides the same utility to assess stormwater impacts as both fish and macro-invertebrate sampling but may provide a more thorough and comprehensive evaluation.
- Can be used to prioritize further and more detailed monitoring, such as chemical characterizations or toxicity testing.

Advantages of Method:

- Composite monitoring allows for both long-term trend analysis as well as short-term impact assessments.
- Composite monitoring provides more comprehensive information relative to pollutant source identification. Locations are more easily confirmed when multiple metrics are indicating degradation.
- Composite monitoring is useful for whole watershed assessments as well as site specific impact assessments.

Disadvantages of Method:

- Regional modifications of metrics will be necessary over a fairly wide range of taxa.
- Seasonal changes in species composition will require strict adherence to consistent sampling frequency.
- Major flow events will affect data validity.
- Reference condition health can skew results.
- Cannot alone characterize the precise causes of degradation, this will usually involve other tools.

Indicator Useful for Assessing:

* Aquatic Integrity of:	
Lakes	●
Streams	●
Estuaries	●
* Land Use Impacts	●
* Stormwater Mgmt Programs	●
* Whole Watershed Quality	●
* Industrial Sites	◐
* Municipal Programs	●

Key:	
Very Useful	●
Mod. Useful	◐
Not Useful	○

Indicator Advantages

* Geographic Range	●
* Baseline Control	◐
* Reliable	●
* Accuracy	●
* Low cost	○
* Repeatable	●
* All Watershed Scale	●
* Familiar to Practitioners	●
* Easy to use & Low training	◐

Key	
Very Advantageous	●
Mod. Advantageous	◐
Not Advantageous	○

Cost

See Table 3.3C

Case Study: Pitt, R.E.
Effects of Urban Runoff on Aquatic Biota
Handbook of Ecotoxicology, Lewis Publishers, Inc. 1994; Chapter 30

This case study analyzes the effects of urban runoff on the receiving waters of Coyote Creek, near San Jose, California. The study describes the changes to the aquatic environment as the creek passes from an upstream non-urban area through an urbanized area.

The Coyote Creek is a reasonably large waterway which drains an area of approximately 200,000 acres. The urban portion of San Jose is within the downstream one-third of the approximately 45 mile long watershed. Sampling was conducted during the period of March 1977 to August 1980. Several parameters were sampled during the study period, including; basic hydrologic conditions, water quality, sediment properties, general habitat characteristics, fish, benthic organisms, attached algae, and rooted aquatic vegetation. The use of the above array of indicators provided a broad picture of the impacts of urbanization on Coyote Creek. The results of the study showed that there were distinct differences in species diversity, composition and abundance between the urban and non-urban portions of the study area. The non-urban areas supported a more diverse aquatic community, more native fishes and many more benthic macroinvertebrate taxa. The urban portions of the study area were composed of an aquatic community of mainly the most pollutant-tolerant species of fish and macroinvertebrates. There were changes in the physical habitat between the non-urban and urban portions of the creek, however it is believed that these differences could not account for the magnitude of change to the aquatic community through the urban reach.

Due to a wide variety of possible factors affecting the biological community, it is impossible to directly identify all of effects as being attributed to urban runoff alone. In a system as large as the Coyote Creek other factors such as extreme flows, drought, stream gradient, effects of impoundments, etc. may contribute to biological degradation. The evidence presented in this case study indicates that urban runoff is responsible for a large portion of the impacts to biological organisms.

Method References:

- Index of Biotic Integrity (IBI): Karr, J.R.; Fausch, P.L. Angermeier, P.R. Yant, and I.J. Schlosser., 1986. Assessing Biological Integrity in Running Waters: A Method and Its Rationale. *Special Publication 5. Illinois Natural History Survey.*

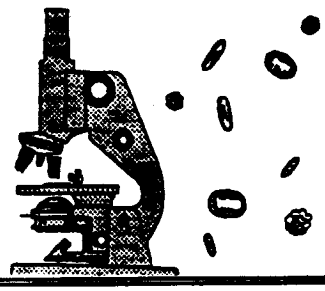
- Index of Well Being (I_{wb}): Gammon, J.R. 1980. The use of community parameters derived for electrofishing catches of river fish as indicators of environmental quality., In: *Seminar on Water Quality Management Tradeoffs.* Report No. EPA-905/9-80-009.

- Rapid Bioassessment Protocols (RBP): Plafkin, J.L.; et al. 1989. *Rapid Bioassessment Protocols for use in Streams and Rivers Benthic Macroinvertebrates and Fish.* Report No. EPA/440/4-89/001.

- Invertebrate Community Index (ICI): Ohio Environmental Protection Agency. 1987. *Biological Criteria for the Protection of Aquatic Life: Vol. II. User's Manual for Biological Assessment of Ohio Surface Waters.* Ohio Environmental Protection Agency, Columbus, OH.

- Biological Assessment: Davis, W.S., T.P. Simon (eds). 1995. Biological Assessment and Criteria-Tools for Water Resource Planning and Decision Making. Lewis Publishers. Boca Raton, FL.

Environmental Indicator Profile Sheet



Indicator Profile No. 16

Other Biological Indicators

Biological Indicators

Tools Used to Measure Indicator:

- Phytoplankton Indices
- Zooplankton Indices
- Diatoms community measurments
- Periphyton Indices

Description:

There are several additional biological monitoring methods that have been used to assess water quality. Examples of some of these include surveys of: plankton (phytoplankton, zoophankton, periphyton, diatoms) Bryozoans, algal microfossils, amphibians and bacteria. Some of these are more commonly used than others and some have been used for direct assessment of urban stormwater runoff while others are for different water quality evaluations (such as wastewater effluent monitoring, water treatment plant monitoring, CSOs, etc.). This profile is targeted primarily at the utility of plankton surveys as a biological indicator. Bryozoans are technically considered macro-invertebrates, algal microfossils are part of sediments and bacteria are addressed separately under the Human Health Criteria indicator profile.

Utility of Indicator to Assess Stormwater Impacts:

- Plankton can be used to assess water quality through changes in community structure, patterns of distribution and relative proportions of sensitive and insensitive species.
- Plankton can be used to evaluate thermal pollution, presence of toxic pollutants, nutrients and excessive sedimentation.

Advantages of Method:

- Valuable as a continuous monitoring tool because the nature of the cell structure allows for continuous integration of stresses that effect growth and reproduction. Good for assessing short term impacts.
- Phytoplankton (free floating algae) have distinct species which flourish in eutrophic conditions and distinct species which are indicitive of clean water. This is particularily useful in estuaries and freshwater lakes.
- Periphyton (attached forms of algae) are traditionally used in lotic systems as an indicator of water quality.
- Diatoms and other single-celled microscopic plants provide a quantifiable measure of water quality degradation over a wide geographic area.

Indicator Useful for Assessing:

* Aquatic Integrity of:	
Lakes	●
Streams	◐
Estuaries	●
* Land Use Impacts	◐
* Stormwater Mgmt Programs	◐
* Whole Watershed Quality	○
* Industrial Sites	◐
* Municipal Programs	◐

Key:	
Very Useful	●
Mod. Useful	◐
Not Useful	○

Indicator Advantages

* Geographic Range	●
* Baseline Control	◐
* Reliable	○
* Accuracy	◐
* Low cost	◐
* Repeatable	●
* All Watershed Scale	◐
* Familiar to Practitioners	○
* Easy to use & Low training	○

Key	
Very Advantageous	●
Mod. Advantageous	◐
Not Advantageous	○

Cost

See Table 3.3C

Disadvantages of Method:

- May have limitations due to transient nature and variable distribution of species, and the influence of large storm events (washout).
- Requires fairly sophisicated sampling and laboratory work to quantify analysis and report results. Some methods and indices may over-simplify the ecological conditions by evaluating only species composition rather than community structure and dynamics.
- Short lifespans of organisms are not particularly suited for long term monitoring studies.
- Indicator populations are often highly seasonal in nature.
- Few stormwater managers have training or experience in interpreting sample data.

Case Study: Morgan, M.D., 1987
Impact of Nutrient Enrichment and Alkalinization on Periphyton Communities in the New Jersey Pine Barrens.
Hydrobiologia, Vol. 144, No. 3, p 233-241

Periphyton was used to evaluate impacts associated with urban residential and agricultural land uses in the New Jersey Pine Barrens. Communities of periphyton in three developed streams were compared with those of three undeveloped streams. 53 periphyton species were encountered in a sampling period of one year. Species richness was significantly greater in the disturbed streams. Species composition also varied between the two conditions. Elevated pH and nitrates in the disturbed conditions contributed to the effects of species composition.

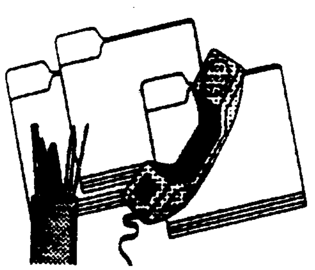
Method References:

- Phytoplankton and Zooplankton: Gast, H.F.; R.E.M. Suykerbuyk, R.M.M. Roijackers, 1990. Urban Storm Water Discharges: Effects Upon Plankton Communities., In: *Water Science Tech.*, Vol. 22, No. 10/11, pp. 155-162.

- Diatoms: Maples, R.S., 1987. Diatoms as Indicators of Water Quality in Three Bayous of the Calcasieu River/Lake Complex., In: *Ecosystem Analysis of the Calcasieu River/Lake Complex*. Report No. DOE/EP/31111-1 Vol. 2.

- Periphyton: Falter, C.M.; J. Kann, M. Beckwith, 1988. Attached Benthic Algae (periphyton) in the littoral of Lake Pend Oreille, Idaho. *8th Annual International Symposium on Lake and Watershed Management, 1988.*

Environmental Indicator Profile Sheet



Indicator Profile No. 17

Public Attitude Surveys

Category: **Social**

Tools Used to Measure Indicator:

- Direct mail to public
- Public workshops with citizens/citizen assoc.
- Interviews with targeted audience

Description:

Public attitude surveys are directed at targeted groups to assess general awareness of key water quality problems and willingness to finance (via government spending) restoration efforts. A targeted group is solicited with a direct mailout, an interview or other mechanism of communication to gather information regarding an existing or potential program. The results of a survey are usually gathered into a summary report which may, for example, indicate that the public believes urban runoff to be the most significant source of pollution in the watershed or that funding for restoration efforts should be increased. This information is then used by decision makers in helping to formulate watershed management policy, develop restoration budgets and workplans, or implement stream restoration programs, for example.

Utility of Indicator to Assess Stormwater Impacts:

- Can be used to assess the public's perception of existing or proposed water quality programs (e.g., citizen volunteer monitoring, proposed waterbody restoration program, maintenance program implementation for BMP's, etc).
- Can be used as a foundation for political action to stress the relative value the public places on a particular water quality issue.
- Can be used as a mechanism for soliciting public or private funding for a particular water resource issue.
- Can be a major component of a public educational program which incorporates results of surveys into future programs.
- Helps managers develop more effective pollution prevention programs based on reported behaviors and targets scarce resources toward specific watersheds, population groups, or watershed interest groups.

Advantages of Method:

- Effective way to obtain information regarding citizen attitudes/concerns for a particular issue or set of issues.
- Gives decision makers information on how proposed programs are likely to be received by the targeted audience.
- Generally is relatively easy to interpret results and therefore can be an effective tool for non technical applications.

Indicator Useful for Assessing:

* Aquatic Integrity of:	
Lakes	○
Streams	○
Estuaries	○
* Land Use Impacts	○
* Stormwater Mgmt Programs	●
* Whole Watershed Quality	◐
* Industrial Sites	○
* Municipal Programs	◐

Key:	
Very Useful	●
Mod. Useful	◐
Not Useful	○

Indicator Advantages

* Geographic Range	●
* Baseline Control	◐
* Reliable	◐
* Accuracy	◐
* Low cost	◐
* Repeatable	●
* All Watershed Scale	●
* Familiar to Practitioners	◐
* Easy to use & Low training	◐

Key	
Very Advantageous	●
Mod. Advantageous	◐
Not Advantageous	○

Cost

See Table 3.3D

Disadvantages of Method:

- Results of survey are dependent on the number of people who respond and the degree of importance people place on water quality issues.
- Results can be dependent on the socioeconomic status of the community being surveyed and the relative importance water quality plays in people's lives.
- Results of survey can be skewed by the relative knowledge of the target audience. Survey practitioners must consider target audience's understanding of topic in formulating questionnaires and be prepared to follow up with future surveys.
- Language barriers and lack of phone or address information may result in missing key population groups.
- Does not directly measure changes occurring in the receiving water.

Case Study: Blair, J., G. Slater, A. McLaughlin, 1994
The Chesapeake Bay Attitudes Survey
Chesapeake Bay Program, Communications Subcommittee, Final Report, April 28, 1994.

The Survey Research Center at the University of Maryland at College Park conducted a survey of residents in the Chesapeake Bay watershed. The goal of this study was to provide baseline data on the attitudes, behaviors, and opinions of residents about pollution, water quality, funding, and clean-up efforts in the Bay watershed. The survey was conducted from October 6, 1993 through January 27, 1994. A total of 2004 people were interviewed.

The study results indicated that 85% of all respondents were either very concerned or somewhat concerned about pollution in the Bay. This level of concern varied by distance from the Bay. Concern was greatest for people living closest to the Bay. Approximately one-third of the respondents thought that business and industry was the main cause of pollution in the Bay. About half of the respondents thought the Bay was more polluted today compared to ten years ago.

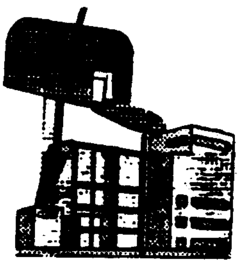
Seventy-eight percent of the respondents who reported being familiar with the Bay said that pollution had not interfered with any of the things they do for recreation on the Bay. Sixty-eight of these respondents thought that the water quality was unsafe for aquatic life; sixty percent thought water quality was unsafe for swimming, and fifty-three percent thought the water quality made seafood unsafe.

The major sources of pollution identified by respondents were business and industry, commercial shipping spills, recreational boating, landfills, construction, and farming. Sixty-one percent said efforts to clean-up the Bay were too little.

Method References:

- Direct Mail: Hampton Roads Municipal Communicators, 1992. *Environmental Attitudes Surveyed in Hampton Roads*, Hampton Roads Municipal Communicators
- Public Workshops: Hoffman, R.K., 1981. *The Public's Perspective on Nonpoint Sources. Nonpoint Pollution Control - Tools and Techniques for the Future*, Proceedings of a Technical Symposium, P 35-38
- Interviews with Target Audiences: Desvousges, W.H.; V.K. Smith, M.P. McGivney, 1983. *Comparison of Alternative Approaches for Estimating Recreation and Related Benefits of Water Quality Improvements.* Misc. Rep Ser. U.S. EPA. No. EPA/230/05-83/001

Environmental Indicator Profile Sheet



Indicator Profile No. 18

Industrial/Commercial Pollution Prevention

Category: **Social**

Tools Used to Measure Indicator:

- Direct mail out to industry
- Workshops with industry representative groups
- Interviews with individual industry personnel

Description:

Surveys of pollution prevention efforts for industrial sites are conducted to assemble data regarding the costs and benefits associated with NPDES stormwater permit compliance. Site managers are surveyed to obtain information regarding permit implementation costs (e.g., BMP construction costs, spill prevention training costs), technical issues regarding implementation of structural and nonstructural BMPs, and potential benefits gained.

Utility of Indicator to Assess Stormwater Impacts:

- Can be used to assess industry's perception of effectiveness of stormwater BMPs and methods for improvement.
- Can be used to assemble cost information and compare implementation costs between different industries and different geographic locations.
- Can be a component of an industry stormwater educational program which incorporates results into future pollution prevention programs.
- Can foster partnerships with industry and help managers identify site conditions that they may be unaware of (e.g., illicit connections from floor drains).

Advantages of Method:

- Effective way to obtain information regarding industry attitudes and perception of the importance of stormwater programs.
- Results of survey are based on industry input and therefore will likely be more directed at specific concerns/problems which affect industry operations which may lead to more cost effective ways of doing things.
- Generally is relatively easy to interpret results and therefore can be a useful tool for non-technical policy decisions.

Disadvantages of Method:

- Results of survey are dependent on the information provided by industry personnel and may be skewed to industry's advantage
- Surveys are not usually based on highly technical information and may not adequately address complex water quality issues.
- Industry may be suspicious that participation in the surveys may lead to costly regulation.

Indicator Useful for Assessing:

* Aquatic Integrity of:	
Lakes	○
Streams	○
Estuaries	○
* Land Use Impacts	○
* Stormwater Mgmt Programs	●
* Whole Watershed Quality	○
* Industrial Sites	●
* Municipal Programs	○

Key:	
Very Useful	●
Mod. Useful	◖
Not Useful	○

Indicator Advantages

* Geographic Range	●
* Baseline Control	◖
* Reliable	◖
* Accuracy	◖
* Low cost	◖
* Repeatable	●
* All Watershed Scale	●
* Familiar to Practitioners	◖
* Easy to use & Low training	◖

Key	
Very Advantageous	●
Mod. Advantageous	◖
Not Advantageous	○

Cost

See Table 3.3D

Case Study: Beck, P.C.
Stormwater Permit Program An Industrial Experience
Stormwater NPDES- Related Monitoring Needs. Conference Proceedings, American Society of Civil Engineers. MT. Crested Butte, CO August 7-12, 1994

The Coors Brewing Company, located in the foothills of the Rocky Mountains west of Denver, is the third largest brewer in America and subject to the NPDES stormwater discharge permit. Coors' will be operating under four general stormwater permits. Coors has completed stormwater outfall sampling at more than twenty stormwater discharge locations. The results of the sampling showed that average concentrations fell within requirements for bottled water and RCRA Health Based Standards. Maximum values were in some cases substantially above the average values. Additional work is probably necessary to fully assess the normal distribution of data at any given outfall. Nutrients and suspended solids showed a wide range of variation among different samples and different results.

Coors has taken some corrective actions for areas with unusually high pollutant concentration values. For example, an outfall with a 3190 mg/l BOD_5 concentration was near a yeast drying facility and spilled yeast was responsible for the high value. Corrective actions were taken to reroute storm drains from the existing outfall to the process treatment plant. Other problems were also addressed: Roof drains on fermenting buildings were rerouted from a discharge into the adjacent creek to the process treatment plant. Storm drains in high traffic areas were modified to collect the five year storm and divert it to the sanitary system. Lean-to roof structures were installed over waste material collection bins and over above ground fuel storage facilities.

Method References:

- Workshop with industry group: Brosseau, G. 1992. *1992 Summary Report - Vehicle Service Facility Waste Minimization Program.*, Palto Alto Regional Water Quality Control Plant, Uribe & Associates

Environmental Indicator Profile Sheet

Indicator Profile No. 19

Public Involvement and Monitoring

Category: **Social**

Tools Used to Measure Indicator:

- Number and type of public involvement groups
- Quantity of volunteer monitoring performed
- Number of hotline reports
- Advisory council

Description:
Public participation in stormwater programs is one measure of overall program effectiveness. Successful implementation of stormwater programs depends, in large part, upon the active support and participation of the public. Citizen monitoring programs, stream segments adopted, watershed stewardship groups, public education (including school curricula), participation in watershed education events are all components of public involvement programs. Other measures of public participation include participation in household hazardous waste recycling efforts, number of calls made to report illegal dumping into the storm sewer system or streams, and membership in citizen advisory groups.

Utility of Indicator to Assess Stormwater Impacts:

- Can be used to help modify citizen behaviors related to source controls.
- Can help reduce monitoring expenses and expand a jurisdiction's monitoring database.
- Can help identify pollutant sources through citizen watchdog actions.
- Can help prepare students to be knowledgeable about water pollution issues and respectful of existing water resources.
- Can generate political support for additional stormwater and watershed funding.
- Can foster acceptance of projects through close relationships with communities, and can provide input for adjacent residents on siting and aesthetic concerns

Advantages of Method:

- Jurisdictions with active public involvement programs are more likely to have a population which is informed about water quality issues and therefore is more receptive to program initiatives, funding issues, and pollution prevention efforts.
- Programs can be initiated by local governments with relatively little expense.
- Provides decision makers with information on public perceptions which is useful in watershed management programs.

Indicator Useful for Assessing:

* Aquatic Integrity of:	
Lakes	◖
Streams	◖
Estuaries	◖
* Land Use Impacts	◖
* Stormwater Mgmt Programs	◖
* Whole Watershed Quality	◖
* Industrial Sites	○
* Municipal Programs	◖

Key:	
Very Useful	●
Mod. Useful	◖
Not Useful	○

Indicator Advantages

* Geographic Range	●
* Baseline Control	○
* Reliable	◖
* Accuracy	◖
* Low cost	●
* Repeatable	○
* All Watershed Scale	●
* Familiar to Practitioners	●
* Easy to use & Low training	●

Key	
Very Advantageous	●
Mod. Advantageous	◖
Not Advantageous	○

Cost

See Table 3.3D

Disadvantages of Method:

- Monitoring may not always meet strict quality control protocols and, therefore, may not be scientifically useful for expanding databases.
- Citizen activists may not understand technical issues and may be less receptive to political and financial tradeoffs associated with particular projects.
- Educational efforts may take several years to affect citizen behavior.
- The lack of citizen involvement group participation may be a function of socioeconomic environment rather than actual program effectiveness.
- Does not measure or change the behavior/attitudes of residents that do not participate in the programs.

Case Study: Texas Natural Resource Conservation Commission
Texas Watch: Volunteer Environmental Monitoring
Texas Natural Resource Conservation Commission, P.O. Box 13087, Austin, TX 78711

This information packet describes Texas Watch, the statewide volunteer environmental monitoring program of the Texas Natural Conservation Commission. The program is one component of the agency's strategy to combat nonpoint source pollution. Texas Watch addresses nonpoint source pollution in two ways: it assists professional data gathering efforts by enlisting volunteers to monitor water quality in their communities and it provides an excellent tool with which to educate the public about nonpoint source pollution through teacher involvement and the media.

Method References:

- Number and type of public involvement groups: Fullmer, J., 1994. Successful Grass-Roots Strategies for Public Education and Participation In Watershed Protection Policy Making., In: Pawlukiewicz, J.; et.al. (eds.), 1994. Proceedings for *Watershed '93: A National Conference on Watershed Management.*, Alexandria, VA., Mar 21-24, 1993., USEPA No. 840-R-94-002
- Quantity of Monitoring: Ely, E (ed.); 1994. Volunteer Monitoring: Past, Present & Future., *The Volunteer Monitor*. Vol. 6, No. Spring 1994

Environmental Indicator Profile Sheet

Indicator Profile No. 20

User Perception

Category: **Social**

Tools Used to Measure Indicator:

- Direct mail to public
- On-site interviews
- User survey and counts

Description:
Successful stormwater management efforts depend, in large part, on public support. Public support, in turn, depends upon its valuation of water resources. The public's valuation of a particular water body is usually based on more than water chemistry. Appearance, surroundings, ease of access, and apparent water quality are all considered by the average user. Trash, floatables, and turbidity will detract from the appearance of the water body. Surroundings are perceived as less than ideal when there is limited tree cover or other bank-side vegetation. Extremely dense vegetation, limited physical access, or remoteness may also detract from perceived value. Finally, oily waters, unusual colors and odors will also count against the water body.

It is possible that water bodies with generally good water quality may be perceived as being in poor condition by the public if access is limited or the water is turbid. On the other hand, biologically impaired waters may be perceived by the public as "clean" solely based on the lack of obvious pollution such as tires or bottles.

Utility of Indicator to Assess Stormwater Impacts:

- Can be used to assess the public's perception of existing conditions in the watershed.
- Can be used as a foundation for educating the public about the "hidden" impact of water quality pollution.
- Can be used as a platform for generating stewardship programs and public support for water restoration efforts.
- Can be a major component of a public educational program which incorporates results of surveys into future programs.

Advantages of Method:

- Effective way to obtain information regarding citizen attitudes/concerns for a particular issue or set of issues.
- Gives decision makers information on what aspects of watershed restoration are most important to the public.
- Survey results are generally easy to interpret and therefore can be an effective tool for non-technical applications.
- Targets the portion of the public most likely to be knowledgeable about water quality issues and be supportive of watershed restoration efforts.

Indicator Useful for Assessing:

* Aquatic Integrity of:	
Lakes	◖
Streams	◖
Estuaries	◖
* Land Use Impacts	○
* Stormwater Mgmt Programs	◖
* Whole Watershed Quality	◖
* Industrial Sites	○
* Municipal Programs	◖

Key:

Very Useful	●
Mod. Useful	◖
Not Useful	○

Indicator Advantages

* Geographic Range	●
* Baseline Control	◖
* Reliable	◖
* Accuracy	◖
* Low cost	◖
* Repeatable	●
* All Watershed Scale	●
* Familiar to Practitioners	◖
* Easy to use & Low training	◖

Key

Very Advantageous	●
Mod. Advantageous	◖
Not Advantageous	○

Cost

See Table 3.3D

Disadvantages of Method:

- Results of survey are dependent on the number of people who respond and the degree of importance people place on water quality issues.
- Results can be dependent on the socioeconomic status of the community being surveyed, the proximity of the water body, and the designated recreational usage.
- Results of survey are site-specific. The survey results assess concerns about a specific water body, not the entire watershed.
- Language barriers and lack of phone or address information may result in missing key population groups.
- Does not directly measure changes occurring in water quality.
- Can be very costly to obtain a representative survey sample.

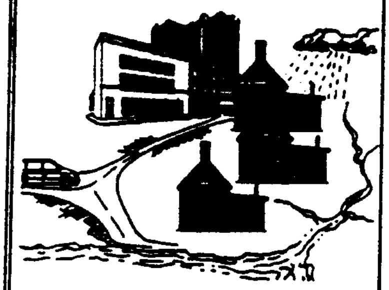
Case Study: Desvousges, W.H.; V.K. Smith, M.P. McGivney, 1983.
Interviews with Target Audiences: Comparison of Alternative Approaches for Estimating Recreation and Related Benefits of Water Quality Improvements
Environmental Protection Agency, Misc. Rep Ser. U.S. EPA. No. EPA/230/05-83/001

Pollution control policy can reduce the amount of effluents going into a particular river. In turn, this changes the water quality and ecological habitat. The public then may be able to use the river more for in-stream activities such as swimming, boating, and fishing and for withdrawal purposes such as drinking water, irrigation, and cooling. However, measuring change in use understates the total benefits of the pollution control if there are positive "intrinsic" benefits for preserving the potential for future use and vicarious consumption. This study compares three methods for measuring overall recreation and related benefits of improved water quality. These methods are travel cost, contingent calculation, and contingent ranking. The comparison is based on detailed interview data for 305 user and nonuser households in the Pennsylvania portion of the Monogahela River watershed. The benefits measurement approaches show consistent results for comparable changes in water quality. The results of this project strongly support the feasibility of measuring the recreation and related benefits of water quality improvement.

Method References:

- Direct Mail: Hampton Roads Municipal Communicators, 1992. *Environmental Attitudes Surveyed in Hampton Roads*, Hampton Roads Municipal Communicators
- Methodology: Interviews with Target Audiences: Brinkley, C. And W. Hanemann, 1978. *The Recreation Benefits of Water Quality Improvement: Analysis of Day Trips in an Urban Setting*. U.S. EPA

Environmental Indicator Profile Sheet



Indicator Profile No. 21

No. of Illicit Connections Identified/Corrected

Category: **Programmatic**

Tools Used to Measure Indicator:

- Investigative monitoring using wet and dry weather sampling, visual observations, GIS, dye testing, smoke testing, etc.

Description:

This indicator involves the identification and correction of illegal and/or improper waste discharges into storm drainage systems and receiving waters. Dry weather flows potentially contribute substantial loadings to receiving waters. Jurisdictions have programs to identify, prioritize pollutants, and implement corrective actions to eliminate or minimize these non-stormwater entries.

Utility of Indicator to Assess Stormwater Impacts:

- Since illicit connections can contribute substantially to pollutant loadings, the number identified and corrected can have a direct and immediate effect on water quality.
- Can be used as a measure to assess the effectiveness of a municipality's overall stormwater program.
- Sampling can help define the frequency and severity of illegal discharges to the storm sewer system (i.e., non sanitary system).

Advantages of Method:

- Results are easily interpreted by politicians and administrative officials which help make programs sustainable and justify funding.
- Can be part of a citizen volunteer monitoring program.
- Helps many communities identify the locations and size of all storm and sanitary outfalls. Often many are "lost" over time due to poor record keeping.

Disadvantages of Method:

- The number of illicit connections identified is not necessarily representative of the total number of illicit connections in existence.
- Programs to identify, prioritize, and correct illicit connections can be very costly to operate and personnel training can be expensive.
- Does not measure the hydrological impact of storm flows in the pipe system.
- Site-specific monitoring may be required to characterize volume of flow and pollutant constituents of illicit connection.

Indicator Useful for Assessing:

* Aquatic Integrity of:	
Lakes	●
Streams	●
Estuaries	●
* Land Use Impacts	◖
* Stormwater Mgmt Programs	◖
* Whole Watershed Quality	◖
* Industrial Sites	●
* Municipal Programs	●

Key:	
Very Useful	●
Mod. Useful	◖
Not Useful	○

Indicator Advantages

* Geographic Range	●
* Baseline Control	○
* Reliable	◖
* Accuracy	◖
* Low cost	◖
* Repeatable	◖
* All Watershed Scale	◖
* Familiar to Practitioners	●
* Easy to use & Low training	◖

Key	
Very Advantageous	●
Mod. Advantageous	◖
Not Advantageous	○

Cost

See Table 3.3E

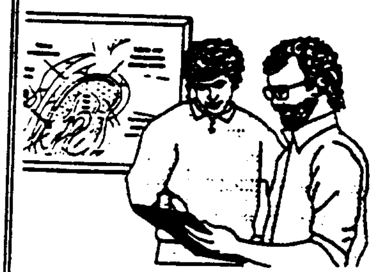
Case Study: Minor, J.D., 1995
Finding Illicit Connections and Discharges with P²IL
Torno, J.C. (ed.) 1995. Stormwater NPDES-related monitoring needs. Conference proceedings. American Society of Civil Engineers. Mt Crested Butte, CO. August 7-12, 1994

Finding illicit connections for the City of Scarborough, Ontario, Canada, located on the north shore of Lake Ontario, requires dedicated *Programs* and *Procedures*, executed with *Intuition* and *Luck* (P^2IL). The City of Scarborough with a population of approximately 550,000, is about 85% developed. Sixteen per cent of the total area is within industrial districts. There are approximately 400 industrial/commercial/institutional (ICI) sites with stormwater discharges. The City has more than 800 storm drainage outfalls draining to three watercourses. Pollution prevention efforts occupy approximately 6000 manhours per year, equipment and lab costs are approximately $50,000 (CDN) and start up costs were approx. $200,000 CDN. The drainage system with outfalls has been mapped using GIS, waterways are monitored during wet and dry weather, and problem outfalls are identified with chemical, biological and visual techniques. Outfalls are further evaluated using flow meters, non-intrusive sensors, video cameras, dye testing, smoke testing, and pressure testing for the presence of illicit connections.

Method References:

- Identification of Illicit Connections: Pitt, R.; M. Lalor, D.D. Adrian, R. Field, D. Barbe, 1993. *Investigation of Inappropriate Pollutant Entries into Storm Drainage Systems: A User's Guide.*, Alabama Univ. In Birmingham. Dept. of Civil Engineering. EPA-600-R-92-238.
- Discharge Characterization: Schmidt, S.D.; D.R. Spencer, 1986. Magnitude of Improper Waste Discharges in an Urban System. *In: Journal of the Water Pollution Control* Federation. Vol. 58, No. 7, July, 1986, pp. 744-748.

Environmental Indicator Profile Sheet



Indicator Profile No. 22

No. of BMPs Installed, Inspected, and Maintained

Category: **Programmatic**

Tools Used to Measure Indicator:

- Development Site Plans
- Property Owner/Developer Interviews
- No. of Construction Permits Issued
- Local Inspection Programs

Description:

By tracking the number of BMPs that are installed, inspected, and maintained in a given area, stormwater practitioners may be able to measure the progress and effectiveness of municipal programs. As more BMPs are installed, one may assume with reasonable confidence that progress in the stormwater arena is being made. Regular inspection and maintenance of BMPs will ensure that existing stormwater management resources are fully utilized, will help identify facilities which require retrofits, and will identify areas requiring additional management resources.

Program implementation can also be tracked through review of the maintenance backlog. Large BMP maintenance backlogs may indicate that additional monetary and manpower resources are required to ensure effective operation of existing BMPs.

Utility of Indicator to Assess Stormwater Impacts:

- Inspections can expose weaknesses in BMP design, reveal maintenance needs, and determine needs for enforcement actions.
- Can be used to determine whether existing BMPs are sufficient in scope and size to adequately address a community's stormwater management needs.
- Helps a municipality improve the design criteria for future BMPs by determining which practices have more problems.
- Provides useful data when conducting stormwater retrofit inventories.

Advantages of Method:

- Since BMPs are specifically designed to provide a particular level of performance, it is relatively easy to determine whether their functions are being achieved.
- Educational programs can be developed to involve private organizations in data collection. Such programs may also serve to educate the public about BMP usage, performance, and maintenance needs.
- Increased performance monitoring and reporting increases the likelihood that BMPs will be properly maintained.
- Can be combined with GIS and watershed simulation models to determine the cumulative watershed benefits of implementation of stormwater BMPs.

Indicator Useful for Assessing:

* Aquatic Integrity of:	
Lakes	○
Streams	○
Estuaries	○
* Land Use Impacts	◖
* Stormwater Mgmt Programs	◖
* Whole Watershed Quality	◖
* Industrial Sites	◖
* Municipal Programs	●

Key:

Very Useful	●
Mod. Useful	◖
Not Useful	○

Indicator Advantages

* Geographic Range	●
* Baseline Control	●
* Reliable	◖
* Accuracy	◖
* Low cost	○
* Repeatable	●
* All Watershed Scale	◖
* Familiar to Practitioners	◖
* Easy to use & Low training	○

Key

Very Advantageous	●
Mod. Advantageous	◖
Not Advantageous	○

Cost

See Table 3.3E

Disadvantages of Method:

- There is little standardization in place for reporting BMP performance, possibly resulting in conflicting inspection reports.
- Many watershed managers choose BMPs based on cost, with design performance a secondary consideration. As a result, even if a BMP performs according to design, it still may not adequately protect receiving water quality.
- BMP inspections and maintenance are costly and require extensive staff time.

Case Study: Lindsey, G.; L. Roberts, and W. Page. 1992
Maintenance of Stormwater BMPs in Four Maryland Counties: A Status Report
Journal of Soil and Water Conservation. 47(5): 417-422, Sept./Oct. 1992.

Field inspections were made of more than 250 stormwater facilities in four Maryland counties. The types of facilities inspected included dry basins, wet and extended detention basins, infiltration basins and trenches, dry wells, underground storage facilities, and vegetated swales. Trained inspectors evaluated performance (inappropriate ponding of water, slow infiltration, incorrect flow patterns, clogging of facility, excessive sediment or debris, water bypassing facility, design shortcomings, structural failures, erosion at intake or outfall) and maintenance criteria (facility functioning as designed, quantity controlled as designed, quality benefits produced by ability, enforcement action needed, maintenance action needed) for each facility. While most (64%) of the facilities were found to be functioning as designed, many needed maintenance, especially to correct excessive sediment and debris problems. Inspectors believed that enforcement action was warranted at many sites. The condition of different types of facilities varied significantly. Several models were used to explain results, including a series of chi-square tests to determine the independence of facility status and objective and subjective variables. Overall, the investigations documented the need for improved inspection and maintenance by stormwater management regulatory authorities.

Method References:

- General: Galli, J.; 1992. *Analysis of Urban BMP Performance and Longevity in Prince George's County, Maryland.*, Metropolitan Washington Council of Governments. Publication No. 92711

Environmental Indicator Profile Sheet

Indicator Profile No. 23

Permitting and Compliance

Category: **Programmatic**

Tools Used to Measure Indicators:

- NPDES Industrial Permits
- Construction Permits
- Local Inspection Programs

Description:
NPDES stormwater regulations require many municipal and industrial stormwater dischargers as well as construction site developers to obtain discharge permits. Permit requirements generally focus on identification and control of significant sources of nonpoint source pollution. Most permits also require implementation of pollutant reduction measures. These measures encompass structural BMPs such as sediment control basins and non-structural measures such as good housekeeping and personnel training.

Tracking the number and type of NPDES stormwater permits issued, the number of stormwater discharges in compliance with their permits, and the number and type of BMPs implemented in conjunction with the permits allows municipalities to gauge the relative impact of various pollutant sources (i.e., urban versus industrial versus construction), determine if regulatory baselines are being met, and identify the need for additional enforcement activities.

Utility of Indicator to Assess Stormwater Impacts:

- Can be used to identify potentially significant contributors of pollutants.
- Can be used to assess the level of industrial support for stormwater management efforts.
- Can be used by NPDES program managers to assess compliance with regulations and designate areas for improvement.
- Allows identification of uncontrolled sources of pollution to stormwater.

Advantages of Method:

- Permitting is already required by many states.
- Comprehensive permitting structures have already been established.
- The majority of the cost and time burden associated with implementation and identification of pollutant control measures is borne by private sources.
- Fosters communications between developers, industry, and regulatory agencies responsible for developing and implementing stormwater management strategies.

Indicator Useful for Assessing:

* Aquatic Integrity of:	
Lakes	○
Streams	○
Estuaries	○
* Land Use Impacts	◖
* Stormwater Mgmt Programs	◖
* Whole Watershed Quality	◖
* Industrial Sites	◖
* Municipal Programs	●

Key:

Very Useful	●
Mod. Useful	◖
Not Useful	○

Indicator Advantages

* Geographic Range	●
* Baseline Control	●
* Reliable	◖
* Accuracy	◖
* Low cost	●
* Repeatable	●
* All Watershed Scale	◖
* Familiar to Practitioners	◖
* Easy to use & Low training	◖

Key

Very Advantageous	●
Mod. Advantageous	◖
Not Advantageous	○

Cost

See Table 3.3E

Disadvantages of Method:

- Some industrial sites are reluctant to identify the most effective measures, instead opting for less expensive measures with meet the minimal requirements.
- Processing permits and inspections to ensure compliance require significant staff time.
- Many permitting programs are conducted under the auspices of State or regional EPA programs. Local and municipal jurisdictions and watershed advisory bodies may have difficulty in obtaining permit

Case Study: Newport, R.G. and T.E. Davenport. 1988
Stormwater Nonpoint Source Pollution Control
American Water Resources Association Technical Publication Series. TPS 88-4, p 183-193, 1988

The Rouge Basin in Southeast Michigan is a significant example of a situation where stormwater is contributing to use impairment. To address urban stormwater problems, EPA and State pollution control agencies will issue discharge permits to the owner/operators of stormwater collection and conveyance systems and related outfalls. These permits will require data collection and reporting, and the development and implementation of pollution reduction programs. In some cases, these programs will require capital improvements, but in many instances, the cost-effective approach for solving the problems will be BMPs. These BMPs will reduce the introduction of pollutants to the storm sewer through management of nonpoint source (NPS) pollution. Requiring nonpoint source control components as part of stormwater permits will ensure (1) that the permits address all pollutants originating from nonpoint sources; (2) that the BMPs required under the permits will economically control the identified pollutants; and , (3) that the NPS control activities identified will be fully implemented.

Method References:

- Permitting: *Watershed Protection and Stormwater Permitting Seminar*, August 29 and 30, 1990. Sponsored by North Carolina Sections of AWWA/WPCA and APWA..
- Compliance: Brinigar, S.C. et al. 1992. Complying with Storm Water Permits. Pollution Engineering. February 15, 1992.

Environmental Indicator Profile Sheet

Indicator Profile No. 24

Growth and Development

Category: **Programmatic**

Tools Used to Measure Indicator:

- GIS Systems, land use mapping
- Other physical, biological or chemical monitoring techniques.

Description:

As development in a watershed grows, imperviousness increases and the aquatic system is generally subjected to greater stress. This stress may include higher NPS pollutant loadings and increased stormwater runoff flows. Erosion within the stream system increases as the stream downcuts and widens to adjust to the new flow regime.

The relative health of a given system as measured through ecological impacts to the aquatic community (i.e., water quality, physical habitat, and biological diversity and health) can be correlated with the impervious percentage of the watershed. Zoning patterns in a watershed can be used to estimate existing and potential watershed imperviousness based on land use-imperviousness relationships.

The potential for continuing urbanization (and thus increased watershed imperviousness) can be tracked through review of building permits, environmental impact statements, and changes in population. Increases in the numbers of building permits issued and environmental impact statements completed and increased population are indicative of continuing urbanization.

Utility of Indicator to Assess Stormwater Impacts:

- Can be used to evaluate existing and potential impacts to aquatic systems. Imperviousness can predict aquatic health degradation thresholds.
- Can be used to evaluate the effectiveness of BMPs in extending development thresholds (e.g., increasing impervious area limits without increasing aquatic health degradation).
- Can be used as a planning tool in making zoning and master planning decisions.

Indicator Useful for Assessing:

* Aquatic Integrity of:	
Lakes	◖
Streams	●
Estuaries	◖
* Land Use Impacts	●
* Stormwater Mgmt Programs	◖
* Whole Watershed Quality	●
* Industrial Sites	◖
* Municipal Programs	●

Key:	
Very Useful	●
Mod. Useful	◖
Not Useful	○

Indicator Advantages

* Geographic Range	◖
* Baseline Control	◖
* Reliable	◖
* Accuracy	◖
* Low cost	◖
* Repeatable	●
* All Watershed Scale	●
* Familiar to Practitioners	◖
* Easy to use & Low training	●

Key	
Very Advantageous	●
Mod. Advantageous	◖
Not Advantageous	○

Cost

See Table 3.3E

Advantages of Method:

- Easily measured using land use mapping or GIS technology.
- Easily understood by policy decision makers and politicians.
- Inexpensive to measure and report (however, development of a detailed GIS can be very expensive).
- Can provide a uniform method for measurement and assessment.
- Provides a comprehensive measure of the cumulative impact of land development on subwatersheds.
- Many of the indicator parameters are already tracked by local jurisdictions.

Disadvantages of Method:

- Measurement and use of growth indicators is not yet standardized.
- Assessment of stream quality has not been statistically correlated with impervious area.
- Does not precisely measure imperviousness, but rather estimates relative increases in imperviousness.
- Zoning changes, environmental impact statements, and building permits represent probable (not definite) changes in imperviousness.
- Does not take into account that development can increase without increasing aquatic health degradation.

Case Study: Booth, D.B.; L.E. Reinelt, 1994

Consequences of Urbanization on Aquatic Systems - Measured Effects, Degradation Thresholds, and Corrective Strategies

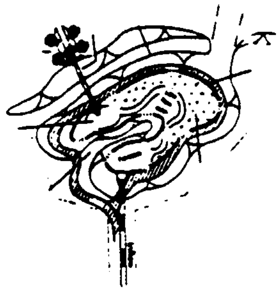
Pawlukiewicz, J.; et. al., (eds.). 1994. Watershed '93: A National Conference on Watershed Management, USEPA 840-R-94-002

Several watersheds in King County, Washington were evaluated to assess the effect of urbanization on stream and wetland system health. Watershed imperviousness was used as the unit of measure of urbanization. Stream structure (bankfull width, depth and fluctuations in water level) and biological function (species and population counts and rapid field assessments of habitat quality) were evaluated. Results indicated that aquatic system function (as measured by fish populations) was indirectly proportional to watershed impervious area. While there was no distinct threshold where population densities dropped, there was a measurable effect at reasonably low levels of imperviousness (10 - 15%). Habitat degradation was measured in terms of "degraded, good or excellent". There was marked degradation at imperviousness between 8 and 10%. Change in physical structure with increasing imperviousness was also measured. For example, stable channels, with little or no erosion, and unstable channels, where long continuous reaches of bare and eroding banks occur, were evaluated as impervious area increases. At impervious area percentages above 10%, stream channel instability is dominant.

Method References:

- Watershed Mapping: Sogona, F.J.; C.G. Phillips, 1994. Application of Watershed Index of Pollution Potential to Aerial Inventory of Land Uses and Nonpoint Pollution Sources., In: Pawlukiewicz, J., et. al., (eds.), *Watershed '93: A National Conference on Watershed Management*. USEPA 840-R-94-002
- Biological Monitoring: Mangun, W.R. 1989. A Comparison of Five Northern Virginia Watersheds in Contrasting Land Use Patterns., In: *J. Environmental Systems*, Vol. 18(2) 133-151
- General: Schueler, T.R., 1994. The Importance of Imperviousness., *In: Watershed Protection Techniques*, Vol. 1, No. 3 pp.100-111

Environmental Indicator Profile Sheet



Indicator Profile No. 25

BMP Performance Monitoring

Category: **Site Indicators**

Tools Used to Measure Indicator:

- Biological Monitoring
- Chemical Monitoring
- Physical Monitoring

Description:

Stormwater BMPs are specifically designed to reduce pollutant loadings into natural water bodies. The evaluation of BMP performance can provide stormwater program managers with a more accurate assessment of pollutant removal capability.

BMP effectiveness is evaluated based on stormwater sampling of the mass and concentration of pollutants into and out of the facility. Alternatively, biological and/or physical indicators can be evaluated upstream and downstream of a facility to aid in assessing effectiveness of a specific practice or series of practices.

Controls are measured relative to design, cost, and other similar factors. Secondary characteristics which may be evaluated include habitat provisions, safety, aesthetics, groundwater recharge, and recreational opportunities.

Utility of Indicator to Assess Stormwater Impacts:

- By comparing BMP performance data, stormwater managers may be able to select BMPs that provide the best pollutant removal effectiveness in the most cost-effective manner.
- Comparison of temporal data can be used to determine the need for BMP maintenance.
- Can be used in conjuction with biological and physical/hydrological indicators, to get a more accurate representation of the total aquatic community condition.
- Can be used to identify those BMPs which are not meeting pollutant removal expectations.
- Can be used as a basis to create, update, and enforce minimum design standards to meet target pollutant removal expectations.

Indicator Useful for Assessing:

* Aquatic Integrity of:	
Lakes	●
Streams	●
Estuaries	◐
* Land Use Impacts	◐
* Stormwater Mgmt Programs	●
* Whole Watershed Quality	◐
* Industrial Sites	●
* Municipal Programs	●

Key:

Very Useful	●
Mod. Useful	◐
Not Useful	○

Indicator Advantages

* Geographic Range	◐
* Baseline Control	◐
* Reliable	◐
* Accuracy	◐
* Low cost	○
* Repeatable	●
* All Watershed Scale	◐
* Familiar to Practitioners	◐
* Easy to use & Low training	○

Key

Very Advantageous	●
Mod. Advantageous	◐
Not Advantageous	○

Cost

See Table 3.3F

Advantages of Method:

- Since BMPs are specifically designed to provide a particular level of performance, it is relatively easy to determine whether their functions are being achieved.
- Educational programs can be developed to involve private organizations in data collection. Such programs may serve to educate the public about BMP usage, performance, and maintenance needs.
- Increased performance monitoring increases the likelihood that BMPs will be properly maintained.

Disadvantages of Method:

- There is little standardization in place for reporting BMP performance, resulting in a wide range of effectiveness being reported.
- Many watershed managers choose BMPs based on cost, with design performance a secondary consideration. As a result, even if a BMP performs according to design, it still may not adequately protect receiving water quality.
- Extensive monitoring is required to gain sufficient understanding of BMP effectiveness.
- A large number of paired samples must be collected to establish performance.
- Method requires extensive data interpretation and management.
- The performance of a monitored BMP may reflect site specific or watershed specific conditions, and may not always be generalized.

Case Study: Martin, E.H. 1988

Effectiveness of an Urban Runoff Detention Pond-Wetlands System

Journal of Environmental Engineering, 114(4): 810-827. August 1988.

An urban detention system, composed of a detention pond and wetlands in series (approximately 800 and 3000m^2, respectively), was analyzed to determine its effectiveness in reducing stormwater runoff constituent loads. The pond inlet, pond outlet/wetlands inlet, and wetlands outlet were monitored during eleven storm events. Samples were analyzed for concentrations of major ions, selected chemical and physical characteristics, metals, and nutrients. The system's efficiency was determined using three quantifying methods: event mean concentration, summation of loads, and regression of loads. For most pollutants, the three methods yielded similar results.

The detention pond was generally effective in removing 42-66% of suspended solids and suspended metals. Nutrient removal efficiencies were more variable due to changes in species and phase during transport through the pond.

The wetlands were effective in reducing both suspended and dissolved loads of solids and metals. Removal efficiencies for total nitrogen and phosphorus were 21 and 17%, respectively.

The full system, combining the pond and wetlands treatment, achieved appreciable reductions of most pollutants. The system was particularly effective in reducing solids, lead, and zinc, with efficiencies ranging between 55 and 83%. Total nitrogen and phosphorus efficiencies were somewhat lower: 36 and 43%, respectively.

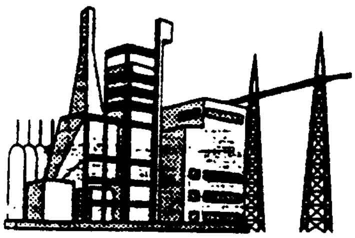
Method References:

- Biological monitoring: Plafkin, J.L.; M.T. Barbour, K.D. Porter, S.K. Gross, R.M. Hughes. 1989. *Rapid Bioassessment Protocols for use in Streams and Rivers: Benthic Macroinvertebrates and Fish.* Report No. EPA/440/4-89/001. U.S. EPA, Office of Water.

- Chemical monitoring: Taylor, G.F. 1990. *Quantity and Quality of Stormwater Runoff from Western Daytona Beach, Florida, and Adjacent Areas.* USGS Water-Resources Investigations Report 90-4002.

- Physical monitoring: MacRae, C.R.; A.C. Rowney, 1992. The Role of Moderate Flow Events and Bank Structure in the Determination of Channel Response to Urbanization., In: *45th Annual Conference Resolving Conflict and Uncertainty in Water Management.* Conference Proceedings. Canadian Water Resources Association, Kingston, Ontario. June 1992.

Environmental Indicator Profile Sheet



Indicator Profile No. 26

Industrial Site Compliance Monitoring

Category: **Site Indicators**

Tools Used to Measure Indicator:

- Visual inspections

Description:
NPDES permitting now requires most industrial sites to develop and implement pollution prevention plans and implementation of on-site best management practices. Compliance monitoring is conducted by either industry representatives, regulatory officials or certified inspectors. Monitoring may include pollutant constituent monitoring, as part of a permit condition, or visual inspections to check compliance with the approved and adopted pollution prevention plan.

While pollutant constituent data and compliance with pollution prevention plans documenting the success or failure of a program can be extremely useful, water quality managers may consider other information in assessing management efforts. Examples include: number of staff hours devoted to monitoring, public outreach efforts, pollution prevention training for employees, and documentation of pollution prevention teams.

Utility of Indicator to Assess Stormwater Impacts:

- Can be used to help evaluate the performance of structural and non-structural stormwater BMPs.
- Can help assess the contribution of industry to overall water quality degradation or improvement.
- Can induce public education, support and activism.
- Can solicit political pressure and support regarding planning issues.
- Can be used to determine industrial stormwater management needs, evaluate water quality trends, and target restoration efforts.
- Can help identify areas where technical support or research are needed to help address problems.

Indicator Useful for Assessing:

• Aquatic Integrity of:	
Lakes	○
Streams	○
Estuaries	○
• Land Use Impacts	◖
• Stormwater Mgmt Programs	●
• Whole Watershed Quality	○
• Industrial Sites	●
• Municipal Programs	○

Key:	
Very Useful	●
Mod. Useful	◖
Not Useful	○

Indicator Advantages

• Geographic Range	●
• Baseline Control	●
• Reliable	◖
• Accuracy	◖
• Low cost	●
• Repeatable	◖
• All Watershed Scale	○
• Familiar to Practitioners	◖
• Easy to use & Low training	●

Key	
Very Advantageous	●
Mod. Advantageous	◖
Not Advantageous	○

Cost

See Table 3.3F

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Advantages of Method:

- Because the land areas involved are often small, few sampling stations are necessary.
- Several sites may combine efforts in the same area, resulting in the efficient use of monitoring resources.
- Several like industries may combine efforts, across a broad geographic area, to maximize efficiency of resources.
- Pollution reductions may show a correlation with various industrial efforts, enhancing the chances that runoff problems can be solved with relative ease.
- Can contribute significant understanding to pollutant source area problems.

Disadvantages of Method:

- Overall watershed health may be difficult to assess by this method.
- Industrial sites may be reluctant to employ the method for reasons such as cost, time, and concern about regulatory consequences resulting from data revelations.
- NPDES sampling requirements, to date, have not been stringently enforced by permitting agencies and quality assurance/quality control concerns may pose a problem for future compliance monitoring.
- The results and impacts of many techniques may be difficult to assess (e.g., BMPs, pollution prevention, public outreach), and may be a disincentive for industrial site managers to implement them.
- Very few industrial sites have streams, lakes or estuaries on-site.

Case Study: Settine, R.L.; K Burchfield. 1983
Sampling and Analysis of Industrial Benthic Polynuclear Aromatic Hydrocarbons in Industrialized Urban Watersheds. Completion Rept. 1 Oct 82 - 31 Mar 83.

A method is reported for the sampling and analysis that accurately describes the contour and distribution of benthic polynuclear aromatic hydrocarbons of Opossum Creek. The analytical methodology consisted of using fused silica capillary chromatography coupled with selected ion mass spectrometry to identify and quantify areas of high concentration of specific benthic compounds. It is apparent from the 'grid technique' herein reported that this model can be applied for future stream system analysis and would be an extremely reliable aid for engineering decisions with regard to cleanup.

Method References:

- Workshop with industry group: Brosseau, G. 1992. *1992 Summary Report - Vehicle Service Facility Waste Minimization Program.*, Palto Alto Regional Water Quality Control Plant, Uribe & Associates.

CHAPTER IV CRAFTING AN INDICATOR MONITORING PROGRAM - A METHODOLOGY

Historically, stormwater monitoring programs were often "cookbook" efforts, regulatory-driven, and focused almost exclusively on end-of-pipe water chemistry. Although the data collected through such efforts could be used to determine baseline conditions, the monitoring results were generally unsuited for assessment of long-term stormwater management success. On the other hand, monitoring programs which incorporate stormwater indicators can be specifically tailored to address the information needs of individual municipalities and industrial sites. When selected correctly, stormwater indicators can assess the long-term effectiveness of stormwater management programs as well as provide the baseline data.

Stormwater indicator monitoring programs are based on specific data requirements, management goals, and resource constraints as determined by individual stormwater management authorities. Therefore, monitoring parameters and indicators will vary from municipality to municipality and from industrial site to industrial site. However, a common methodology can be used to develop stormwater indicator monitoring programs. This methodology is based on the general considerations which are common to all monitoring efforts.

- What is the overall purpose of the monitoring program? Is the purpose to assess baseline conditions, assess the effectiveness of the stormwater management program, or both?
- What resources are available? Is there historical data; complementary or conflicting efforts; sufficient staff, funding, and political support?
- Does the stormwater monitoring program have the ability to adequately assess the success of the stormwater management effort?

A comprehensive two-phase methodology (or protocol) for crafting a stormwater indicator monitoring program is outlined in Figures 4.1 and 4.2. The two phases correspond to the two over-riding purposes for stormwater monitoring: Level 1, Problem Identification and Level 2, Assessment of Management Program. Municipalities and industrial sites with limited or no data available for characterization of baseline conditions will most likely begin at Level 1. When baseline conditions are known, a Level 2 monitoring program should be implemented.

This methodology is presented as a flexible, dynamic tool for development of an effective stormwater indicator monitoring program. Stormwater management officials do not have to begin with Step 1 of Level 1. Instead, stormwater managers are encouraged to review the methodology and determine which level most accurately represents their monitoring needs. Furthermore, because this assessment is an ongoing task, stormwater managers should frequently review their monitoring program. An effective stormwater indicator monitoring program will address current data requirements and provide an adequate basis for a long-term assessment of the management program.

FIGURE 4.1
STORMWATER INDICATOR METHODOLOGY
LEVEL I, PROBLEM IDENTIFICATION

① ESTABLISH MANAGEMENT SPHERE

Who will be responsible for implementation? A government agency (municipality, county, or state) or a site-specific industry? What other programs are being implemented within the watershed? Can this program be developed and implemented on a watershed-wide or basin basis?

⇓

② GATHER/REVIEW HISTORICAL DATA

Identify what programs and studies have already been implemented in the watershed.
Determine what problems associated with stormwater have already been identified.
Assess the effectiveness of earlier efforts and programs.

⇓

③ IDENTIFY POTENTIAL RECEIVING WATER IMPACTS

Identify uses and characteristics which may be impacted by stormwater runoff.

Hydrology and Hydrodynamics (Flooding, Drainage)
Biological Integrity (Fish Diversity, Macro. Community)
Non-contact Recreation (Sports Fishing)
Supply (Potable Water)
Contact Recreation (Swimming)
Aqua-culture (Shellfish Harvesting, Food Fishing)

⇓

④ INVENTORY RESOURCES AND IDENTIFY CONSTRAINTS

Determine manpower and funding limitations.
Identify regulatory-mandated deadlines and programs.

Staffing
Scheduling Constraints
Funding
Regulatory Compliance

⇓

⑤ ASSESS BASELINE CONDITIONS

Use rapid (qualitative) assessment methods versus detailed quantitative techniques to assess baseline conditions.

Indicator Options by Receiving Water Use

Concern:	Hydrology & Hydrodynamics	Biological Integrity	Non-contact Recreation	Water Supply	Contact Recreation	Aqua-culture
Type of Indicator to be Considered:	*Physical Social Programmatic Site*	*Biological Water Quality Social Programmatic Site*	*Water Quality Physical Biological Social Programmatic Site*	*Water Quality Biological Social Programmatic Site*	*Biological Water Quality Physical Social Programmatic Site*	*Biological Water Quality Physical Social Programmatic Site*

FIGURE 4.2
STORMWATER INDICATOR METHODOLOGY
LEVEL II, ASSESSMENT OF MANAGEMENT PROGRAM

① STATE GOALS FOR PROGRAM

Based on baseline conditions, resources, and constraints, articulate goals for stormwater management program in terms of measurable achievements.

Example: We want to increase level and diversity of the fish population in the next 5 years.
To accomplish this, we must improve biological integrity, water quality, and physical conditions.

⇓

② INVENTORY PRIOR AND ONGOING EFFORTS

Identify prior stormwater management efforts and assess success of prior efforts.
Identify current stormwater management efforts both within the municipal boundaries and the larger watershed.
Assess success of ongoing efforts.
Incorporate complementary programs and goals.
Identify potential conflicts.

⇓

③ DEVELOP AND IMPLEMENT MANAGEMENT PROGRAM

Identify and implement specific program facets in order to achieve goal.

Example: In order to increase the fish population, we will retrofit BMPs, require stormwater BMPs all new development, remove fish barriers, and re-introduce some aquatic species.

⇓

④ DEVELOP AND IMPLEMENT MONITORING PROGRAM

Based on goals, program structure, resources and constraints, select indicators to be used to assess success of stormwater management program. Level II indicators will likely be more quantitative in comparison to Level I techniques. Quantitative analysis is required to identify pollutant sources and assess success of program.

Example: macro-invertebrate assemblage, fish assemblage, public opinion surveys, toxicity testing.

⇓

⑤ ASSESS INDICATOR RESULTS

Analyze indicator monitoring results.

What do the monitoring results indicate about the success of the stormwater management program?
Have the indicators accurately reflected the effectiveness of the management program?
What do the indicators suggest about the ability of the stormwater indicator monitoring program to measure of overall watershed health?

⇓

⑥ RE-EVALUATE MANAGEMENT PROGRAM

Re-evaluate resources and constraints.
Update (if necessary) assessment of baseline conditions.
Review and revise program goals.
Review and revise indicator monitoring program.
Implement revised management program.

CHAPTER V THREE SCENARIOS FOR INDICATOR USE

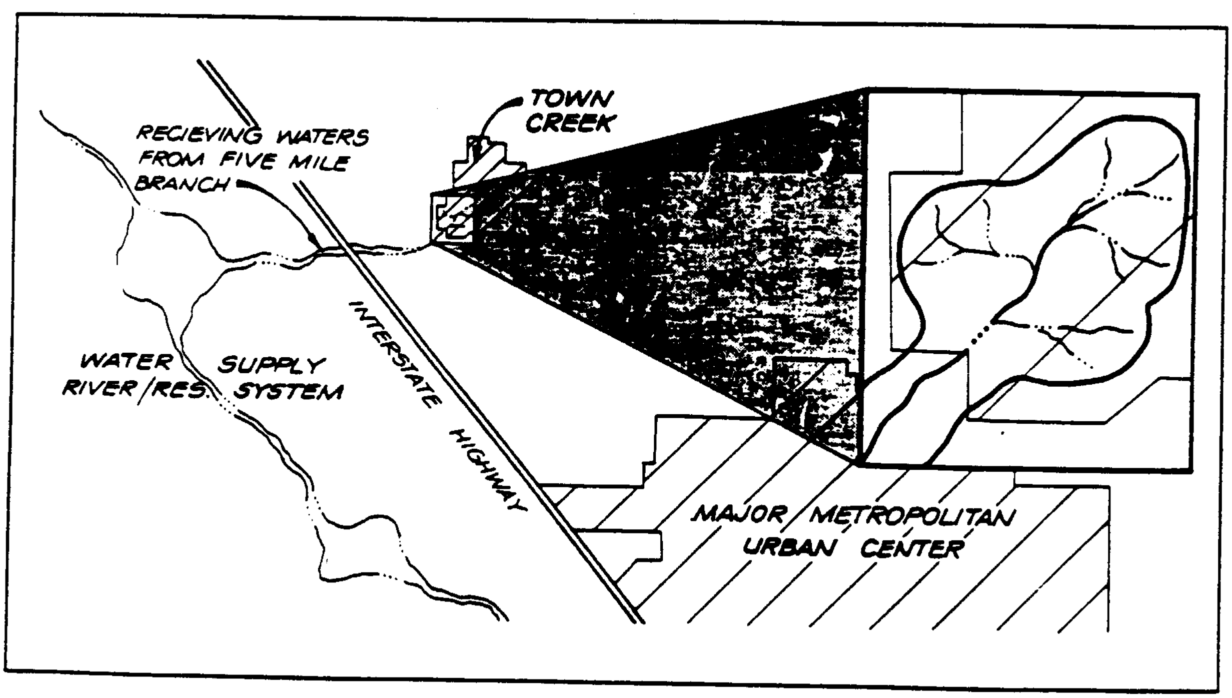
Three theoretical scenarios are described to illustrate the potential application of stormwater indicators in real world situations. The three scenarios are imaginary case studies, but are based on actual locations and conditions. Some of the baseline facts have been modified to more fully illustrate the utility of stormwater indicators as assessment tools for stormwater management program evaluation. The locations and scenarios were selected to represent different regions of the country and to test application of the indicators to different resource management situations.

The first scenario is an example of using both the Level I and Level II methodologies discussed in Chapter IV; the second scenario primarily focuses on Level II methodology; and the third scenario is intended to present a simplified Level I and Level II methodology for a small industrial park site.

SCENARIO I - MODERATELY SIZED MUNICIPALITY - EXPERIENCING RAPID GROWTH

Five Mile Branch is a third order stream located in the Southern Piedmont region of the United States. The entire five-square mile Five Mile Branch Watershed lies within the medium-sized municipality of Town Creek. Town Creek is a rapidly growing, moderately sized town with a population of approximately 40,000 and is located 15 miles from an adjacent major urban center (Figure 5.1). A majority of the town citizenry seeks to protect the natural integrity of Five Mile Branch and its tributaries, while encouraging an atmosphere of sustainable development. The Five Mile Branch Watershed lies exclusively within the town boundaries and drains to a drinking water-supply river/reservoir system which serves the adjacent large metropolitan area. As part of

FIGURE 5.1 LOCATION AND CONTEXT OF TOWN CREEK AND FIVE MILE BRANCH



a state-initiated effort to protect source areas for drinking water-supply, the Town is being encouraged to prepare a watershed management plan to help reduce stormwater-borne pollutant loads to the receiving waters. A two year period is being allocated to develop and begin implementation of the watershed stormwater management plan. Every five to seven years the watershed stormwater management plan is reviewed and modified as necessary to reflect current and anticipated future conditions.

Responsible Party Identification

One of the first recommended elements of preparing a watershed management plan is to identify the parties with authority to conduct and implement the plan. Since the Five Mile Branch Watershed falls completely within the boundaries of Town Creek, the Town will have complete authority to develop and implement the plan. The Town is the recipient of a $200,000 grant from the State, covering a two year period, to study the implementation of source controls within the watershed. The Town Creek Council has allocated an additional budget of $150,000 ($75,000 per year) to prepare and begin implementation of the Five Mile Branch Watershed management plan.

Portions of the Town drain to receiving waters outside its limits (outside of the Five Mile Branch Watershed). Even though these areas are not part of the Five Mile Branch Watershed management plan, they are under the town's overall management authority. A cooperative agreement, in the form of a Regional Water Quality Authority, between the region's municipalities and the State has been set up to coordinate watershed management efforts. The Town is a member of the Regional Water Quality Authority and contributes an annual fee to belong to the organization. In return, the organization provides technical staff and expertise for watershed and land use planning, enforces regionally adopted land use plans, and provides inter-local coordination for watershed management issues. The Five Mile Branch Watershed Management Plan is being prepared in compliance with the land use guidelines and recommendations of the Regional Water Quality Authority.

Previously Collected Data

A comprehensive flood plain and flood management study was completed for the watershed within the last 10 years. This effort produced the original data-set of land use and topography, which is used to establish baseline conditions for the current work effort. The flood management report documented flood prone areas, identified potential flood control structures, and established a 100 year floodplain limit. Water quality analyses or impact assessments to the aquatic environment were not addressed in this report.

Although very little water quality data has been previously collected within the watershed, two separate studies have yielded some baseline information. First, as part of the State's 305(b) reporting and drinking water-supply source protection strategy, several chemical and some physical parameters were monitored at three locations in the watershed over a five year period. Grab samples were collected three times a year during both wet weather and dry weather periods. The monitoring data appears to indicate that in general, dry weather water quality is exceptionally good at the locations tested. Furthermore, only moderately high levels of TSS were present in three of five storm events sampled.

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An additional set of data was recently collected by a citizen's stream stewardship organization, consisting of two years of data, collected at two separate locations, two times per year. This information consisted of biological monitoring data, using macro-invertebrates (identified to family level only) as an indicator species. The results indicate that at least one location, located downstream from an older large-lot residential area, appears to have a reasonably healthy biotic community. The biological community at the second location, located downstream from a regional shopping mall, shows indications of a moderately degraded system.

Receiving Water Uses and Targeted Protection Areas

Five Mile Branch drains to a larger river/reservoir system which serves as a drinking water-supply to the adjacent large municipality. The control of nutrients, particularly phosphorous, is of primary concern to water-supply managers. In addition, a rare darter species has been found in the drainage basin, downstream of the Five Mile Branch basin. This rare darter species is considered a warm water fish and requires clean water and a sandy/gravely substrate for reproduction. The darter has been known to use the lower Five Mile Branch as refuge during the hot summer months of July and August. Over 10 miles of headwater streams (first and second order) flow through the Five Mile Branch Basin. The protection of these small streams from the impacts of urbanization, particularly with respect to controlling erosion and other physical disturbances, are of primary concern to many citizens of Town Creek.

Town Creek Staff and Fiscal Resources

Town Creek has several full-time employees within the Department of Public Works (DPW), Division of Water Resources (DWR). Only one staff member has been assigned to the project with the understanding that the work effort will require approximately 50% of her time.

As discussed above, Town Creek has a annual budget of $175,000 for two years to prepare the watershed management plan, begin partial implementation of the plan, and provide one year of monitoring. The Town has retained an outside consultant to conduct baseline monitoring, assist in identification of program goals, develop implementation management strategies, prepare a long-term monitoring plan, and conduct monitoring to assess management efforts after the first year of implementation. The Town staff person is responsible for managing the consultant's contract. including contract management; helping the consultant with presentations to the Town Council; and providing input and reviews for issues related to Town goals, prioritizing Town citizen concerns, or providing direction in allocating future Town resources.

Assessment of Baseline Conditions in Five Mile Branch Watershed

Since the primary objectives of the watershed management plan are to identity and control non-point source pollutants and protect the streams within Five Mile Branch Watershed, the following indicators are used to identify problems areas:

- Growth and development (Profile No. 24) is evaluated for all existing development and projected for all future development within the whole watershed.
- Biological monitoring (Profile No. 12 & No. 13) is conducted for the Five Mile Branch mainstem and tributaries for a total of 10 stations (Fish assemblage and macro-invertebrate assemblage).

- Physical assessments (Profile No. 7 & No. 8) are conducted for the mainstem and tributaries for a total stream length of approximately 3.5 miles (stream widening/downcutting, and habitat monitoring).
- Water quality monitoring (Profile No. 1) is conducted at one station at the confluence with the receiving water body (pollutant constituent monitoring of phosphorus, dissolved oxygen, TSS, and fecal coliform).
- Public attitudes (Profile No. 17) are surveyed once within a portion of the watershed.

The timetable to collect and assemble the baseline information is limited to one year. Growth and development is assessed over a two month period. Biological and physical assessments are conducted two times per year (in the spring and fall) and compared against a reference condition from a nearby watershed. Water quality monitoring is conducted for three storm events, using manually collected grab samples and a flume to establish the stage-discharge relationship. The public attitude survey is conducted within a portion of the watershed containing a mix of commercial, light industrial, and residential land uses, for a population of approximately 3,500 people.

Using the Town's already established geographic information system (GIS), existing development is measured in terms of impervious area. Based on current zoning, the ultimate impervious area is estimated and mapped. This effort yields valuable information on areas of the watershed which are at risk of degradation due to proposed levels of imperviousness.

Biological monitoring of the streams yielded the following results:

- The undeveloped areas are almost pristine, with a high abundance of species and high diversity.
- The residential land uses show moderate stream channel erosion, fair to poor aquatic habitat, and a moderately impacted aquatic community.
- The commercial/light industrial land uses show moderate to severe channel alterations, and a degraded aquatic biological community.
- The newly developed areas (constructed with BMPs) show light to moderate channel alterations and a moderately impacted aquatic community

The water quality pollutant constituent monitoring results indicate moderate nutrient levels, low fecal coliform levels and very low TSS levels for two of the three storm events. Data for one winter storm showed elevated TSS following several days of above average rainfall.

The public attitude survey results indicate that a majority of citizens are concerned with growth- related impacts to streams; consider water quality and biological integrity to be important; are willing to support moderate management efforts with money from the town's General Fund, realizing that other services may be slightly compromised; and are unwilling to increase taxes or pay user fees to provide for substantial protection of water resources.

The cost to conduct the baseline monitoring efforts discussed above, compile the results, and prepare a summary report is approximately $116,000. This figure includes the consultant fee plus the proportionate salary and overhead costs of the town staff person. Therefore approximately $234,000 is available to complete the management plan report, institute some implementation measures, and conduct one year of post-implementation monitoring.

Watershed Management Plan - Implementation Program

Identification of Watershed Management Goals for Five Mile Branch

Based on the results of the baseline monitoring, the consultant, town staff and Town Creek Council have developed the following realistic goals as strategic elements of the watershed management plan.

- Protect, to the maximum extent possible, pristine streams in undeveloped areas by limiting development in those areas where the highest quality streams systems exist, instituting extensive and redundant BMP controls in areas already slated for development, and instituting land development techniques which minimize impervious area and maximize stream protection.
- Improve stream habitat and biological diversity for already degraded streams.
- Reduce nutrient and sediment loadings in receiving waters.
- Maintain or increase the habitat and population of the sensitive darter species within the lower reaches of Five Mile Branch.

Prioritize Goals for Implementation Strategy

The consultant, town staff and Town Council in conjunction with the general public (through a series of pubic meetings) have developed the follow priority for implementation of management strategies. This hierarchy will form the basis for allocating limited resources for implementation of management measures over the next several years.

1. Protection of most pristine resources
2. Increased protection for other undeveloped lands
3. Nutrient and sediment reduction to receiving water body
4. Protection of rare darter species
5. Enhancement of degraded streams

Implementation of Management Strategies

The implementation plan being developed by the consultant reflects the priority of achievable goals. The list of specific management measures include:

- Revisions to land use plans and zoning modifications to limit growth within the most pristine areas (may require innovative strategies, such as overlay zoning, transfer of development rights, conservation easements, etc.).
- Revisions to subdivision codes and stormwater management ordinance to require/encourage additional site planning techniques to reduce impervious areas and require more stringent BMPs for stream protection in developing areas.
- Public education and outreach program for nutrient reduction; investigate retrofit opportunities for existing residential areas.
- Revisions to erosion/sediment control regulations for areas draining directly to darter habitat to require additional redundant practices; additional inspections of construction sites for these areas; provide increased buffer requirements through the subdivision process for lower reaches of Five Mile Branch; provide instream habitat improvement projects for lower Five Mile Branch.

- Investigate retrofit opportunities upstream of degraded stream reach lengths; provide instream habitat enhancement and channel stabilization projects; replace or augment riparian cover along stream banks and buffers.

These measures will certainly not be implemented overnight; they require time and a change in public opinion to be fully implemented. Whether the management measures work or not is tested through post- implementation monitoring and assessment of results. A re-evaluation of these management strategies is likely as time passes.

As part of the consultant's scope of services, a management plan report is prepared which includes: a summary of baseline conditions, the goals and implementation strategy priority, a cost estimate, and a timetable for implementation of the management measures. The cost estimate is assessed on an annual basis with capitalization costs identified up front. The Town Creek Council reviews the cost analysis and determines whether sufficient funding is available within the General Fund to pursue implementation. Based on the current financial projections, only the last element (restoration of degraded streams) is likely to be beyond the budgetary means of the town. However, since this element has been prioritized as the last component of implementation, it is retained in the plan as a longer term goal when adequate funding is available.

It is projected that the town will expend approximately $135,000 to implement the first four elements of the management strategy in the first year of the plan. Therefore, approximately $99,000 will remain to conduct assessment monitoring and compile a summary report of results.

Monitoring Program Development Strategy and Assessment of Results

An indicator monitoring program will be used to assess the success of the management strategies. The consultant develops the monitoring program to directly measure the effects of management measures on the targeted resources with respect to protection and/or restoration. The following list of indicators is presented to the town staff and Council for review and approval:

- Biological and physical/hydrological indicators are proposed in areas experiencing growth to evaluate the effects of more stringent stormwater management controls and site planning techniques. These indicators are structured as a paired subwatershed analysis with one area being developed without modified stormwater and site planning controls and the other area being developed with the more stringent stormwater regulation and enhanced site planning techniques (Profile Nos 7, 8, 12, and 13).
- Water quality assessment at one station at the confluence with the receiving water body (pollutant constituent monitoring of phosphorus, dissolved oxygen, TSS, and fecal coliform - Profile No. 1)
- Public attitude survey of citizens within the watershed to evaluate the public's perception of how well management practices are working and to determine whether additional funding would be supported by the general populace (Profile No. 17).

The results of the first year of monitoring are compared directly with the management strategies to assess the effectiveness of the program. However, because nearly all of the management strategies will take several years to fully implement, several years of monitoring data will be required to completely assess the effectiveness of the program. A 5-year duration is recommended for re-assessment of the watershed management plan. As monitoring data is compiled over this 5-year period, sufficient data will emerge to enable assessment. At this end of the 5-year period, a re-evaluation of resource protection goals, management strategies, and implementation priority should be conducted.

SCENARIO 2 OLDER INDUSTRIAL MUNICIPALITY - RESOURCE RESTORATION

The Town of Kelsey, an older industrial city, is developing a stormwater management program in compliance with NPDES regulations for medium-sized municipalities (current population is approximately 150,000). The Town lies on the shore of Hannah Bay, a shallow embayment to one of the Great Lakes (Figure 5.2). Most of the 25 square mile Bay watershed lies within city boundaries. The Town of Kelsey's stormwater management program will focus on the portion of the watershed within Town boundaries, including seven miles of stream which drain to Hannah Bay.

Within the Town, there is significant older residential development and some light industrial and commercial areas. Industrial and commercial development is also concentrated along the Bay waterfront. The area surrounding the Town of Kelsey is mostly agricultural, although there is some low density residential development.

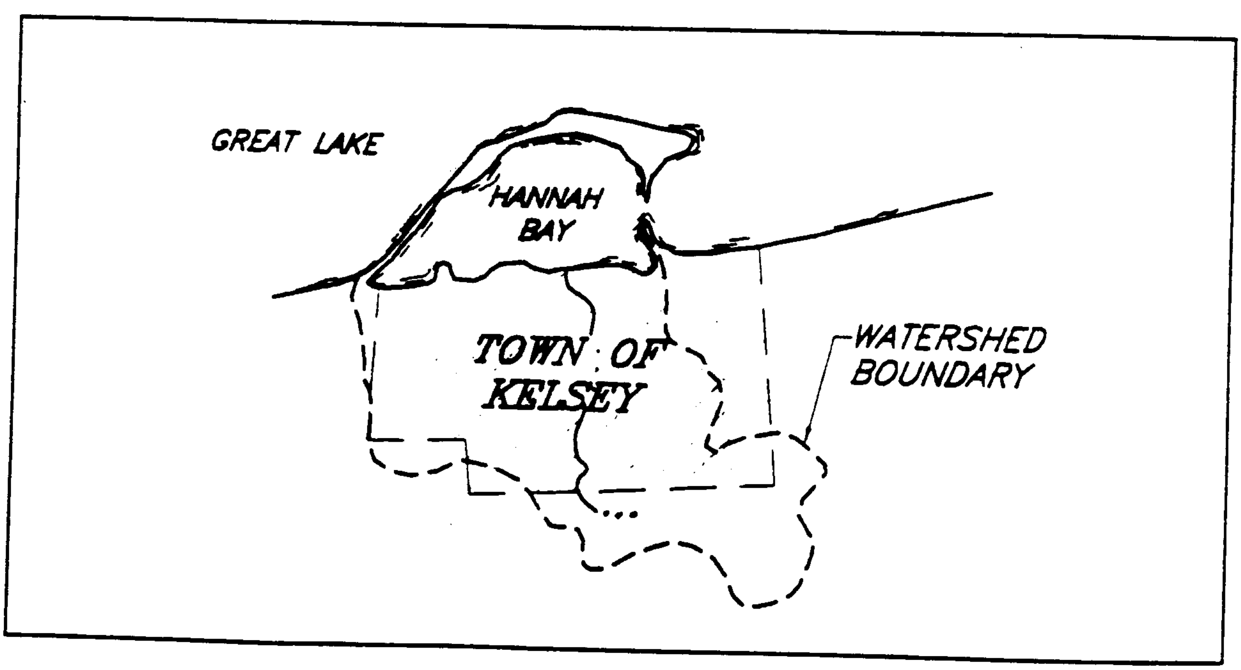
Almost all of Hannah Bay watershed is sewered and serviced by a wastewater treatment plant which discharges outside the Bay. The storm sewerage system contains both separate and combined sewers. Hannah Bay has designated water uses including warm water fisheries, potable water supply, and contact recreation (i.e., boating, fishing, and swimming).

The Town of Kelsey has completed NPDES Phase I stormwater monitoring. (NPDES regulations are enforced and regulated by the State.) The State has implemented a vigorous point source control program, but has not established stormwater quality standards.

Program Objectives and Prior Efforts

The Town of Kelsey's stormwater management program will complement the Hannah Bay Remedial Action Plan (RAP). The RAP outlines strategies to restore and protect aquatic resources in the Hannah Bay watershed. The RAP was developed by the State in conjunction with EPA, the

FIGURE 5.2 THE TOWN OF KELSEY



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International Joint Commission, and the Town of Kelsey and is based on guidance provided by the Great Lakes Water Quality Board.

Included in the RAP is a review of historical and current water quality data. Degraded water quality conditions have been reported since the 1970's. Problems include algal blooms, dissolved oxygen depletion, fish kills, malodorous conditions, reduced clarity, excessive growths of aquatic macrophytes, and high fecal coliform. Warm water fisheries have been impaired by polycyclic aromatic hydrocarbons (PAHs) and algal blooms. Contact recreation has been impacted by high fecal coliform concentrations. In addition, sediment dredging is restricted due to high heavy metals, nutrient, oil and grease, volatiles, and PAH concentrations. The most significant sources of these pollution problems are nonpoint source pollution from urban runoff and combined sewer overflows (CSOs).

The Town of Kelsey has two objectives for its stormwater management program: (1) protection of Hannah Bay fisheries and (2) minimization of impacts affecting recreational use of Hannah Bay.

Responsible Parties and Resources

The Town of Kelsey does not have the staff nor monetary resources needed to implement a full-scale stormwater management program. Growth in the Town is stagnant, and many factories have closed. Furthermore, there is little citizen support for allocating funds towards this effort. The Town has allocated $50,000 for stormwater management during this year. The stormwater management program will be implemented by the Town's Public Works Department which has assigned (part-time) one engineer and one technician to the stormwater effort.

The Town has entered into a partnership with the State and a nearby land grant university. The State has supplied a twelve-month, $150,000 grant and will provide technical support. Additional staff resources and technical support (including computers and research documents) will be provided by the university. Finally, because CSOs have been identified as a significant pollution source, the wastewater treatment plant authority has also been identified as a potential source of support.

Management Program

In a series of meetings with the State, the WWTP authority, and the university, the Town of Kelsey outlined a five task stormwater management program which includes:

- Task 1, Industrial Runoff Control;
- Task 2, Residential Runoff Control;
- Task 3, CSO Reduction;
- Task 4, Habitat and Water Quality Assessment; and
- Task 5, Public Involvement.

Task 1, Industrial Runoff Control

The focus of this effort is reduction of the toxicity and volume of runoff from industrial facilities. The Town, with assistance from the State, will ensure that all industrial facilities within the Town of Kelsey and subject to NPDES stormwater regulations have applied for, or are operating under, a valid NPDES stormwater permit. The Town will also work with the State to develop stormwater runoff guidelines; identify pollution prevention techniques (e.g., no exposure, good housekeeping); and identify feasible pre-treatment and structural BMP options for industrial facilities. In conjunction with the WWTP authority, the Town will investigate possible diversions of runoff from industrial facilities to the treatment plant. Because there are a significant number of boating support and marina operations along the Hannah Bay waterfront, the Town will focus much of its NPDES compliance efforts on these facilities.

Task 2, Residential Runoff Control

The purpose of this task is to reduce the toxicity of runoff from residential areas. The Town will establish a household hazardous waste collection/recycling center, possibly in conjunction with local industries. The Town and the university will develop and conduct lawn care seminars to train homeowners in proper lawn care procedures including mowing regimes, types and amounts of products, and application procedures. Finally, a storm drain stenciling program will be started, possibly with the assistance of local Girl and Boy Scout Troops.

Task 3, CSO Reduction

This is a planning-level effort. This task will focus on identification of options for increasing sewer capacity, re-routing overflows, and/or providing treatment for the overflows (in cooperation with the WWTP authority). The relative cost of the various options will be determined. Potential funding options, including user fees, stormwater utility, and increased taxes, will also investigated. The Town will enlist the expertise of the WWTP authority. The university and State will be responsible for identifying reduction options and funding opportunities.

Task 4, Habitat and Water Quality Assessment

Shale sediment from eroding stream channels has been identified as a significant factor with respect to water quality problems in Hannah Bay. It has been speculated that the fine shale sediment encourages precipitation of pollutants in the water column. Prior to consideration and construction of streambank protection measures, the Town will assess current physical habitat and water quality conditions in the stream system. The focus of this effort is 3.5-mile Tate Creek, the largest tributary to Hannah Bay, which flows through a highly developed subwatershed. The assessment will be conducted in conjunction with the university and citizen monitoring groups.

Task 5, Public Involvement

Public involvement efforts are included in Task 2 (storm drain stenciling) and Task 4 (citizen monitoring). In addition, the Town and the university will develop and implement a series of seminars designed to educate the public regarding stormwater runoff, its environmental impacts, and management options. One of the primary purposes of this effort is to garner public support for current and future funding of the stormwater management effort.

Monitoring Program

The success (or failure) of the Town of Kelsey's stormwater management program will be assessed within a long-term (i.e., 5 years or more) framework. Most of the management program is in the planning phase. Full implementation of structural BMPs, pollution prevention measures, and storm sewer modifications may not be achieved for many years. Some measures may be eliminated from consideration based on the results of the CSO reduction and habitat and water quality assessment efforts.

The Town of Kelsey monitoring program will focus on anticipated long-term benefits and is designed to assess the five management program tasks. Indicators included in the monitoring program include water quality pollutant constituent monitoring (Indicator No. 1), human health criteria (No. 6), physical habitat monitoring (No. 8), fish assemblage (No. 12), public attitude surveys (No. 17), and permitting and compliance (No. 23). These indicators will be used to assess the program as follows:

Task 1, Industrial Runoff Control:

Permitting and compliance (No. 23): The State will provide the Town with a list of industries (within Town boundaries) subject to NPDES stormwater regulations; the number of permits issued; and copies of the permits. The Town will request copies of the Storm Water Pollution Prevention Plans from each permitted facility. An increase in the percentage of facilities subject to NPDES controls which have obtained permits is a potential indicator of success.

Water quality pollutant constituent monitoring (No. 1): The Town will select three locations in Hannah Bay and three locations in the stream system to monitor total phosphorus, total Kjedhal nitrogen, nitrate, dissolved oxygen, PAH, hydrocarbons, copper, lead, pesticides, and chemical oxygen demand. At least one site will be located upstream and at least one site downstream of major industrial development.

A total of 12 events will be monitored; 6 monthly baseflow events(April through September) and 6 storm events. The university will be responsible for collection and most analyses. A private laboratory will be contracted for the pesticides and PAH analyses. Long-term, general improvements in the monitored constituents is a potential indicator of success.

Fish assemblage (No. 12): The State (via the Department of the Environment) currently conducts fish pathology studies in Hannah Bay and its tributaries. The studies are used to track fishery health and focus on disease and poor health as evidenced by liver tumors, fin rot, and lesions. The State will continue these studies and will provide the Town of Kelsey with the monitoring results. The RAP linked fish tumors to elevated PAH levels in Hannah Bay. A reduction in the number of liver tumors is considered a potential indicator of success.

Task 2, Residential Runoff Control

Water quality pollutant constituent monitoring (No. 1): The water quality monitoring effort outlined in Task 1 will be used to assess the success of this effort. Monitoring sites will be located upstream and downstream of major residential development. Long-term, general reductions in pesticide concentrations have been identified as a potential indicator of success.

Task 3, CSO Reductions

Human health criteria (No. 6): The County (via the Health Department) conducts monthly fecal coliform surveys in Hannah Bay and immediately following storm events. During the swimming season, the maximum fecal coliform level is a geometric mean of 200 per 100 milliliters based on five samples. When fecal coliform levels exceed this level, the County closes beaches along Hannah Bay. Consumptive fishing is restricted whenever fecal coliform levels exceed 14 per 100 milliliters. The County has agreed to provide the Town of Kelsey with its survey results. The Town will use this information as baseline data.

Task 4, Habitat and Water Quality Assessment

Physical habitat monitoring (No. 8): Rapid Bioassessment Protocols will be used to evaluate physical habitat conditions in Tate Creek. University staff and students, citizen monitoring groups, and individual volunteers will be trained to conduct these surveys. The survey results will be used to describe baseline conditions. It is anticipated that these surveys will be conducted on an annul basis. General improvements in the habitat scores is considered a potential indicator of success.

Water quality pollutant constituent monitoring (No. 1): The water quality monitoring effort outlined in Task 1 will also be used to assess water quality in the stream system. Two monitoring sites will be located in Tate Creek. Long-term reductions in pollutant concentrations (or increases in dissolved oxygen) have been identified as potential indicators of success.

Task 5, Public Involvement

Public attitude surveys (No. 17): The Town, in partnership with the university, will develop and conduct a public attitude survey. This survey will focus on the public's knowledge about problems associated with stormwater, CSOs, the cost of various solutions, habitat and water quality conditions in Hannah Bay, sources of pollution in the watershed, and willingness to fund stormwater management efforts. Approximately 2,000 households will be included in the survey.

The Town tentatively plans to conduct a similar survey in five years. Heightened awareness of stormwater issues and increased willingness to fund stormwater management have been identified as potential measures of success.

Program Costs

The costs incurred by the Town of Kelsey for each phase of its stormwater management effort is outlined below.

Task 1, Industrial Runoff Control		
Stormwater runoff guidelines	$	2,000.00
Identification of industrial site options	$	5,000.00
Review of potential runoff diversions to WWTP	$	5,000.00
Permitting and compliance assessment	$	2,000.00
Water quality pollutant constituent monitoring	$	70,000.00 [1]
Fish assemblage (fish pathology) studies	$	0.00 [2]
subtotal	**$**	**84,000.00**
Task 2, Residential Runoff Control		
Household hazardous waste collection/recycling center	$	10,000.00
Lawn care seminars	$	5,000.00
Storm drain stenciling program	$	2,000.00
Water quality pollutant constituent monitoring	$	0.00 [3]
subtotal	**$**	**17,000.00**

[1] Cost for successive years will be approximately $45,000. This year's cost included $35,000 start-up costs.
[2] Conducted by State Department of the Environment.
[3] Costs included in Task 1.

Task 3, CSO Reductions		
Review of options		$ 5,000.00
Human health criteria (fecal coliform) surveys		$ 0.00 [4]
	subtotal	**$ 5,000.00**
Task 4, Habitat and Water Quality Assessment		
Physical habitat monitoring (Rapid Bioassessment Protocol)		$ 30,000.00
Water quality pollutant constituent monitoring		$ 0.00 [3]
	subtotal	**$ 30,000.00**
Task 5, Public Involvement		
Public seminars		$ 10,000.00
Public attitude surveys		$ 30,000.00
	subtotal	**$ 40,000.00**
	TOTAL	**$ 176,000.00**

[4] Conducted by County Health Department.

SCENARIO 3 - SMALLER INDUSTRIAL PARK - SOURCE CONTROL FOCUS

Century Industrial Park is a 30-acre industrial park, located in a highly urbanized, southern west-coast municipality. Century consists of 16 properties of individually owned facilities. The major industrial uses are trucking related services, an auto salvage yard, and metal plating operations, in addition to several smaller, less intensive uses.

The site is located in a semi-arid region, which receives approximately 14 inches of rainfall per year, most of this during the fall and winter months. All stormwater runoff is collected by an on-site drainage system and piped to the property line. A small, off-site intermittent channel conveys stormwater runoff from the industrial park directly to a tidal estuary surrounded by a highly urban area (Figure 5.3).

Five years have elapsed since Century Industrial Park was originally issued a National Pollution Discharge Elimination System (NPDES) permit. During this period, a pollution prevention plan has been in effect which includes an intensive outreach program to assist site owners with methods for implementing source controls (good housekeeping measures). In addition, several structural best management practices (BMPs) were proposed for the most intensive activities. For one reason or another, only one on-site oil/water separator structure had been installed at the metal plating facility.

Responsible Party Identification

The individual property owners were identified as regulated industries under the state's implementation of the Phase I NPDES permit process. The site owners pulled together their resources and filed a single joint application for an individual NPDES permit, instead of 16 separate ones. The state recognizes Century Industrial Park as the legal entity responsible for implementation and compliance with the NPDES permit conditions.

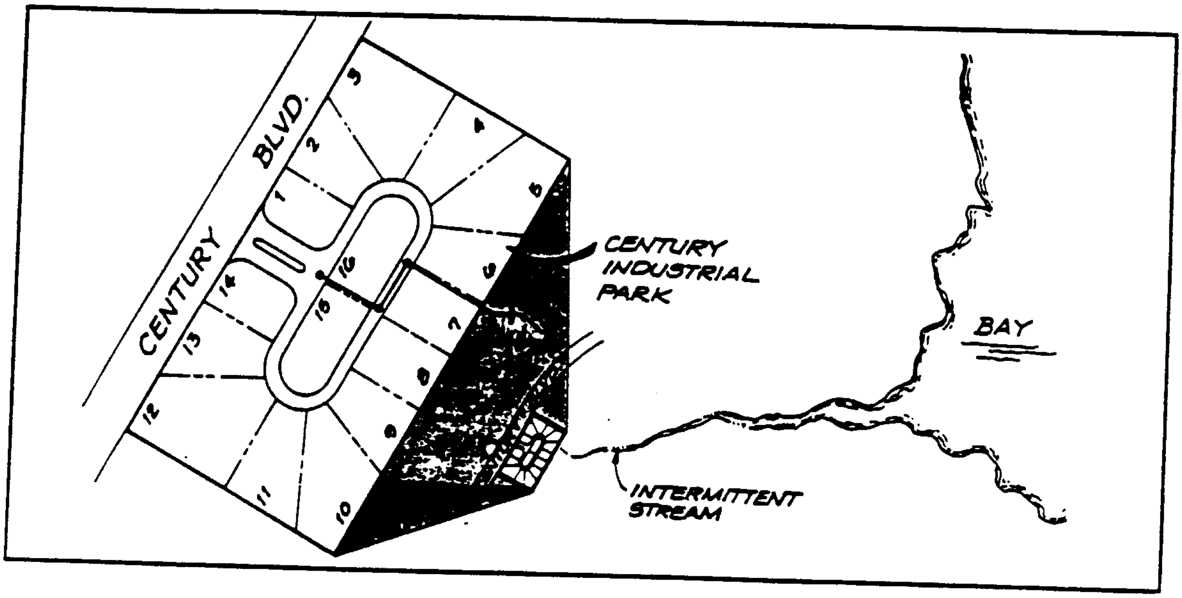

FIGURE 5.3 CENTURY INDUSTRIAL PARK

Previously Collected Data and Assessment of Baseline Conditions

Data collected for the NPDES permit application and subsequent monitoring conducted as a condition of the permit contained end-of-pipe pollutant constituent data from five storm events. Rainfall from these events ranged in size from 0.12" to 1.96". The data confirmed that high levels of dissolved and total zinc, copper, and lead were being exported from the site during storm events. These levels were compared with the Water Quality Exceedance Frequencies (WQEFs) for total metals. All five storm samples exceeded the target water quality objectives.

Toxicity tests consisting of a two tiered approach were also conducted. Short-term, 7-day chronic toxicity tests were carried out on wet weather samples on *Ceriodaphnia Dubia* to establish the condition of consistent toxicity at the site. Next, a Toxicity Identification Evaluation (TIE) was performed to measure and identify chemical constituents responsible for the observed toxicity. This procedure involves both physical and chemical alterations of water samples to eliminate particular compounds or classes of compounds. The results of the TIE indicated that a large majority of toxicity was due to dissolved metal ions. Another conclusion appears to be that the WQEFs which are based on total metals, may be overly conservative. In many cases, particulate-bound metals are less toxic (based on the results of the TIE) and only the dissolved component is consistently causing toxicity.

Receiving Water Uses and Target Protection Areas

As stated above the site drains to an urban estuary. This waterbody has been impacted by human influences for many years. It is believed that metals are the principal pollutant affecting aquatic health, particularly those particulate-bound metals within the bottom sediments. Other parameters, such as poly-aromatic hydrocarbons (PAHs), and nutrients are often cited as contributors to the degraded aquatic community.

The intermittent stream which drains the site has been armored over the years to stabilize the channel banks and bottom to reduce erosion. Since the channel is intermittent and reasonably well stabilized, the primary management strategy for this site is targeted towards reducing pollutant loadings being delivered to the bay.

Resources

The property owners pay an annual fee to fund the compliance measures of the NPDES permit. Each property owner pays a percentage of the total budget based on the amount of impervious surface and type of industry. The annual budget for the total 30 acre site is $20,000. Century Industrial Park has been identified as a significant contributor of non-point source pollutants to the receiving waters. A $100,000 grant has been appropriated by the State Water Conservation Board for this site to go towards addressing non-point source pollution control. A consultant has been hired to update the on-site pollution prevention plan, prepare a structural BMP implementation plan, and conduct monitoring for the term of the renewal permit.

Management Plan Goals and Priority of Implementation

The consultant in conjunction with the property owners and the State Water Conservation Board have developed the following goals and implementation priority for the term of the permit.

- Reduce total metal export from the site by 40% over existing levels by constructing structural BMPs to serve those properties with the greatest metal loading potential (i.e., auto salvage yard and metal plating facility).
- Reduce total pollutant loadings from the site to increase the percentage of *Ceriodaphnia* survival for a majority of storm events.
- Review and update pollution prevention plans for all on-site properties.
- Ensure compliance with pollution prevention plans.
- Increase the general public's awareness of the management efforts being implemented at Century Industrial Park for use as a platform for increased support for bay-wide stormwater non-point source controls.

Implementation of Management Strategies

The implementation of management efforts will involve the following basic steps to achieve the goals identified above. The approach must be carefully orchestrated since there is limited funding available and potential disruption of business operations must be avoided.

- Structural BMP locations are first identified and a feasibility analysis is conducted. Since the site is an industrial land use, little space is available for larger detention/retention facilities. Additionally, since downstream quantity controls are not warranted, the BMPs should be designed as quality-control facilities. A filtering BMP (such as a sand, compost or peat/sand filter) will probably be the most suitable given the site constraints. These facilities can be located along the edge of existing paved areas or even underground. Given the implementation budget constraints, and potential construction cost of approximately $3,500 per impervious acre (City of Austin, 1990), only about 15 acres can be realistically controlled by these facilities. The structural BMPs should be designed so as to control those portions of the site contributing the greatest pollutant loads (e.g., auto salvage yard, trucking services, and metal plating). Approximately $5,000 should be budgeted annually for the maintenance of these facilities. An additional $1,000 per year should be budgeted for the cleanout and maintenance of the existing oil/water separator structure.

- The pollution prevention plan for each property is reviewed and evaluated to ensure that the good housekeeping and source control measures are incorporated into the plans. Some of these measures include: spill prevention and clean-up procedures; covered storage of materials; covered loading docks and/or cleanup procedures; covered vehicle maintenance and refueling areas; and floor drains connected to sanitary sewers. The cost to conduct this portion of the management plan is approximately $7,500. Construction costs for providing covered facilities will cost more. Each business may need to phase in these expenditures over a few years. Cleanup activities can be paid for, in part, out of the annual NPDES implementation expenses.
- Compliance monitoring is conducted to verify that all properties are following the measures outlined in the pollution prevention plans. Compliance monitoring is in the form of visual inspections only. Compliance monitoring will cost approximately $1,800 per inspection for the entire 30 acre site. This should be conducted at least once per year, but preferably twice.
- The public awareness element consists of distributing informational flyers; news releases; presentations at political forums, technical workshops and conferences; among other media. These elements are spaced over the term of the permit and should be incorporated into the annual budget. $5,000 should be budgeted to set up the program in the first year with $2,500 per year provided, thereafter.

The total cost to implement the above measures is approximately $75,000, not including engineering design costs. Given the $100,000 implementation grant, there should be sufficient funds available to cover the cost of design and construction inspection.

Monitoring Program and Assessment of Results

The monitoring program is developed to select indicators which will assess success of the management efforts in meeting the goals stated above. The following indicators are utilized:

- Pollutant constituent monitoring (Profile No. 1) at inflow and effluent of one structural BMP (for a minimum of three storm events per year).
- Pollutant constituent monitoring (Profile No. 1) at the outfall of the site to assess metal reduction success (for a minimum of three storm events per year).
- 7 day, chronic toxicity testing and TIEs (Profile No 2) at the outfall of the site to assess reduction in toxicity, conducted once per year during the term of the project.
- Industrial site compliance monitoring (Profile No 26), two times per year
- Public attitude survey (Profile No. 17) conducted in the vicinity of the site in year three of the program implementation, to assess the effectiveness of the public awareness efforts.

It is projected that the monitoring will cost $ 23,000 per year for the five year term of the permit. This number is slightly larger than the $20,000 budgeted for NPDES compliance, so some elements may need to be conducted on a bi-annual basis or the annual budget may need to be increased. As monitoring data is compiled over the duration of the permit term, data will emerge to be able to assess the success of the management strategies. After the five year term, a re-evaluation of the management efforts should be conducted and appropriate changes made.

APPENDIX A: REPORT ON STORMWATER INDICATORS MEETINGS

Conducted April - June 1995
By The Rensselaerville Institute
as part of a cooperative agreement with
the U.S. Environmental Protection Agency

INTRODUCTION

As part of a three-stage cooperative agreement with the U.S. EPA, and in conjunction with the Center for Watershed Protection (CWP) and the Water Environment Research Foundation (WERF), The Rensselaerville Institute convened and facilitated six stakeholder meetings which gathered storm water experts from throughout the U.S. The stakeholder groups represented at the meetings included: state and local regulators, EPA regional offices, industry, consultant engineers, and regulated municipalities.

The purpose of these meetings was to gain feedback on the Storm Water Indicator Profiles Document as prepared by the Center for Watershed Protection, and also examine the potential for identifying a core set of storm water indicators that could be used nationwide to track program effectiveness. Participants at these meetings were individuals who are recognized for their expertise in the area of storm water pollution prevention and control. Suggestions for participants were received from professional organizations including ASIWPCA, NAFSMA, APWA, and ACEC, as well as recommendations from EPA headquarters and regional offices, WERF and CWP. The list of participants at each meeting is appendixed to this report.

This report provides a short section describing the methods and approaches used for designing and implementing these six expert stakeholder meetings, and summarizes the key responses and recommendations made by the experts that seemed to become common "threads" throughout most or all of the meetings.

METHODS

Six expert meetings were designed and organized by The Institute: the first three were designed to include mixed stakeholders representing a specific geographic area of the country. These three meetings were held in Denver, CO; Sacramento, CA; and Philadelphia, PA. The second three meetings were designed to gain feedback from single-constituent stakeholders representing various geographic regions of the country and, in one case, Canada. The stakeholder groups represented in these latter three meetings were: regulated municipalities, state regulators, and academia. All three of these latter meetings were conducted in Washington, DC.

The meeting format was designed to stimulate high interaction among participants. The basic guidelines set at each meeting were: experts were to speak their own opinions based on their personal expertise, not represent a corporate or agency "line" when responding to questions; participants were encouraged to ask questions to effectively probe areas of discussion rather than make assertions that tend to cut off interaction between participants; and issues beyond the scope of the defined area of discussion, i.e. selection and application of storm water indicators, and comments pertaining to the Profiles document, were off-limits, e.g. discussions on pending permit applications between permittees and regulators were inappropriate for these meetings.

All participants received the draft Indicator Profiles Document at least one week prior to their assigned meeting to familiarize themselves with the contents of the document and the format designed for meeting discussions. The key questions posed at each meeting were:

- Is there a core set of indicators that could be used nationwide to identify storm water problems?
- Is there similarly a core set of indicators that could be used consistently nationwide to assess storm water program effectiveness?
- What are the strengths and weaknesses of the Profiles document in its present draft form, and what information could be added or modified to improve its usefulness as a guidance tool for communities addressing storm water issues?
- Given certain conditions (as provided to the group in a simulated situation), how would participants approach the development of a storm water monitoring program for a given waterbody?

In each of the sessions, both small-group and whole-group discussions were used to engage participants. In each case of small group deliberations, highlights of those deliberations were presented to the plenary for further consideration and discussion. Consensus and divergent views were equally welcome from participants. The desired outcomes from these expert meetings were to determine:

- Which, if any, indicators that could be used nationwide to assess stormwater programs. If yes, what are the indicators, and what are the parameters of their use as national indicators.
- Those changes that could be made in the Profiles document draft to make it more user-friendly and useful to a wide range of community representatives in making rational and reasonable decisions for determining baseline conditions and selecting appropriate indicators to monitor change after implementation of BMPs.
- What approaches, steps, criteria or protocols would prove useful to communities starting or improving a storm water monitoring program, and the rationale behind using these approaches.
- What small pilots or tests could be tried by WERF or others to test the ability of these approaches to improve present storm water program monitoring efforts.

This report presents some of the key common responses and opinions expressed by participating experts on what they believed to be the most reasonable and cost-effective approaches to storm water monitoring, and what needed to be done to improve both understanding of storm water as a pollutant source and program performance.

Key Responses and Recommendations for Improving Storm Water Program Monitoring and Performance

Some of the key responses and recommendations made by the expert participants which seemed to "thread through" these six meetings were:

1. There are no specific storm water indicators that could be used nationwide comparably as a measure of program effectiveness. Most particularly, no indicator could be comparable in terms of its numerical (quantitative) standard. What experts did believe to be comparable nationwide were strategies and tactics that could be applied to select appropriate indicators

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for any given watershed or sub-watershed. These would include strategies and tactics both for problem identification and determination of program effectiveness.

2. The availability of comparable baseline data is non-existent. Lack of standards and protocols for collection of data in the early promulgation of the regulations resulted in data which are not comparable from program to program and state to state. Further, the large expenditures for initial data collection that have no comparability strongly suggests that better guidance be provided to program developers and implementors on how to decide which data to collect that would be informative, useful and applicable to program improvement.

3. The Profiles document has excellent potential for providing such guidance both to communities starting a storm water monitoring program as well as those wishing to improve their present program. (Note: In each of the six expert meetings, staff from the Center for Watershed Protection received and carefully noted specific references to areas that could be improved for better document use and reference.) The overall conclusion was that the document did an excellent job in presenting key information in an understandable format; experts noted that the document needs to include approaches and protocols that could help bring consistency and common sense to the practice of program implementation and monitoring. Too often indicator selection is a result of what is known or comfortable, not what has been identified as needed to determine or deal with the problem. Basic decision-trees or decision strategies would be highly useful to laypeople referring to the document, as would guiding principles and questions that would help community members better identify and respond to problems.

4. Experts were clear: indicators have distinct roles in program assessment, and not all indicators can be used to serve the same role. Some indicators are used for problem identification; others are used to determine program effectiveness. Still others can only be used to look at program effectiveness over the long-term, while others can only effectively detect short-term gains in the program. Experts believe that problem identification is one of the biggest difficulties with the storm water program; municipalities in particular don't understand how to identify their storm water problems, and therefore often select the wrong indicators for the wrong reasons, thus generating useless data that provide no assessment of whether or not the problem is being solved.

5. One realistic approach to designing a monitoring program is to look first at those indicators that are easiest and least costly to use in order to determine the storm water problems being dealt with, e.g. indicators that are observational in nature are an excellent way to begin (example: walking a stream to assess physical and macro-biological indicators). Cost and time-intensity are two realistic constraints that must be considered in the development of any monitoring program. A third is time-appropriateness of using any given indicator: some indicators are appropriate for problem "screening" (earliest use) while others may need to be used later for finer identification of problems. Overall, experts feel that the indicators represent a toolbox from which the most appropriate tools for the job are selected at the time that they are needed. Not all indicators are used in all programs at all times...nor should they ever be required to be so used by a regulating agency.

6. Beneficial uses must be the target toward which any monitoring program is directed. There has to be a realistic understanding among all parties of what is trying to be achieved through the program. While it is clear that the program's purpose is to close the gap between present water quality conditions and what the desired beneficial uses are, it also has to be made clear

that different waterbodies have different designated uses; "pristine condition" cannot and should not be the goal for every waterbody. The storm water program, designed by a community, has to be based on what is realistically achievable for that given waterbody. All community representatives need to be part of the goal-setting process for the program to succeed; they need to be part of the decision-making on the trade-offs they are willing to make to achieve the goals they set.

7. Education is key to gain buy-in and active support from stakeholders. If a storm water program is to be effective, it must play to all the audiences of a given location. Helping people understand and commit to the program requires attending to their values and beliefs. These different audiences must not only be informed, but they must be persuaded to change their behavior.

SUMMARY

At all six meetings, participant experts offered numerous suggestions for ways to make the Storm Water Indicator Profiles document more widely applicable and more user friendly. Staff at the Center For Watershed Protection made careful note and consideration of each of these suggestions, and many of the suggested changes are reflected in this final version. As more becomes known about storm water and effective approaches for dealing with pollutant sources, The Rensselaerville Institute is confident that this "living document" can grow and develop so that it continually meets community needs with accurate, helpful, up-to-date information and guidance.

The Rensselaerville Institute report ends with what we believe is probably the most important message received from the many experts involved: storm water programs will only be effective when a paradigm shift occurs in regard to our approaches to dealing with it as a pollutant source. Perception has to move from traditional, end-of-pipe, water chemistry, broad-spectrum pollutant monitoring, treatment and command-and-control enforcement, to a mindset focusing on receiving water body quality and the beneficial uses that the community desires for that waterbody. There needs to be strong emphasis on problem identification before a program is designed, and then there needs to be very judicial choice of appropriate indicators so that real progress toward return of the waterbody to beneficial uses can truly be measured. This new mindset must incorporate regulatory flexibility and emphasis on education and voluntary effort as key parts of the implementation plan. Government needs to move from the role of enforcer to be an enabler and technical advisor to communities that are putting forth best-faith efforts to deal with their storm water problems.

APPENDIX B: SAMPLE NPDES PERMIT - MONTGOMERY COUNTY, MD

The enclosed NPDES permit for Montgomery County, Maryland, a large municipal separate storm sewer system jurisdiction, incorporates many of the indicators identified in this document. Several of the following elements are analogous to the Level 1 methodology described in Chapter IV:

- Watershed inventories (e.g., land use and impervious cover) are conducted and GIS mapping is utilized to help identify potential pollution source areas. This provides a quick assemblage of necessary databases, and supports watershed modeling efforts, among other applications.
- Pollutant constituent chemical monitoring is conducted to help characterize stormwater discharges as part of a pilot "pipe detectives" program (Profile No. 1).
- Physical and biological monitoring, on a watershed basis, is applied as a screening tool to identify water quality and habitat impairment (Profile No. 7, 8, 12, and 13).

A watershed-based management program is proposed that further supports the use of indicators in developing and assessing the county's stormwater program. Some elements of the Montgomery County stormwater management program include:

- Maintenance inspections of BMPs are being conducted (Profile No. 22).
- Stormwater waivers issued are incorporated into a tracking system (Profile No. 23).
- Commercial/industrial and residential pollution prevention and public outreach programs are established (Profile No. 18, 19, and 20).
- Illicit connections detection, correction, and enforcement programs are established (Profile No. 21).
- Watershed restoration action plans are being developed to define watershed protection goals, determine monitoring needs, incorporate public education and involvement elements, identify stormwater retrofit and stream restoration opportunities, and implement other projects needed to achieve these goals (Profile No's 1, 7, 8, 12, 13, 19, and 24).

In addition, Montgomery County's permit calls for assessing the effectiveness of controls in reducing pollutant loads. The non-point source loading indicator (Profile No. 3) and various watershed simulation model tools can be used to achieve this objective.

These are just a few of the indicator applications that are incorporated in the attached NPDES permit. A careful review of Montgomery County's permit can provide insights for other jurisdictions in either renewing a permit, carrying out permit conditions, or structuring a new permit.

We would like to acknowledge Mr. Cameron Wiegand of Montgomery County, Department of Environmental Protection, Division of Water Resources Management for his efforts in providing background information on Montgomery County's permit and for his invaluable insights on the application of environmental indicators in the NPDES permit arena.

MARYLAND DEPARTMENT OF THE ENVIRONMENT

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

MUNICIPAL SEPARATE STORM SEWER SYSTEM DISCHARGE PERMIT

PART I. IDENTIFICATION

A. Permit Number: MS-MO-95-006

B. Permit Area

This permit covers stormwater discharges from the municipal separate storm sewer system in Montgomery County, Maryland.

C. Effective Date: March 15, 1996

D. Expiration Date: March 15, 2001

PART II. STANDARD PERMIT CONDITIONS

A. Legal Authority

1. Montgomery County shall maintain adequate legal authority, in accordance with National Pollutant Discharge Elimination System (NPDES) regulations 40 CFR 122.26(d)(2)(i), throughout the term of this permit. In the event that any provision of its legal authority is found to be invalid, the County shall make the necessary changes to maintain adequate legal authority.

B. Source Identification

1. Montgomery County shall continue the development of its Geographic Information System (GIS) and submit appropriate topographic maps with a scale between 1:10,000 and 1:24,000 and their associated data layers to the Maryland Department of the Environment (MDE). GIS mapping shall include the location of the County's storm sewer system; each currently operating or closed municipal landfill or other treatment, storage or disposal facility for municipal waste; any known NPDES stormwater discharger; and major structural controls for stormwater discharges. Additionally, Montgomery County shall submit land use activities; an estimate of the average runoff coefficient for each land use type; estimates of population densities and projected growth for a ten year period; and the location of publicly owned parks, recreational areas, and other open lands.

2. Montgomery County shall complete GIS development according to the following schedule:

a) By 3/17/97, Little Falls watershed and Anacostia River drainage including the Sligo Creek, Northwest Branch, Paint Branch, and Little Paint Branch watersheds.

b) By 3/16/98, Potomac River drainage including the Cabin John Creek, Lower Rock Creek, and Upper Rock Creek watersheds.

c) By 3/15/99, Great Seneca Creek watershed and Potomac River drainage including the Watts Branch and Muddy Branch watersheds.

d) By 3/15/2000, Little Seneca Creek, Patuxent River drainage including the Lower Patuxent, Hawlings River, Haight's Branch, Scott's Branch, and Upper Patuxent watersheds, and Potomac River drainage east of Great Seneca Creek including the Potomac River Direct, Minnehaha Branch, and Rock Run watersheds.

e) By 3/15/2001, Dry Seneca Creek watershed, Potomac River drainage west of Great Seneca Creek including the Potomac River direct, Horsepen, and Broad Run watersheds, and Monocacy River drainage including the Monocacy River Direct, Furnace Branch, Little Monocacy River, Little Bennett Creek, Bennett Creek, and Farney Branch watersheds.

3. Montgomery County shall compile and submit any new source identification information including the identification and mapping of storm sewer system outfalls, land use activities, population estimates, runoff coefficients, major structural controls, landfills and controls, publicly owned lands, NPDES dischargers, and industries organized by watershed and Standard Industrial Classification (SIC) codes in the annual reports submitted to MDE pursuant to PART IV "ANNUAL PROGRESS REPORTS" of this permit.

C. Discharge Characterization

1. By 6/17/96, Montgomery County shall submit storm event monitoring data and analysis to MDE for the remaining storm events at each of its five Part 2 representative outfalls.

2. Within 6 months of MDE's approval of Montgomery County's proposed long-term monitoring program, the County shall commence chemical sampling at one outfall and its appropriate in-stream monitoring station.

3. Chemical sampling at these and any additional outfalls or in-stream stations shall comply with procedures developed as a direct result of the County's involvement in NPDES monitoring committee meetings established according to PART III "SPECIAL PROGRAMMATIC CONDITIONS" of this permit.

4. Montgomery County shall complete the following minimum requirements for chemical monitoring:

a) A total of 12 storm events shall be monitored per year at each monitoring location with at least three occurring per quarter. Quarters shall be based on calendar year. If extended dry weather periods occur, baseflow samples shall be taken at least once per month. If no flow is observed at the outfall during periods of dry weather, samples shall be taken at the in-stream monitoring stations only.

b) Three discrete samples shall be taken for stormwater flow at both outfall and in-stream monitoring stations. Samples submitted for analysis shall be representative of the approximate flow at the following three intervals along the hydrograph: the midpoint of the rising limb, the peak, and the midpoint of the falling limb.

c) Flow rates and temperature shall be recorded at points when discrete samples are taken.

d) Collected samples shall be submitted to a laboratory for analysis according to methods listed under 40 CFR Part 136 for the following parameters:

BOD_5	Fecal Coliform
TKN	Nitrate plus Nitrite
Total Phosphorus	Cadmium
Copper	Lead
Zinc	Oil and Grease
pH	TSS

e) For each storm event, a description of any equipment problems and weather conditions such as duration and intensity shall be recorded.

5. Montgomery County shall incorporate physical and biological monitoring with the chemical monitoring described in PART II., C., 2. above. Physical and biological monitoring shall commence with the chemical monitoring and procedures and protocols shall be determined through the County's involvement in NPDES monitoring committee meetings established according to PART III "SPECIAL PROGRAMMATIC CONDITIONS" of this permit.

6. Beginning in 1996, Montgomery County shall conduct habitat, physical, and biological monitoring on a watershed basis as a County-wide screening tool to identify water quality impairment and establish reference stream criteria. Where the source of impairment is determined not to be a result of physical limitations, chemical specific testing shall be conducted to identify the source of impairment. The source of impairment shall be eliminated in accordance with the County's illicit connection inspection program as identified in PART II., D., 8. and 9. of this permit.

a) Sampling procedures shall be in accordance with Montgomery County's Water Quality Monitoring Program: Stream Monitoring Protocols document which has been incorporated into this permit as Appendix 6. or any subsequent revisions as a result of the NPDES monitoring committee meetings established according to PART III "SPECIAL PROGRAMMATIC CONDITIONS" of this permit.

b) By 3/15/2001, baseline watershed and reference stream biological monitoring shall be completed for all County watersheds

7. Reporting Frequency and Requirements

a) Chemical laboratory results shall be recorded on MDE's long-term monitoring database (Appendix 3) and submitted with annual reports.

b) Field results and analysis for physical and biological monitoring shall be submitted with annual reports. The analysis shall integrate the results from chemical, physical, and biological monitoring.

c) Annual and seasonal pollutant load estimates, using data collected as a result of the long-term monitoring efforts, shall be submitted with annual reports.

d) Pollutant loads shall be estimated for all identified municipal storm sewer outfalls and submitted to MDE according to the schedule established for GIS development in PART II., B., 2. of this permit.

e) By 3/16/98, Montgomery County shall assess its monitoring program and, if warranted, outline potential alternative sampling sites and procedures.

D. Management Programs

1. Montgomery County shall maintain an acceptable stormwater management program in accordance with the Environment Article, Title 4, Subtitle 2, Annotated Code of Maryland.

2. Montgomery County shall conduct preventative maintenance inspections of all stormwater management facilities at least on a triennial basis. Inspections, necessary corrective action, and enforcement actions shall be documented and summarized in annual reports.

3. Montgomery County shall submit information regarding its stormwater management program on the latest version of MDE's stormwater management spreadsheet (Appendix 4) in annual reports.

4. By 3/17/97, Montgomery County shall establish a database for tracking and evaluating the impacts of stormwater waiver issuance in each watershed. Emphasis shall also be placed upon strengthening the criteria for evaluating stormwater management waiver requests and providing enhanced public input.

5. Montgomery County shall conduct watershed studies and submit action plans for protecting surface and ground water resources. These plans shall include restoration/mitigation measures and include an implementation schedule to reduce or eliminate sources of water quality impairment. Montgomery County shall submit summaries of the watershed assessments and action plans according to the following schedule:

   a) By 3/17/97, the Little Falls and Sligo Creek watersheds.

   b) By 3/15/99, the Paint Branch, Little Paint Branch, Upper Rock Creek, and Lower Rock Creek watersheds.

   c) By 3/15/2001, the Watts Branch, Cabin John Creek, and Northwest Branch watersheds.

6. By 3/17/97, Montgomery County shall perform an assessment regarding the effects of road maintenance activities including street sweeping, litter control, deicing procedures, and the application of herbicides for vegetation control on stormwater discharges. This assessment shall include an analysis of alternative practices for reducing pollutants associated with road maintenance activities. By 3/16/98, Montgomery County shall incorporate effective alternative practices in its road maintenance procedures for reducing pollutants.

7. By 6/17/96, Montgomery County shall implement its proposed industrial, residential, and commercial pollution prevention and public outreach programs. These programs are to include educational information regarding the proper use of herbicides, pesticides, and fertilizers. Hazardous waste and general water quality information shall also be provided to the public. Education efforts shall be documented and summarized in annual reports.

8. By 6/17/96, Montgomery County shall implement its illicit connection detection and enforcement program. During the first year, program implementation shall occur in the Little Falls and Paint Branch watersheds. Each year thereafter, program implementation shall be expanded into at least five additional watersheds until all of the County's 29 designated watersheds have been assessed. At a minimum, the program shall include the following:

   a) The number of outfalls to be screened in targeted areas. Targeted areas shall include industrial and commercial land uses and those outfalls where pollutants were detected during Part 1 dry weather flow screening.

   b) Visual inspection of targeted areas. Follow-up inspections using chemical testing shall be performed immediately after discovering an illicit discharge in which the source is not apparent.

   c) Provisions for field screening data to be recorded on MDE's Part 1 field screening database.

   d) Fines for continued noncompliance by illicit dischargers.

   e) Procedures for public identification and reporting of illicit discharges.

   f) Progress reports that include an updated list of targeted outfalls and an inspection schedule.

9. Beginning 6/17/96, Montgomery County shall eliminate any illegal storm drain system discharge discovered through its illicit connection inspection program. Additionally, the County shall work cooperatively with MDE to ensure that industrial dischargers secure NPDES permits and that agricultural sources are minimized.

10. Montgomery County shall maintain an acceptable erosion and sediment control program in accordance with the Environment Article, Title 4, Subtitle 1, Annotated Code of Maryland.

11. By 6/17/96, Montgomery County shall implement "responsible personnel" certification classes to educate construction site operators regarding erosion and sediment control requirements. Education efforts are to be documented and summarized in annual reports.

12. Beginning in 1997, Montgomery County shall evaluate all management programs and identify any necessary changes. This information shall be submitted in annual reports.

E. Program Funding

1. Montgomery County shall maintain adequate program funding to comply with all conditions of this permit.

F. Assessment of Controls

1. Annually, Montgomery County shall submit estimates of expected pollutant load reductions as a result of its implementation of management programs. Additionally, the effectiveness of resource protection and stream habitat improvements shall be used to assess the effectiveness of the County's management programs and pollutant control strategies.

PART III. SPECIAL PROGRAMMATIC CONDITIONS

Since the signing of the Chesapeake Bay Agreement in 1983, the State of Maryland has been working toward meeting the goal of reducing by 40% the discharge of nutrients to the Chesapeake Bay by the year 2000. To achieve this nutrient goal, the State has developed strategies to improve the water quality in the tributaries that drain to the Bay. In Maryland, the Bay watershed has been subdivided into ten major tributaries which have each been assigned a 40% nutrient reduction goal. Characterizations of specific tributaries have been made in terms of land use, nutrient loads, and water quality. Additionally, strategy options have been developed based on identified problems in order to guide the restoration effort in each individual tributary.

Montgomery County lies within three of the Chesapeake Bay's ten major tributaries. These include the Upper Potomac, Middle Potomac, and Patuxent River basins. This NPDES permit requires Montgomery County to assist with the implementation of the strategy designed to meet the nutrient reduction goals of the above basins. The specific permit conditions presented below will promote a watershed based approach to controlling the contribution of pollutants from stormwater runoff. Coordination between and among other jurisdictions is a major requirement and the identification of those appropriate jurisdictions will occur jointly with MDE. Additionally, deadlines, priorities, and scheduling to satisfy specific conditions will be determined in conjunction with MDE. In any case, progress toward meeting these conditions shall be reported to MDE.

A. Programmatic Coordination

1. Montgomery County shall coordinate water quality restoration and protection efforts in watersheds shared with other jurisdictions. These efforts shall include:

a) the exchange of information on restoration/protection program effectiveness;

b) the definition of watershed management measures to support restoration/protection efforts;

c) the identification of appropriate watershed boundaries for planning and program development efforts; and

d) the coordination of planning and zoning activities to support the goals of watershed management.

B. Data Management

1. Montgomery County shall develop standards for record keeping and databases to meet the standard permit conditions in Part II of this permit. These standards shall be developed in concert with other appropriate jurisdictions and include:

a) management practice databases and GIS compatibility among jurisdictions for base maps, pollutant source area locations, stormwater management facility location and description, and land use and zoning designations;

b) comparable population estimates and growth projections; and

c) consistent land use and runoff coefficients.

C. Discharge Characterization

1. Montgomery County shall develop standards for discharge characterization. These standards shall be developed in concert with other appropriate jurisdictions and include:

a) coordination of long-term monitoring site selection among other appropriate jurisdictions;

b) standards for field and laboratory methods;

c) standards for monitoring databases; and

d) standards for annual and seasonal pollutant load estimates.

D. Management Programs

1. Montgomery County shall develop management program standards. These standards shall be developed in concert with other appropriate jurisdictions and include:

a) preventative maintenance procedures;

b) watershed management plans and retrofit assessments;

c) development and implementation of public information and educational programs; and

d) watershed inventories, illicit discharge inspection programs, and water quality enforcement.

E. Assessment of Controls and Annual Progress Reporting

1. Montgomery County shall develop standards for loading reduction estimates, annual progress reports, and stormwater management program effectiveness.

2. Along with other jurisdictions, Montgomery County shall evaluate the cumulative impact of its stormwater management waiver policy with regard to receiving water quality.

PART IV. ANNUAL PROGRESS REPORTS

Annual progress reports required under 40 CFR 122.42(c) will facilitate the long-term assessment of Montgomery County's NPDES stormwater program. According to EPA guidance, these reports shall be based on assessment techniques proposed by jurisdictions in Part 2 NPDES applications. These reports shall include:

§122.42(c) "(1) The status of implementing the components of the storm water management program that are established as permit conditions;"

§122.42(c) "(2) Proposed changes to the storm water management programs that are established as permit conditions...;"

§122.42(c) "(3) Revisions, if necessary, to the assessment of controls and the fiscal analysis reported in the permit application...;"

§122.42(c) "(4) A summary of data, including monitoring data, that is accumulated throughout the reporting year;"

§122.42(c) "(5) Annual expenditures and budget for year following each annual report;"

§122.42(c) "(6) A summary describing the number and nature of enforcement actions, inspections, and public education programs;"

§122.42(c) "(7) Identification of water quality improvements or degradation;"

MDE has developed a spreadsheet (Appendix 4) for the reporting and tracking of NPDES data. This spreadsheet lists components of Montgomery County's NPDES stormwater program along with appropriate reporting parameters. Annual progress reports, including MDE's spreadsheet, shall be submitted to MDE by the anniversary date of permit issuance for each year of the permit term.

PART V. ENFORCEMENT AND PENALTIES

A. Program Review and Evaluation

In order to assess the effectiveness of the permittee's NPDES program for eliminating non-stormwater discharges and reducing the discharge of pollutants to the maximum extent practicable, MDE will review and evaluate program implementation, annual reports, and periodic data submittal on an annual basis. Procedures for the review of local erosion and sediment control and stormwater management programs exist in Maryland's Sediment Control and Stormwater Management Laws. Additional periodic reviews and evaluations will be conducted to determine compliance with permit conditions. Continuation or reissuance of this permit beyond March 15, 2001 will be subject to MDE's review and evaluation of Montgomery County's compliance and implementation of the conditions of this permit.

B. Discharge Prohibitions and Receiving Water Limitations

The permittee shall effectively prohibit non-stormwater discharges through its municipal separate storm sewer system. NPDES permitted non-stormwater discharges are exempt from this prohibition. Discharges from the following will not be considered a source of pollutants when properly managed: water line flushing; landscape irrigation; diverted stream flows; rising ground waters; uncontaminated ground water infiltration to separate storm sewers; uncontaminated pumped ground water; discharges from potable water sources; foundation drains; air conditioning condensation; irrigation waters; springs; footing drains; lawn watering; individual residential car washing; flows from riparian habitats and wetlands; dechlorinated swimming pool discharges; street wash water; and fire fighting activities. The discharge of stormwater containing pollutants which have not been reduced to the maximum extent practicable is prohibited.

The permittee shall not cause the contamination or other alteration of the physical, chemical, or biological properties of any waters of the State, including a change in temperature, taste, color, turbidity, or odor of the waters or the discharge or deposit of any organic matter, harmful organism, or liquid, gaseous, solid, radioactive, or other substance into any waters of the State, that will render the waters harmful to:

(1) Public health, safety, or welfare;

(2) Domestic, commercial, industrial, agricultural, recreational, or other legitimate beneficial use;

(3) Livestock, wild animals, or birds; or

(4) Fish or other aquatic life.

C. Duty to Mitigate

The permittee shall take all reasonable steps to minimize or prevent any discharge in violation of this permit which has a reasonable likelihood of adversely affecting human health or the environment.

D. Duty to Comply

The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Clean Water Act (CWA) and is grounds for enforcement action; permit termination, revocation, or modification: or denial of a permit renewal application. The permittee shall comply at all times with the provisions of the Environment Article, Title 4, Subtitles 1, 2, and 4; Title 7, Subtitle 2; and Title 9, Subtitle 3 of the Annotated Code of Maryland.

The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used by the permittee to achieve compliance with the conditions of this permit. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems which are installed by the permittee only when the operation is necessary to achieve compliance with the conditions of the permit.

E. Sanctions

1. Penalties Under the CWA - Civil and Criminal

The CWA provides that any person who violates any permit condition is subject to a civil penalty not to exceed $25,000 per day for each violation. Any person who negligently violates any permit condition is subject to criminal penalties of $2,500 to $25,000 per day of violation, or imprisonment of not more than 1 year, or both. Any person who knowingly violates any permit condition is subject to criminal penalties of $5,000 to $50,000 per day of violation, or imprisonment for not more than 3 years, or both.

2. Penalties Under the State's Environment Article - Civil and Criminal

Nothing in this permit shall be construed to preclude the institution of any legal action nor relieve the permittee from civil or criminal responsibilities and/or penalties for noncompliance with Title 4, Title 7, and Title 9 of the Environment Article, Annotated Code of Maryland, or any federal, local, or other State law or regulation.

The Environment Article, §9-342, Annotated Code of Maryland, provides that any person who violates a permit condition is subject to a civil penalty up to $1,000 for each violation, but not exceeding $50,000 total. The Environment Article, §9-343, Annotated Code of Maryland, provides that any person who willfully or negligently violates a permit condition is subject to a criminal penalty not exceeding $25,000 or imprisonment not exceeding 1 year, or both.

The Environment Article, §9-343, Annotated Code of Maryland, provides that any person who falsifies, tampers with, or knowingly renders inaccurate any monitoring device or method required to be maintained under this permit shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than six months per violation, or both.

The Environment Article, §9-343, Annotated Code of Maryland, provides that any person who knowingly makes any false statement, representation, or certification in any records or other document submitted or required to be maintained under this permit, including monitoring reports or reports of compliance or noncompliance shall, upon conviction, be punished by a fine of not more than $10,000 per violation, or by imprisonment for not more than six months per violation, or both.

F. Permit Revocation and Modification

1. Permit Actions

This permit may be modified, revoked and reissued, or terminated for cause. The filing of a request by the permittee for a permit modification, or a notification of planned changes or anticipated noncompliance does not stay any permit condition. A permit may be modified by the Department upon written request by the permittee and after notice and opportunity for a public hearing in accordance with and for the reasons set forth in the Code of Maryland Regulations (COMAR) 26.08.04.10 C.

After notice and opportunity for a hearing and in accordance with COMAR 26.08.04.10., the Department may modify, suspend, or revoke and reissue this permit in whole or in part during its term for causes including, but not limited to the following:

a) Violation of any terms or conditions of this permit;

b) Obtaining this permit by misrepresentation or failure to disclose fully all relevant facts;

c) A change in any condition that requires either a temporary reduction or elimination of the authorized discharge; or

d) A determination that the permitted discharge poses a threat to human health or welfare or to the environment and can only be regulated to acceptable levels by permit modification or termination.

2. Duty to Provide Information

The permittee shall furnish to the Department, within a reasonable time, any information which the Department may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit; or to determine compliance with this permit. The permittee shall also furnish to the Department, upon request, copies of records required to be kept by this permit.

G. Property Rights

The issuance of this permit does not convey any property rights in either real or personal property, or any exclusive privileges nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of federal, State, or local law or regulations.

H. **Severability**

The provisions of this permit are severable. If any provision of this permit shall be held invalid for any reason, the remaining provisions shall remain in full force and effect. If the application of any provision of this permit to any circumstance is held invalid, its application to other circumstances shall not be affected.

I. **Signature of Authorized Administrator and Jurisdiction**

All applications, reports, or information submitted to the Department shall be signed as required by COMAR 26.08.04.01 D. As in the case of municipal or other public facilities, signatories shall be either a principal executive officer, ranking elected official, or other duly authorized employee.

March 13, 1996

Date

J. L. Hearn, Director
Water Management Administration

Water Environment Federation®
Preserving & Enhancing the Global Water Environment

EFFECTIVENESS OF INDUSTRIAL STORM WATER GENERAL PERMITTING PROGRAM

Prepared for the United States Environmental Protection Agency
Under a Cooperative Agreement with the
Water Environment Federation

EPA COOPERATIVE AGREEMENT
No. CX 823667 - 01
General Permit Review Program No. 4315

Final Report
October 1996

Acknowledgments

This document was developed by the Water Environment Federation (WEF) under a cooperative agreement with the United States Environmental Protection Agency (EPA) in partial fulfillment of EPA cooperative agreement No. CX 823667 - 01. William Swietlik served as EPA project manager. Linda Blankenship and Susan Merther served as project coordinators for WEF and Dr. William Hancuff served as principal author. The services of K.C. Associates of Wilmington, DE were used to distribute and collect the questionnaires, enter the data for computer analysis and perform the required correlations.

Members of the Working Group who helped develop the questionnaire and formulate the study included:

Dan Viscardi (CDM)	Airports Council International - North America
Tony MacDonald	American Association of Port Authorities
Rich Weaver	American Public Transit Association
Robert Fronczak	Association of American Railroads
Robbi Savage/Linda Eichmiller	Association of State and Interstate WPCAs
Tony Wagner/Eric Free	Chemical Manufacturers Association
Jeff Longsworth	Collier, Shannon, Rill and Scott
Frank Sobata	Conrail
Ken Wood	DuPont Nemours (for SOCMA)
Robin Wiener	Institute of Scrap Recycling Industries
John Groenewold	Kraft General Foods
Rick Jarman	National Food Processors Association
Thomas Purcell	Printing Industries of America
Christine Reiter	Synthetic Organic Chemical Manufacturers Association
Joan LeLacheur	Washington Metropolitan Area Transit Authority
John Melby	Wisconsin DNR (for ASIWPCA)

EFFECTIVENESS OF INDUSTRIAL STORM WATER GENERAL PERMITTING PROGRAM

I. EXECUTIVE SUMMARY

Introduction

In 1987 the Clean Water Act was amended by Congress to require the regulation of point source discharges of storm water from industry and from municipal separate storm sewer systems serving over 100,000 people. In 1990 the Environmental Protection Agency (EPA) promulgated implementing regulations requiring, in part, National Pollution Discharge Elimination System (NPDES) permits for all storm water discharges associated with industrial activity. Since then, close to 150,000 industrial facilities have been permitted by EPA and the States. A key requirement of an industrial storm water general permit is the preparation and implementation of a pollution prevention plan by each regulated industrial facility. The purpose of the overall study was to evaluate the effectiveness of this storm water control approach in a way that would aid in improving storm water regulations as well as reducing the burden on business and industry.

This executive summary is subdivided into five parts: introduction, background, methodology, key findings and conclusions. The background provides a general description of the objectives, the methodology provides a summary of the study approach, the key findings highlight the most important results in bullet format, and the conclusions provide observations and recommendations based on the key findings.

Background

The Water Environment Federation (WEF) entered into a cooperative agreement with the EPA in 1994 to study the effectiveness of the NPDES Industrial Storm Water Permit Program. EPA's objective was to increase stakeholder involvement in setting priorities for this program by working with WEF and industry in obtaining input on the effectiveness of the industrial portion of the program. The objective was accomplished through WEF actively involving an industry group in the development of a survey to determine industry's perception of the effectiveness of the general permit requirements.

Methodology

The methods used to conduct this assessment employed the preparation of a questionnaire and its distribution to a broad cross section of industries which are affected by the program. The questionnaire was developed by a work group primarily comprised of representatives from industrial associations but also with input from state water pollution control authorities and EPA.

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A mailing list was constructed from a large number of independent data bases. EPA, which was the NPDES authority in 11 states at the time of the study, maintains a centralized data base of all those who have filed a Notice of Intent (NOI). And all but two States that have permitting authority also maintain similar data bases. These data bases contain various amounts of information about industries which have filed an NOI with EPA, or its equivalent with their appropriate State water pollution control authorities.

Of the 7,500 questionnaires distributed, 376 were undeliverable and 584 were completed and returned, giving an effective return rate of 8.2%. Responses were received from all geographic and climatic regions of the US, representing 237 different four digit SIC code classifications.

Key Findings

The following are the most relevant findings of the survey and are presented in bullet format for brevity.

- The USEPA and the States have been highly effective in providing technical assistance to industry on pollution prevention plan preparation through written guidance: 71.3% used government provided direction exclusively.

- There is some overlap of the requirements of the NPDES Industrial Storm Water Permit Program with other mandated requirements, such as the Spill Prevention Control and Countermeasures (SPCC) and Best Management Practices (BMP's) of the Clean Water Act.

- For those companies which expended resources for compliance with the storm water regulations typical costs were roughly :
  - $ 7,500 for pollution prevention plan preparation,
  - $ 2,500 for annual operating cost (35% incur no annual costs), and
  - $ 25,000 for capital improvements (61% incurred no capital costs)

- Of those respondents who had conducted water quality monitoring, a significant number (36.9%) felt that presently water quality data is not useful in determining whether pollution prevention plan components are successful; i.e. the data is either insufficient (15.7%) or inconclusive (21.2%).

- A subjective evaluation of whether water quality improvement or reduction in storm water runoff is possible resulted in a 50/50 split - half saying "yes" and half "no".

- There was almost an even distribution of respondents when asked if water quality improvements were worth the expenditures with 30.5% saying "yes", 31.2% saying "no" and 31.6% saying "maybe"; there were 6.8% said they didn't know.

- The pollution prevention plan components found to be the most highly effective in preventing pollution from storm water runoff were:
  - good housekeeping,
  - spill prevention and response,
  - preventative maintenance,
  - visual inspections, and
  - employee training.

- When the cost factor was included in the prior analysis by requesting the respondent to identify the most cost effective activities implemented two additional items were provided in the top rankings:
  - ponds and other containment structures, and
  - covered structures and improved storage.

- The pollution prevention plan components found to be the least effective in preventing pollution from storm water runoff were:
  - record keeping and reporting,
  - site mapping,
  - annual site compliance evaluations, and
  - raw material or product substitution.

- When the cost factor was included in the prior analysis by requesting the respondent to identify the least cost effective activities implemented by the companies, sampling and analysis topped the list.

- If the mandated storm water program were discontinued the vast majority (95.1%) would voluntarily continue at least part of the pollution prevention plan: 42.8% all of it; and 52.3% some of it.

- The most frequently identified significant obstacles which prevent the general permits program from being effective include:
  - costs to implement,
  - no follow through (lack of field inspections and enforcement),
  - regulations are complex, confusing and burdensome,
  - arid regions are not uniquely addressed, and
  - lack of company concern.

- Other "comments" received included:
  - hassle for small businesses,
  - other sources cause more pollution,
  - remote and small sites should not be controlled, and
  - program has high costs with low water quality improvements.

Conclusions

The following conclusions and recommendations are based on interpretation of the results of the survey, the key findings and analysis of the questionnaire data.

- There was a high level of response to the questionnaire, and an excellent representation of industrial sectors. The diversity of responses covered all identified variables such as: geographical distribution, gross income, physical plant size, number of employees, and hydrological conditions.
- The USEPA and the States which have primacy in the NPDES permit program have been very thorough in defining the major components of a storm water pollution prevention plan.
- Of those companies regulated by the Storm Water Permit Program 12.5% appear to be out of compliance with the requirement to have a pollution prevention plan.
- Companies which lease their facilities are less likely to comply with the requirement of having a pollution prevention plan than those companies which own their property.
- The cost of a storm water pollution prevention plan and its implementation seem reasonable for most companies although there is concern among small firms.
- Small businesses spend less money on compliance and are more likely to be out of compliance because they lack environmental staff and a clear understanding of the requirements.
- The subjective evaluation of water quality improvement or reduction in storm water pollution as a result of the program is debatable depending on how the data is viewed - 68% felt there is at least some improvement while 66% felt there is little or no improvement. Interpretation of "minor" improvement accounts for the difference.
- Based on the observation that only a very low percentage of the most cost effective storm water pollution prevention controls were in place prior to initiation of the program, the NPDES storm water program has been highly effective in encouraging controls to be implemented.
- The majority of respondents have implemented the plans on time. However, there appears to be about 12% per year increase in plan implementation. This may be attributable to new industries as well as existing companies which become aware of the requirements through enforcement or public awareness programs.

- There are several areas where EPA and the States may improve effectiveness. One of the primary areas is to increase emphasis on those components of the storm water pollution prevention plan that have demonstrated to be effective, such as: good housekeeping, employee training, preventative maintenance, visual inspections, employee training and annual site compliance evaluations.

- It may also be worthwhile to look at improving the efficiency of monitoring since a large quantity of expensive sampling and analysis data is being generated and perceived by industry as being the least cost effective element of the program.

- Consideration should also be given to improving the overall image of the storm water permits program through simplifying the regulations and following up with outreach, education and/or enforcement activities.

II. BACKGROUND

In the eleven states where EPA has NPDES permit program authority it is estimated that approximately 39,000 industrial and municipal dischargers in Phase I are covered by general permits to discharge storm water. It has further been estimated that over an additional 100,000 dischargers are in Phase I covered by states that have primacy.

A majority of these dischargers were required to implement pollution prevention plans by October 1, 1993, one year after the Notice of Intent deadline of October 1, 1992. Many industries have opted to be covered by EPA's multisector storm water general permit proposed November 19, 1993 and finalized on September 25,1996.

EPA is interested in increasing stakeholder involvement and consulting with its "customers" in setting priorities and regulations; and is beginning to look more to industry and its associations for input. Based on this new direction, EPA requested the Water Environment Federation to expand its outreach program under its cooperative agreement to study the general permit program, with a goal of increasing the participation of industrial and state government stakeholders.

The objective of the original project work plan developed in the FY 95 WEF grant project was to provide the Phase I industries (located in the states where EPA has permit authority) an opportunity to report to EPA on the effectiveness of pollution prevention plans used in the NPDES industrial storm water general permitting program and to provide EPA feedback on the success of the program. The approach of the original work was to establish a working group by inviting members of industrial associations, state water program administrators, and other individuals with special qualifications or interests in the regulations, to assist with the development of an industrial survey to be used to assess the effectiveness of the pollution prevention plans. During the early stages of that project, a survey form was completed and a small test survey was conducted.

In FY 96, WEF's grant was expanded. The objectives of this expansion were twofold: 1) to conduct a more broadly based study on the effectiveness of pollution prevention plans covering a wider selection of industries in <u>all</u> States; and 2) to assess whether or not it would be beneficial for industry to be allowed a "no exposure" exemption from the storm water permit program and, if so, examine possible mechanisms for implementation.

Since a portion of the FY 95 grant project had been completed, the original work plan was folded into and became a part of the revised work plan. The work completed under the FY 95 grant included formation of a small work group, development of an industrial survey form, distribution and collection of a limited number of test surveys, and preparation of a preliminary data base management system to analyze results. The expansion of the grant at this stage of the project, i.e. prior to full distribution of the survey, was fortuitous since the majority of the work involving data collection and analysis had not yet been initiated. The expanded requirements were able to take advantage of the survey developed and allow for improved efficiency of data collection and analysis using a professional survey firm.

III. QUESTIONNAIRE DEVELOPMENT

In order to develop a questionnaire that would most accurately reflect the concerns of industry and also result in a high response rate by industry, a working group comprised primarily of industrial representatives was established. The first meeting of the work group was held on January 31, 1995 at the Water Environment Federation Headquarters building in Alexandria Virginia. As a result of this working meeting, WEF was able to formulate a basis for the survey. The questions were put into questionnaire format and distributed to the working group for further refinement. Written comments were received on the form and after a second draft was developed, a conference call was held on March 20, 1995 to discuss the final details.

On completion of the final draft of the survey, it was recommended by the working group that a test survey should be sent out to a select group of recipients. The purpose of this test survey was to obtain the recipients' reactions to the effectiveness of the format, to determine the length of time required to complete the survey and to determine whether a good response could be expected. The test surveys were mailed to 15 firms and returned on April 28, 1995. The form was determined to require about 15 to 20 minutes to complete and the recipients made minor suggestions for refinements.

Shortly after this was completed, it was determined that the cooperative agreement would be expanded to include not only the eleven states over which EPA had jurisdiction, but all 50 states. In addition, it was determined to expand the scope to include an assessment of the "no exposure" exclusion. The expansion of the agreement caused some delays in progress while awaiting final approval. The next meeting of the working group was held on November 13,1995 to take one final look at the survey and finalize the cover letter. The final copy of the cover letter and survey questionnaire are presented in the Appendix. The questionnaire was mailed after the holidays in January, 1996 with a response date request of February 16, 1996.

Method of Approach Used for Questionnaire Distribution.

In order to obtain a good geographical distribution as well as diverse industrial activity representation, the following method of approach was used to distribute questionnaires.

First, it was necessary to obtain a mailing list of all industries in the United States that had submitted a Notice of Intent (NOI) or its equivalent to the controlling governing agency. These industries are the ones that must comply with the storm water permit requirements associated with preparation of storm water management plans.

EPA maintains a database containing all of the names and addresses of those firms which have submitted an NOI in the eleven states over which it maintains jurisdiction. For the remaining states (not including territories such as Puerto Rico and Guam), contact was made with each to obtain a similar database. While the majority of the states maintained some form of database, there was little consistency in the information, format or software used. Only two states did not maintain any data base; Vermont and West Virginia. And two others elected not to participate; Minnesota and Kansas. This level of participation gave the excellent geographical distribution that was desired.

The compilation of all of the data from 46 of the 50 states, after removing duplicates and incomplete records, resulted in a total of 76,286 separate industrial activities. It was determined that a mailing to 10% of the industries would result in a high level of confidence (over 90%) for this study, even with only a 5% response rate. Therefore, it was decided to mail 7,500 questionnaires.

In reviewing the databases obtained from EPA and the states, it was observed that the vast majority of records had identified industries by using SIC codes, so these were used to determine the distribution of questionnaires. Only the states of Hawaii, Iowa, Montana, Washington and one section of Pennsylvania did not have their databases formatted with SIC code designations.

While EPA has specifically defined by SIC code each of the industrial categories which must have an NPDES storm water permit, a few states require all industries regardless of SIC code to file an NOI and develop a storm water pollution prevention or management plan. Additionally, no state has been identified that will not accept an industry's application for an NPDES storm water permit because it does not fall into one of those SIC categories identified in the regulations. Some industrial activities submit a NOI and comply with the regulations even though they may not currently be required to do so. It is speculated that some do it out of lack of familiarity with the regulations and some do it as a precautionary measure to minimize the possibility of litigation.

It is recognized that some states have different requirements from those of the baseline EPA storm water permit program, however it was determined that the majority of those firms which submitted NOI's were required to meet the minimum standards established by EPA relating to development of storm water management plans. It was therefore concluded that since the thrust of this effort was to obtain as broad a representation as possible of all industries which may be affected by the EPA storm water permits program, all SIC codes (with NOI's or equivalent submitted) were included in the database for questionnaire distribution.

The selection of which firms to receive the questionnaire was performed in two steps. The first step was to obtain the distribution of the total number of industrial activities (NOI's) nationwide by state. For example, California had 10.84% of the total, New Jersey had 2.42%, Wyoming had 0.66%, etc. This data was then ranked by state, highest to lowest.

The second step involved using the percent of NOI's by SIC codes within each state and determining the number of questionnaires to be distributed to each based on the SIC code percent distribution within the state. For example, the State of California, which had 10.84% of the total, received 813 of the 7,500 questionnaires distributed.

The next step in the example was to distribute these 813 questionnaires within the State of California in proportion to the SIC Codes. The percent distribution of all SIC codes found in the state of California was made and the number to be mailed to each was determined. For example, if SIC code 0000 represents 4% of California's total, then 4% of 813 or 33 questionnaires should be sent to SIC code 0000 within California.

Using this approach, the number to be distributed to each state was determined and then the number to be distributed to each SIC code within that state was calculated. A quick check was made after distributing among the SIC codes within each state to assure that the total number for the state was correct.

Additionally, as a final check the distribution to SIC codes nationwide was also made. First, the total of all questionnaires to be sent to each SIC code for all of the states, as determined using the above approach for distribution, was made. The results were then ranked numerically in descending order. The same type of calculated distribution was made for each SIC code using the entire original data base. Once the percentage distribution was made, the 7,500 mailing list was used to make a quick check on the numbers obtained using the state distribution approach verses the national distribution approach.

On attempting to implement this approach, it was found that a further refinement of the method was necessary when using the four digit SIC codes for distribution of the questionnaires. In reviewing the actual data for a state with a small number of NOI's, it was determined that distributing questionnaires based on the four digit SIC codes would be a difficult task because of the small numbers falling within each SIC category.

One method considered was to distribute the questionnaires based on percentages of two digit SIC codes. This uses the rationale that two digit groups of SIC codes are similar enough to justify this method. While this is a good generalization for some major groups like SIC 16 - Heavy Construction; it unfortunately doesn't apply for many of the other majors like SIC 20 - Food and Kindred Products; i.e. there are few similarities among the operations of a slaughterhouse and grain milling; or vegetable canning, beverages, dairies and bakeries. Therefore, the refinement in the approach which was employed is as follows.

The four digit SIC codes were used for determining the distribution of questionnaires employing the same rounding approach which is used in math and sciences, i.e. if the decimal part of the whole number is .500 or greater the value is rounded to the next higher whole number and if the decimal fraction is less than .500 it is rounded to the next lower whole number. For example, 13.500 was rounded up to 14 and 13.495 was rounded down to 13. There was little problem with this process for States that had over 1000 in the data base, however a problem presented itself in states like Idaho that only had 235. Therefore, the following refinement was used.

In states with low numbers, the exact same approach was used for selecting the four digit SIC code distribution, however as was mentioned above, there were a large number of codes receiving between 0.5 and 1.5. Nevertheless, after rounding these values to whole numbers the total number to be distributed to the State in question was summed. If the total resulted in too many questionnaires being distributed because of the rounding error; the excess number over that desired was taken from the lowest values in a descending order list of SIC codes. For example, in the case of Idaho, using this selection method resulted in 28 surveys to be mailed. However the initial calculations reveal that only 23 were to be mailed to Idaho, resulting in 5 that must be deleted from the list. By ranking the original SIC code data in descending order from the largest number at the top to the smallest number at the bottom, the lowest five from the bottom of the list were removed and the balance was used for determining the mailing.

Similarly, if the final tabulation had resulted in only 20 on the list then an additional three would have to be added using basically the same approach, only adding the next three on the list. This method eliminated the problems associated with rounding small numbers and simultaneously had the least impact on the overall project objectives.

For the four states and the section of Pennsylvania which did not have SIC code designations in their databases, a completely random sample was taken for distribution of the appropriate number within each state/section.

IV. DISCUSSION OF RESULTS

The survey questionnaire was distributed to 7,500 industrial facilities throughout the United States among a diversity of industries which had filed a Notice of Intent or its equivalent under the NPDES Storm Water Permit Program. Of the 7,500 questionnaires, 376 were returned as non-deliverable. This results in 7,124 being delivered which is used as the base for calculating the "valid" response rate. Since 584 questionnaires were completed and returned this results in a "valid" response rate of 8.2%. The concept of "valid" response is used throughout the report and represents the percentage of those respondents that actually answered the question being analyzed not the total number returning the questionnaire. The response to this survey resulted in a 95 % +/- 4.04 % confidence level.

Responses were received from all geographic and climatic regions of the U.S. representing 237 different four digit SIC code classifications.

Industrial Classification

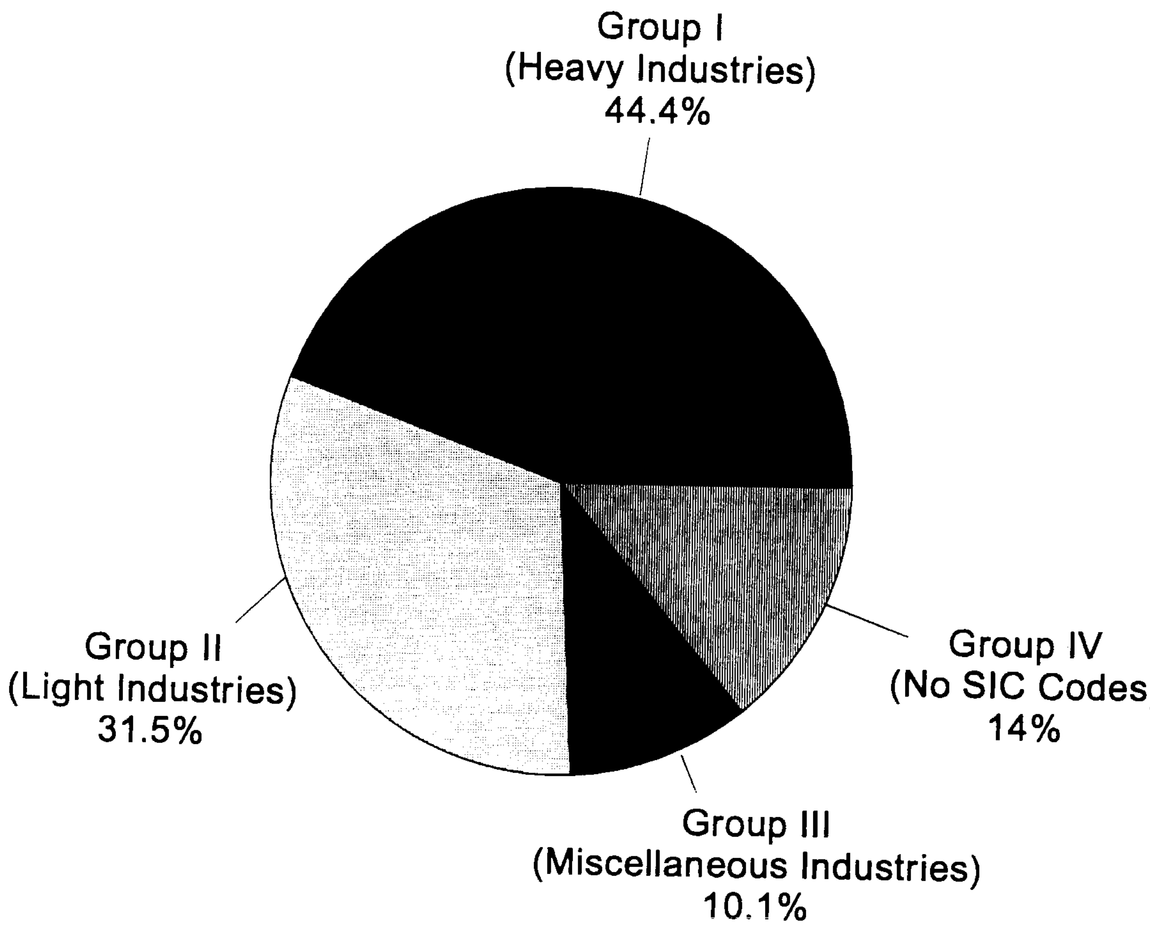
The questionnaire was distributed to industrial activities which had submitted a Notice of Intent or its equivalent to either the State or EPA. The assumption was made that any industry that submitted an NOI to these authorities was aware of its obligation and no attempt was made to validate whether the industry was in fact legally required to do so.

Question 1 asked "What is the primary and secondary standard industrial classification (SIC) code for your facility?" The industries were asked to identify themselves by a primary SIC code and a secondary SIC code. Of the 584 respondents, 82 did not provide an SIC classification. This resulted in 86% identifying a primary SIC code. Only 21% of those providing a primary SIC code also gave a secondary SIC category.

Those industries providing a primary SIC code in the multisector group of industries specifically identified in the Clean Water Act Section 122.26(b)(14)(i) through (x) made up 44.4 % of the respondents and were grouped into a category called Group I for convenience and to facilitate construction of diagrams. Those industries falling under the definition of Section 122.26(b)(14)(xi), i.e. the so called light industries which were allowed the "no exposure" exclusion (before it was remanded to EPA) if it applied to their facility represented 31.5% of the responses and were identified as Group II. In Group III, Miscellaneous, 10.1 % of the responses were received from industrial activities which were in SIC categories not specifically identified in Section 122.26(b)(14). And Group IV included those respondents which did not provide an SIC code. They represented 14.0 % of the responses.

Of the thirteen companies which provided a primary SIC code that fell within Group III, the Miscellaneous group, and also listed a secondary SIC; only three fell into Group I, one fell into Group II and ten, once again, fell into Group III. A pie chart entitled "Standard Industrial Classification Codes" presents the distribution of respondents by Group.

Standard Industrial Classification Codes



Question 1

Three possible explanations were identified for why a company fell into the Group III category: (1) it was located in a state which required all industries to submit an NOI regardless of SIC; (2) the company management felt more comfortable by having a permit whether it was required or not; (3) the industry misinterpreted the requirements. Regardless, it was assumed that all respondents had complied with at least a portion of the regulatory requirements and had valuable input into the survey. Therefore, none were eliminated because they fell into the miscellaneous group. Additionally, those which did not provide an SIC code were also included in the analyses for the same reasons.

Description of Facilities, Staff and Storm Water

Question 2 asked "Concerning industrial storm water run-off, how many facilities are under your responsibility?" The purpose of this question was to determine typically how many industrial facilities an environmental manager may have to control under the storm water program. It was also asked to establish the basis for answering the balance of the questions on the survey as called for in the note preceding Question 3, which states "If you are responsible for more than one facility, answer the following questions based on only one (your primary) facility."

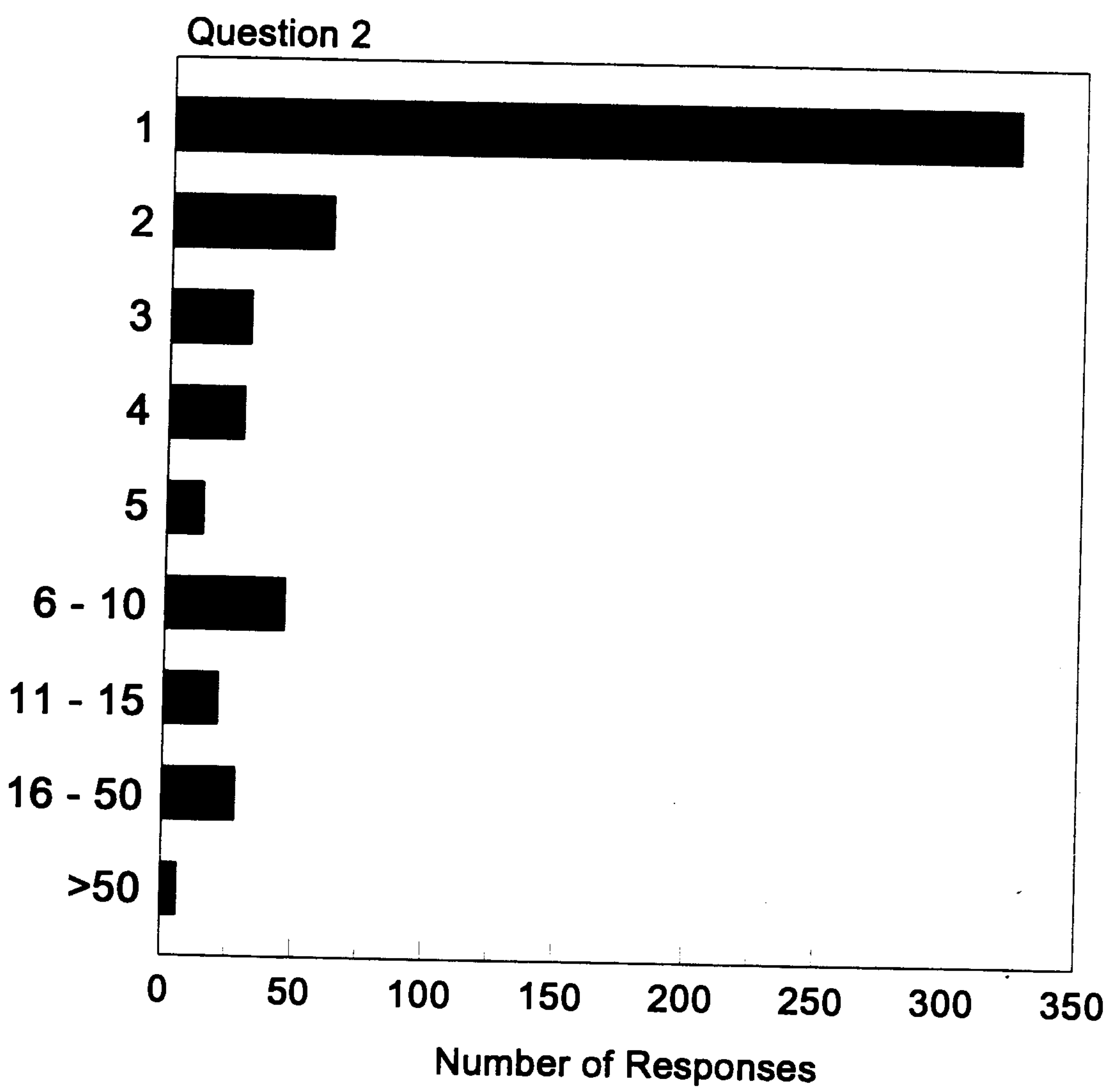
The analysis of the responses to Question 2 are as follows. Slightly over 76% reported that they had environmental staff, even if it was only a part time position. From this response it can be concluded that the majority of individuals who completed the survey questions were knowledgeable about environmental programs.

Over half (57.8%) of the respondents stated that they had responsibility for only one facility. Further, 80.0% had responsibility for four or fewer facilities. This indicates that for the majority of facilities the individual filling out the questionnaire was in all probability sufficiently familiar with the details of his or her primary facility to answer the questions accurately. Only 22 respondents did not answer this question. The chart entitled "Number of Facilities under Respondents Responsibility" presents the distribution of the number of facilities managed by the respondents.

Question 3 requested specific information on the size of the facility; namely the number of full time staff, an estimate of the acreage of the facility, and the number of environmental staff. Although the questionnaire form inadvertently included a blank after the generic question title "What is the size of this facility?", most people ignored the blank and correctly answered the question using the descriptors given in the subsequent parts of the question.

The first part of Question 3 requested the estimated number of full time employees at the facilities. There were 516 respondents that provided an estimate of the number of employees which means that 68 did not respond to this part of the question. The range of full time employees which represented the largest percentage of the distribution was between 1 and 25 with 36.6% falling with those margins. Slightly over half (50.4%) of the

Number of Facilities Under Respondents' Responsibility



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facilities had between 1 and 50 employees, while 9 facilities (1.7 %) reported no employees. The latter cases were probably unstaffed operations such as storage facilities, or natural gas or oil pumping facilities. There were 175 facilities or 33.9% which reported over 100 employees. This demonstrates, using another parameter, that there was considerable diversity in business sizes responding to the questionnaire. The diagram entitled " Number of Full Time Employees" presents a histogram showing the distribution of number of employees.

The responses to the second part of Question 3 on the size of the facility as measured by the acreage varied greatly. There were 497 responses to this part of the question which means that 87 did not provide the land size. The range of facility size which represented the largest percentage of the distribution was between 1 and 5 acres, with 32.2% of the respondents falling within these areas. Only a small percentage (3.8%) had less than one acre. Another 15.7% fell between 5 and 10 acres and 18.7% fell between 10 and 25 acres. As a percentage of the total, the majority of the facilities (70.4%) were located on less than 25 acres. It should not be overlooked that there were 105 facilities which responded that had over 50 acre facilities. Review of the diagram entitled "Estimated Acreage of Facility" gives a good indication that a very wide distribution of facility sizes were represented in the survey.

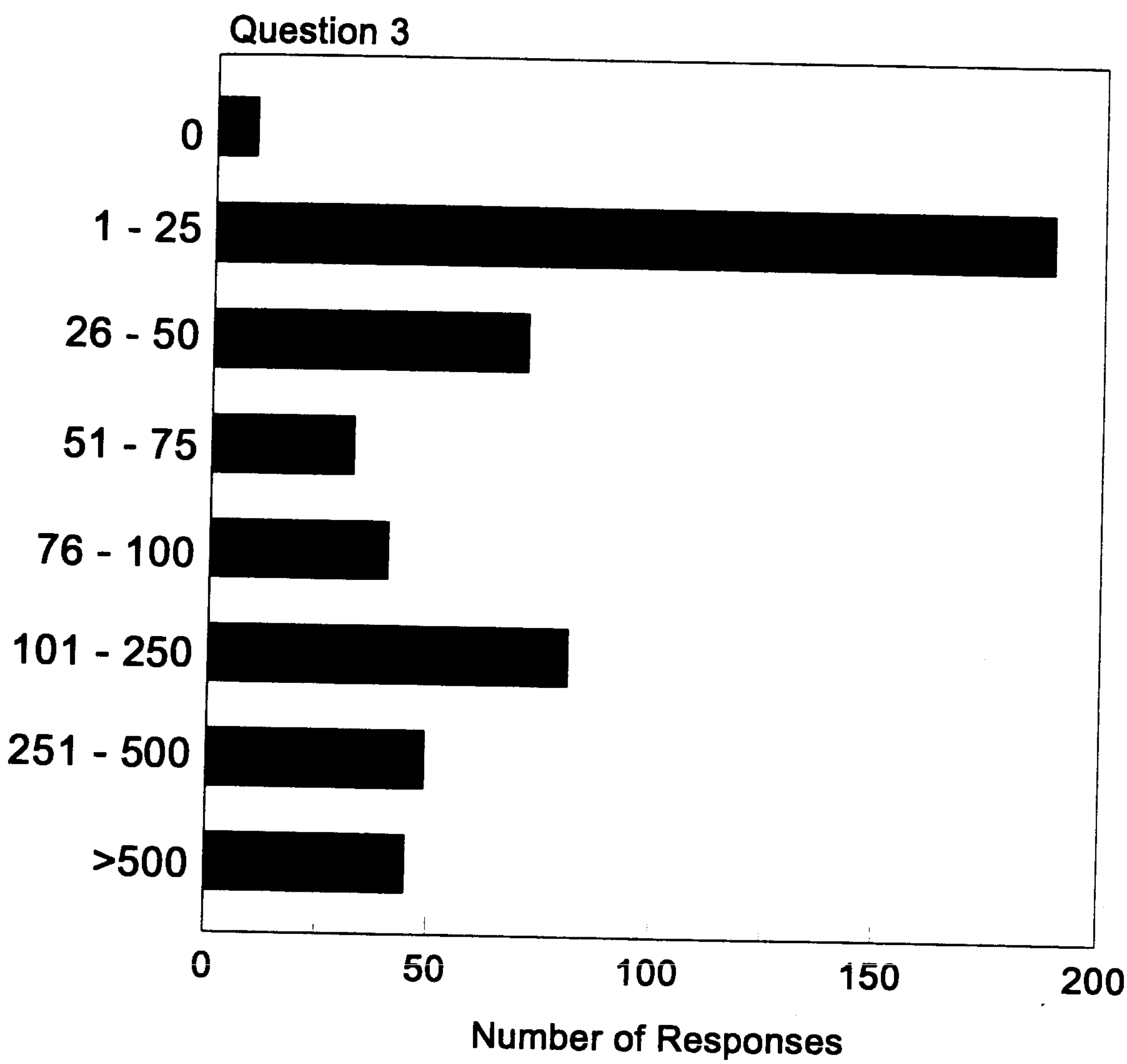
The portion of Question 3 which showed the most interesting results was that related to the number of environmental staff responsible for the facilities. While 81 did not respond to this part of the question, a significant 120 respondents or 23.9% stated that they had no environmental staff. And not including this 23.9%, about half (50.9%) said they had one or less than one (part time) environmental staff. The majority (53.4%) of those with no environmental staff were small businesses, which represents about 30% of all small businesses. The histogram entitled "Number of Environmental Staff" presents the results.

Question 4 addressed ownership of the property on which the facility was located by asking if the property was either owned or leased. The objective of this question was to determine if those who lease property are more or less likely to prepare a storm water pollution prevention plan. The hypothesis was that if a facility did not own its property it may perceive that it does not have to comply with requirements that are primarily associated with land they don't own.

Only 50 respondents did not answer Question 4. As shown on the pie chart entitled "Facility Property Status", the response showed that the vast majority (80.3%) of companies owned as opposed to leased the facility or the property. The analysis testing the hypothesis showed that for those who lease property, 27.6% said (in response to Question 9) that they either didn't have a plan (21.9%) or they didn't know if they had one (5.7%). For all practical purposes, all of these facilities can be concluded to have not prepared a storm water management plan.

This percentage is substantially greater than the 18.7% of the facilities which owned their property and indicated that they either did not have a plan (15.2%) or didn't know if they

Number of Full-Time Employees



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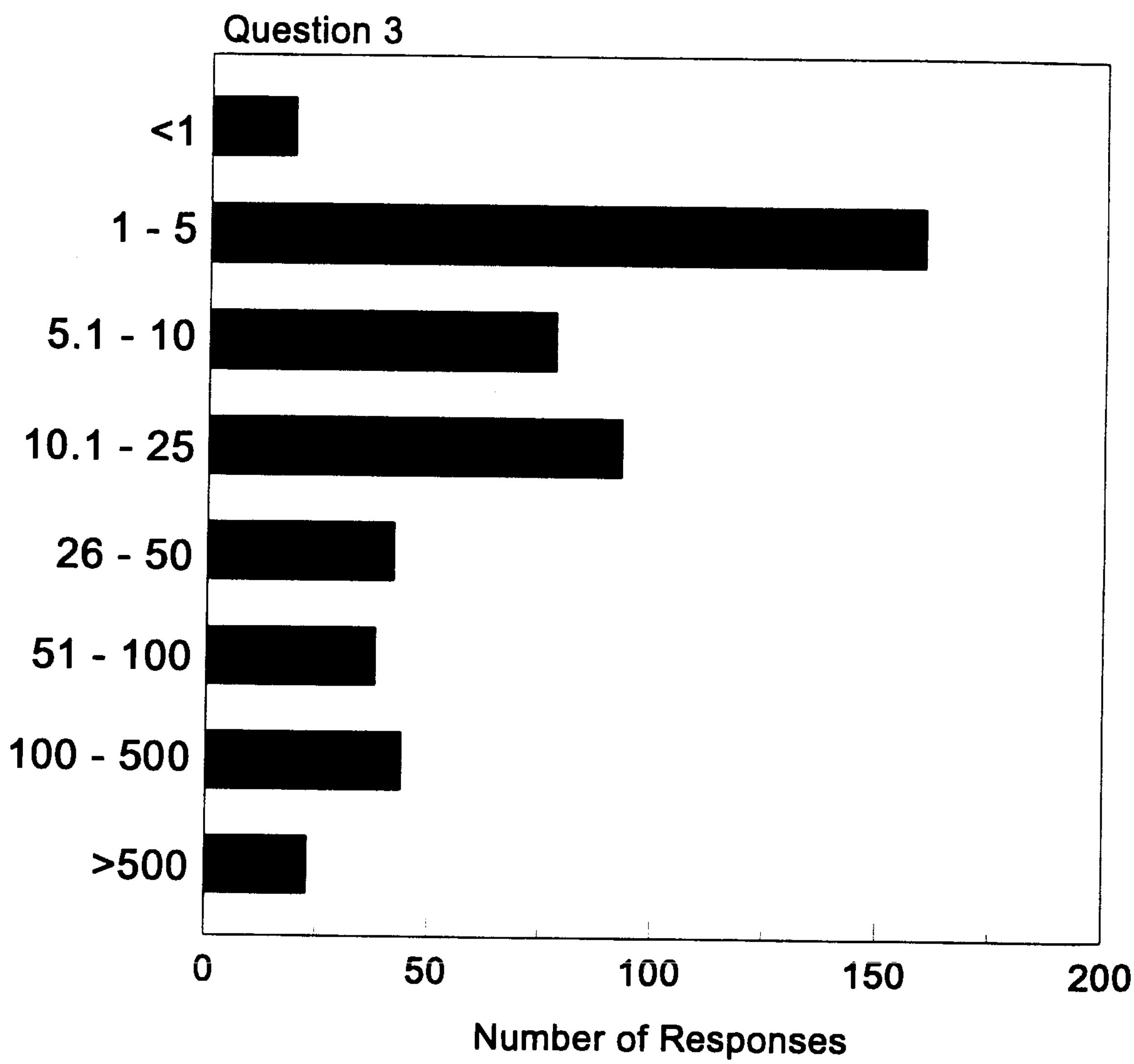
Estimated Acreage of Facility



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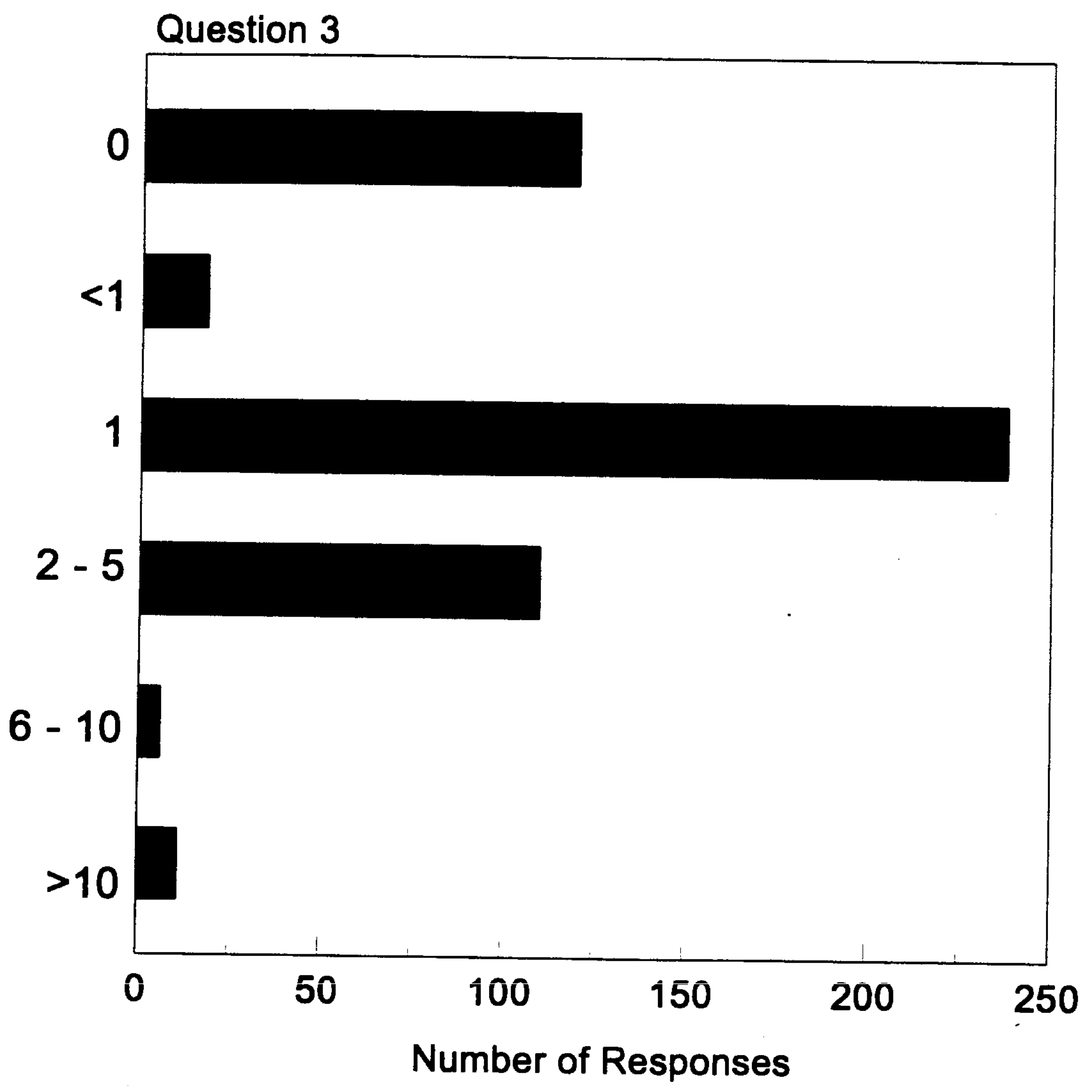
Number of Environmental Staff



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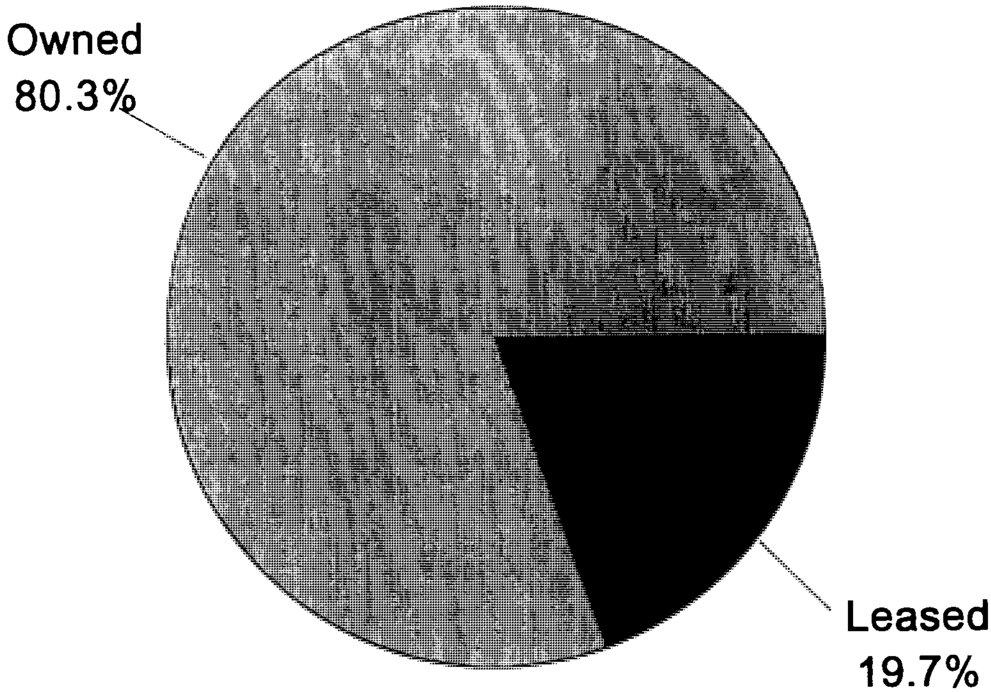
Facility Property Status



Question 4

had one (3.5%). It appears that industrial activities which lease their facilities have a more relaxed approach to complying with the storm water management plan requirements than those who own their facilities. In other words the data appears to validate the hypothesis.

It is speculated that many of those who lease industrial facilities have misinterpreted their responsibilities to comply with environmental regulations. This could stem from the fact that many leasees are restricted from making modifications to the grounds, without written consent from the owner. This gives the impression to the leasee that contamination originating from surface runoff is not their responsibility. Although preparation of a pollution prevention plan does not necessarily require alteration of the property, the foregoing misperception may carry over into the plan preparation requirement.

Question 5 was developed to determine which companies were small businesses so that additional analyses could be performed with this group. The question specifically asked "Is your company categorized as a small business?" The choices of answers were yes, no and don't know. If the respondent answered yes, it was requested that they provide the basis for that determination.

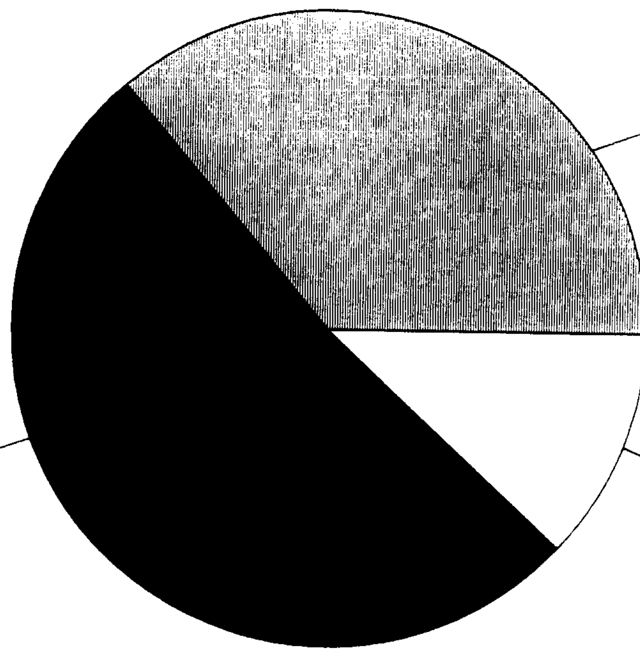
Of the 579 respondents to this question, the majority, 51.8%, stated they were not a small business enterprise; another 36.3% said they were and 11.9% said they didn't know. Only five respondents did not answer this question. A pie chart entitled "Is the Company a Small Business?" displays these results.

During the development of the questionnaire, it was suggested that the Small Business Administration (SBA) definition of "small business" be utilized. It was pointed out that the definition varies based on SIC code and is inconsistent. It was also noted that most small businesses wouldn't know the definition of small business for their SIC code unless they were familiar with a federal government program. It was concluded that anyone who knew the SBA definition for their industry would use it in answering the question but many others who were legitimately small businesses would simply not answer the question because they had never used any of the SBA programs.

Even though the question on why the industry considers itself small was simplified, less than half (40.9%) of those who claimed to be small businesses stated why. One of the respondent's answer to this question, "because it is", probably summarizes the answer for most of those who did not state a reason.

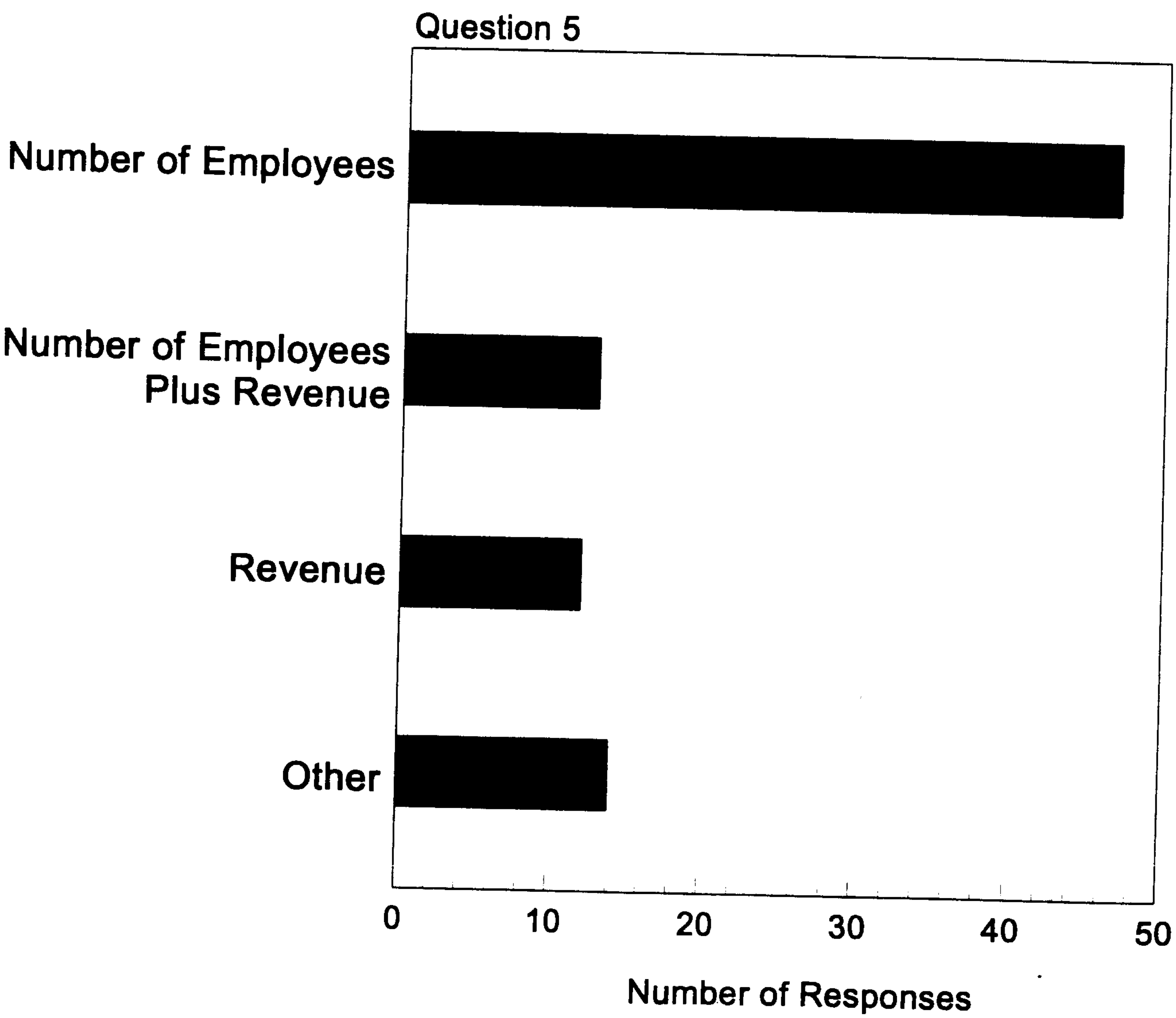
Of the 210 respondents which indicated they were a small business enterprise, only 86 or 40.9 % provided a reason why they were classified as small. The normal basis for determining whether a company is small or not is number of employees and/or annual revenues. Those providing a basis for being classified small were distributed as follows: 54.6% were based on number of employees only, 13.9% were based on revenues only, 15.1% were based on number of employees and revenues and 16.3% provided other reasons. A histogram entitled "Definition of a Small Business As Based On:" presents a distribution of the rationale provided by the companies for why they are a small business.

Is the Company a Small Business?



Question 5

Definition of a Small Business As Based On:



As stated before, one of the main reasons for selectively identifying small businesses was to be able to separate analyses of responses and determine if they were significantly different from the rest. The individual analyses for small businesses are addressed in each question for which it was determined such an analysis might provide valuable information.

Question 6 asks "Does storm water run off this property?" and provides five choices for how it may run off: ditches, trenches, pipes, other point sources (with a request to identify the source) and <u>only</u> surface flow, i.e. no point sources. The respondents were permitted to answer as many of the choices as were applicable to their facility. In retrospect, this question would have been more clearly stated as; "how is storm water conveyed off your property." Also, some clarification should have been made on the definition of a point source for those not familiar with water pollution control terminology. The results are presented in the histogram entitled "Storm Water Runoff Conveyance Structures."

It's clear from the responses to Question 6 that many of the respondents did not understand the question or possibly the choices of answers, because 210 answered the question stating that they had <u>only surface flow</u> and therefore no point sources. If this were the only choice selected (as it should have been to be technically correct) it would mean that all of those 210 industrial activities were not subject to the NPDES storm water regulations. In addition, of those 210 that stated they had only surface flow, 59 or 28.1% stated that they had one or more of the other choices of point source discharges. This is a contradiction in the definition of choices given.

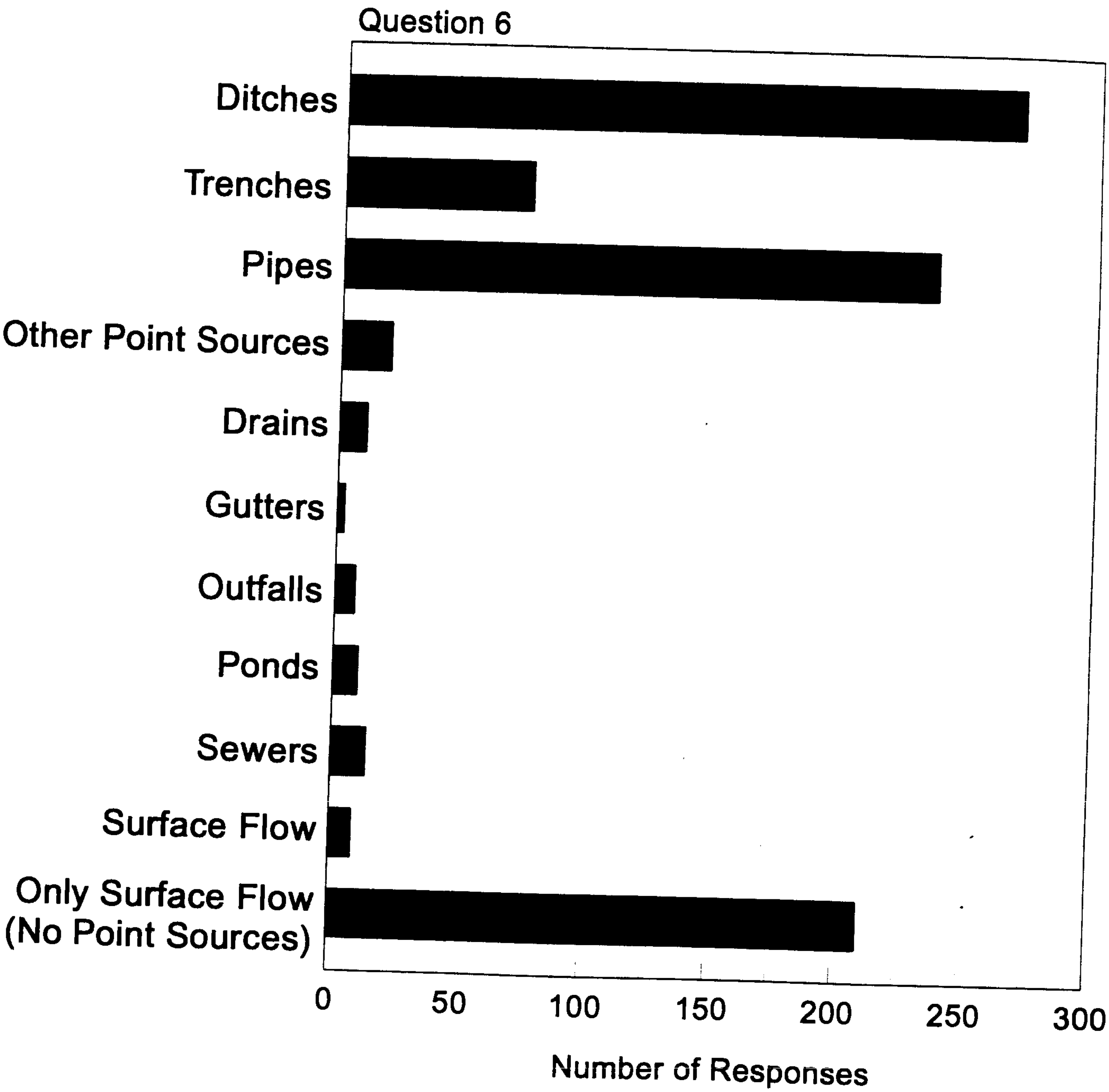
Of the 151 that chose the selection indicating that they had surface flow only and did not also indicate they had other point sources of storm water runoff, 30 (20.0%) stated that they did not have a storm water related pollution prevention plan for this facility and 9 (6.0%) stated they didn't know if they had one.

Question 7 was designed to gather information regarding climatological data to assure there was a representative sample of all weather conditions. It specifically asked "What is the average annual rainfall at your location?" Choices given were presented in 10" increments, i.e. 0 - 10", 11"- 20", 21" - 30", 31" - 40", 41" - 50" and over 50". As can be seen in the histogram entitled "Average Annual Rainfall", the responses represent the full spectrum of hydrological conditions experienced throughout the United States. Analysis of the data resulted in a skewed normal distribution with a median rainfall of 25.75 inches per year and a mode of 18 inches per year. Only 49 facilities did not respond.

Specific Regulatory Requirements

Question 8 was developed to determine how many or what percentage of those being regulated under the storm water permits program were already having to meet perhaps more restrictive hazardous waste requirements under EPCRA. This question specifically asked "Is this facility required to meet the reporting requirements of EPCRA Section 313 regarding 'water priority chemicals'?"

Storm Water Runoff
Conveyance Structures



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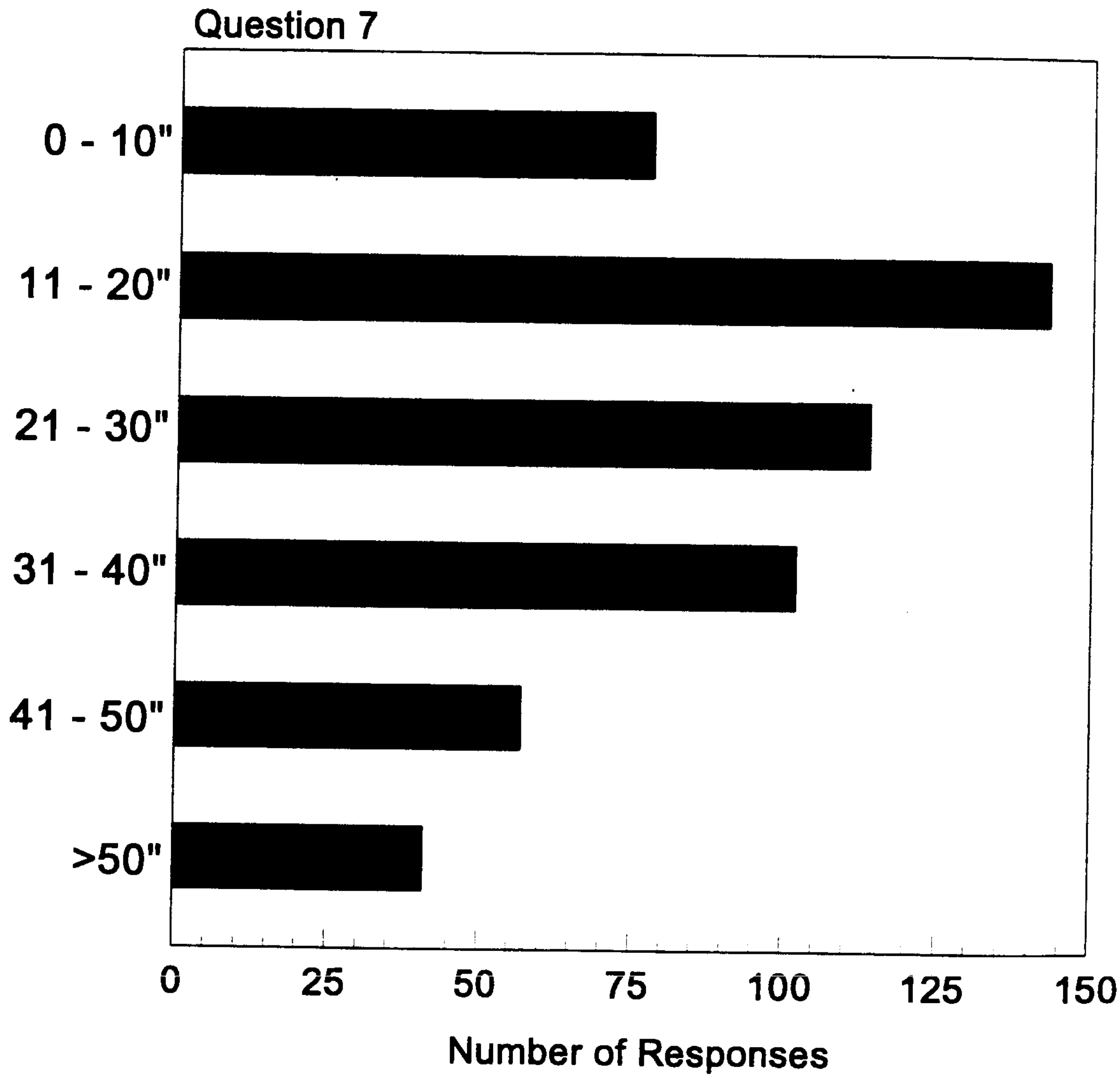
Average Annual Rainfall



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The answers provided some interesting but not surprising results. Only 6 respondents didn't answer the question. Of those that answered it, more said they didn't know if they were required (24.6%) than said yes (20.6%). It appears from this response that a large percentage of industrial facilities (75.4%) which have requirements under the storm water permits program do not have requirements under EPCRA. The pie chart entitled "Facility Required to Meet EPCRA Section 313" presents the distribution of answers.

The NPDES storm water permit program requires that each facility develop a storm water pollution prevention plan. The major goal of this project is evaluating the effectiveness of the program and relies on gathering information on the plan itself. It is recognized that many companies which have submitted an NOI or its equivalent may not have met the requirement of plan preparation yet.

Question 9 was used to separate those facilities which had a storm water management plan from those who did not. Separating those who had a plan allowed the survey to assess more accurately the effectiveness of the program by developing questions that related specifically to those industrial activities which had complied with the requirements. Additionally, it allowed a separate set of questions to be asked of those who had not prepared a plan; to perhaps determine why they had not. Question 9 specifically stated "Do you have a storm water related pollution prevention plan for this facility?" The choices of answers were; yes, no and don't know. Only two facilities did not respond to this question. A pie chart on the following page presents the distribution of responses to this question.

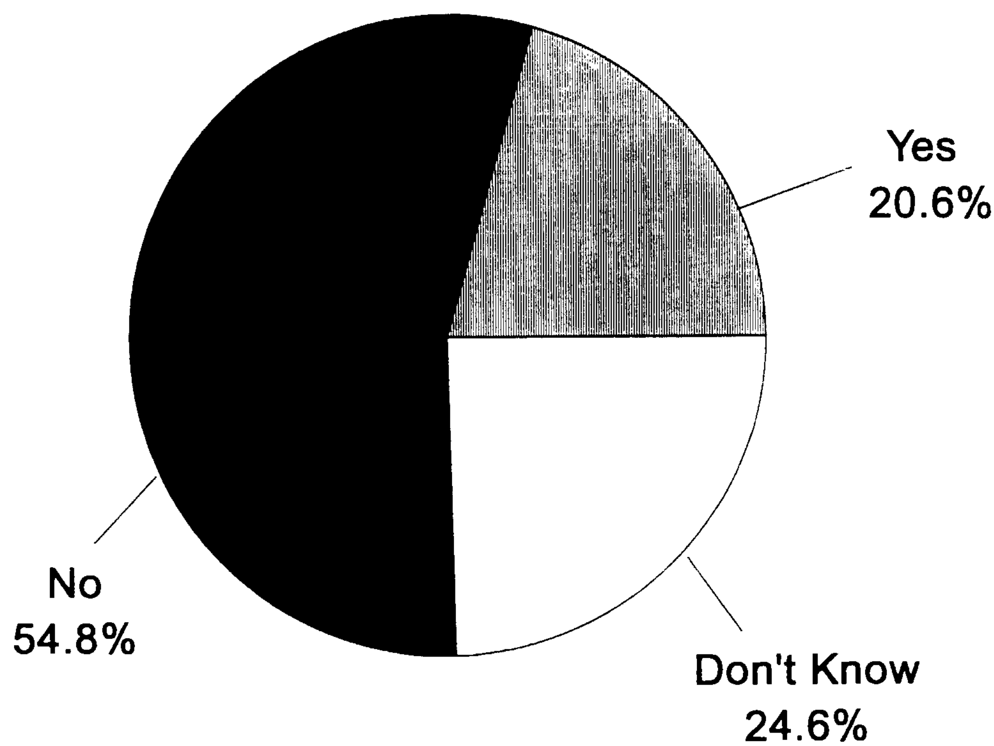
There were 124 respondents or 20.3% who stated that they either did not have a storm water related pollution prevention plan for their facility (101 or 17.4%) or didn't know if they had one (23 or 3.9%). In reviewing the information provided by small businesses in response to this question, it was observed that a higher percentage of facilities replied they did not have a plan (23.0%) or didn't know if they had a plan (7.2%). In fact, of the total of 23 facilities which indicated that they didn't know if they had a plan, 15 were small businesses. This result shows that small businesses tend to not understand the regulatory requirements as well as larger businesses.

Further analysis of those without a plan was made utilizing Questions 10 through 15 which were contained in Section A of the questionnaire. Those who responded that they had a plan were requested to answer Questions 16 through 36 contained in Section B of the questionnaire.

Facilities with No Storm Water Management Plans (Section A)

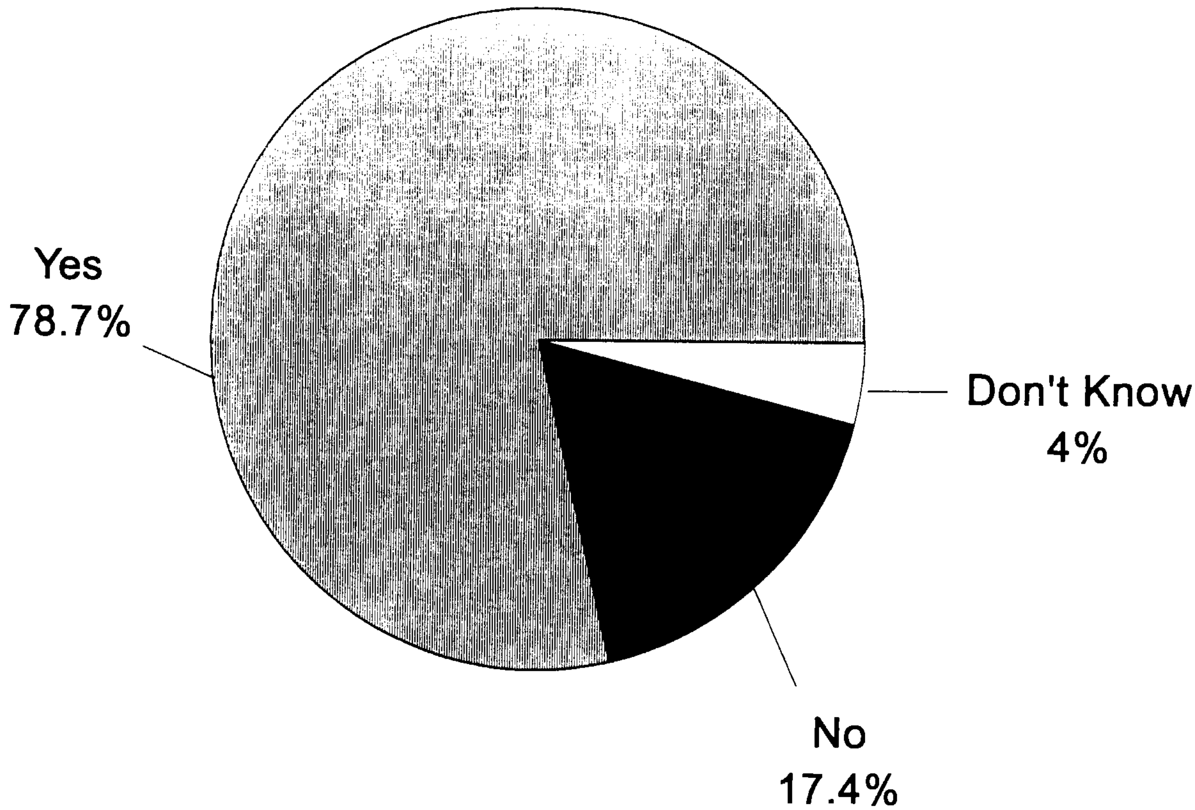
Probably the most important requirement of the storm water permit program is that a facility prepare a storm water management plan. The obvious first question to ask a company which does not have such a plan is whether the facility is regulated. Question 10 asked "Is your facility regulated by the storm water permit program?" The choices of answers were yes, no, and don't know.

Facility Required to Meet EPCRA Section 313



Question 8

Do You Have A Storm Water Related Pollution Prevention Plan?



Question 9

Only three did not respond to this question. And of those that did respond 73 (60.3%) said they were regulated, 27 (22.3%) said they were not and 21 (17.4%) said they didn't know. This data indicates that 58 or roughly 10% of all of the facilities that are in the NOI data bases are either not regulated or don't realize they are regulated by the storm water permit program. A pie chart entitled "Is Facility Regulated by the Phase I Storm Water Permit Program" presents the results of this question.

The next obvious question is whether the industrial activity modified its facility in order to eliminate the need for compliance. Question 11 asked "Did you or will you modify your facilities in order to eliminate the need for compliance with regulations?" There were 109 responses to this question with 24 firms (22.0%) responding yes. Of those 24, fifteen replied yes to Question 10 indicating that if they had modified their facilities to remove themselves from the program, they were either still regulated or will be modifying their facilities sometime in the future to remove themselves from the program. Five of those who said they didn't know if they were being regulated nevertheless said they had modified or will modify their facilities to eliminate the need for compliance.

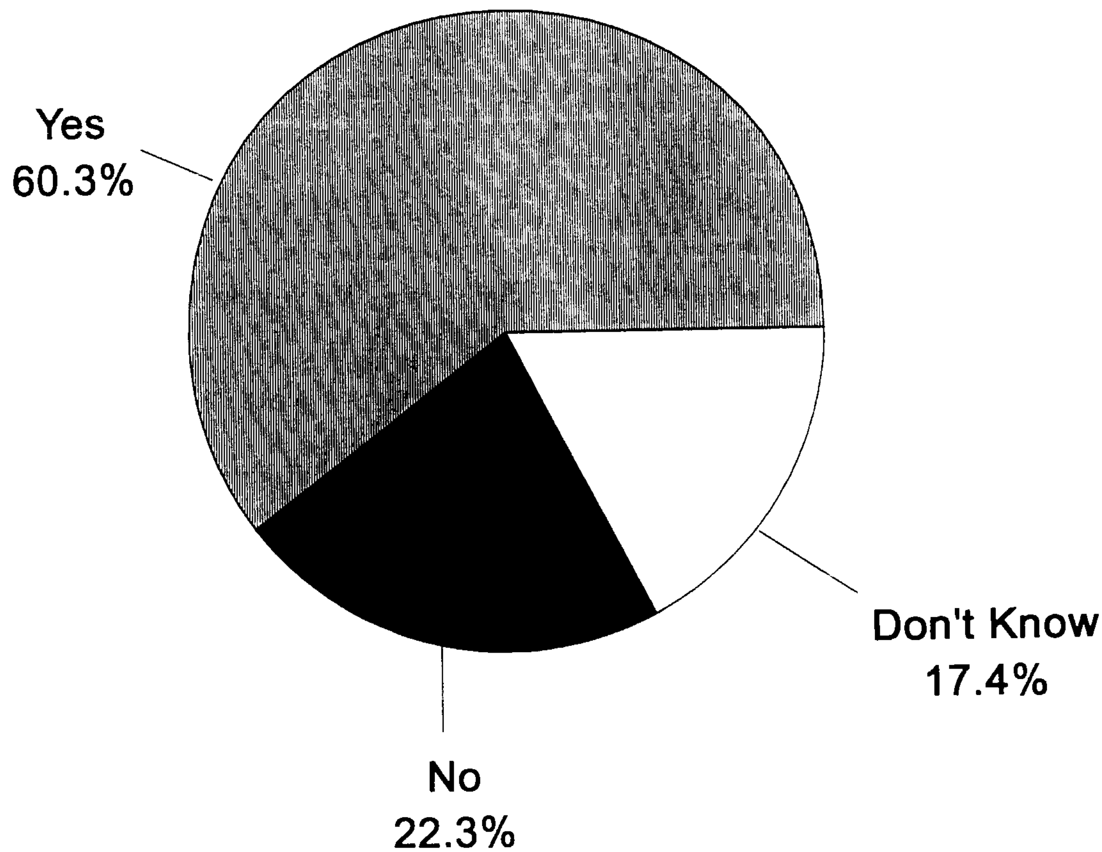
An important follow-up question to be asked of those who modified or plan to modify their facilities in order to avoid the need for compliance relates to how much companies are spending to opt out of the program through the "no exposure" exemption. Question 12 asked "If the answer to Question 11 is yes, how much did it or will it cost? In what year?"

Of the 24 that indicated they had modified their facilities, only 11 provided the cost of modifications. The range was from $1000 to $20,000,000. The latter is planned to be expended in 1997. The only other figure that was given to be expended in the future was $60,000 in 1998; the remainder represented expenditures which had already taken place, most of them occurring in the past three years. Dropping the extremes, i.e. the two highest and two lowest values gives a range of $5,000 to $60,000.

Some of the more expensive projects are probably the total investment in storm water pollution control, as opposed to construction exclusively to eliminate contact with storm water to take advantage of the "no exposure" exclusion. This is clearly a possibility since none of those who invested in facilities to eliminate the need for compliance actually reported that they were not regulated by the storm water permit program and only one reported it didn't know if it was being regulated.

Question 13 asked, "If your facility is regulated by a storm water permit program, who is the lead permitting authority?" The choices of answers were: Environmental Protection Agency - Region _____; State of _____; Local Government Authority (specify) ______; and Other (Specify) _______. This question was included in order to obtain knowledge of the geographical distribution of the respondents and to determine if there were any patterns to facilities that did not have a storm water management plan.

Is Facility Regulated by the Phase I Storm Water Permit Program?



Question 10

In response to this question, of the 124 respondents who said they did not have a storm water management plan, only 66 or 53.2% indicated who was the lead permitting agency responsible for their industrial facility. This left 58 facilities which did not respond. One of the reasons for this is that 48 facilities responding to Question 10 indicated they were not regulated or didn't know if they were regulated by the storm water permit program and therefore were not requested to answer Question 13. The reason for the balance of 10 not responding was either because the facility did not want to reveal the information or, more likely, because they didn't know or weren't sure of the lead agency.

The results of Question 13 revealed that 15.2% of the facilities fell under EPA authority, 81.8% fell under State authority and the remaining 3% were equally split between local government and other authorities.

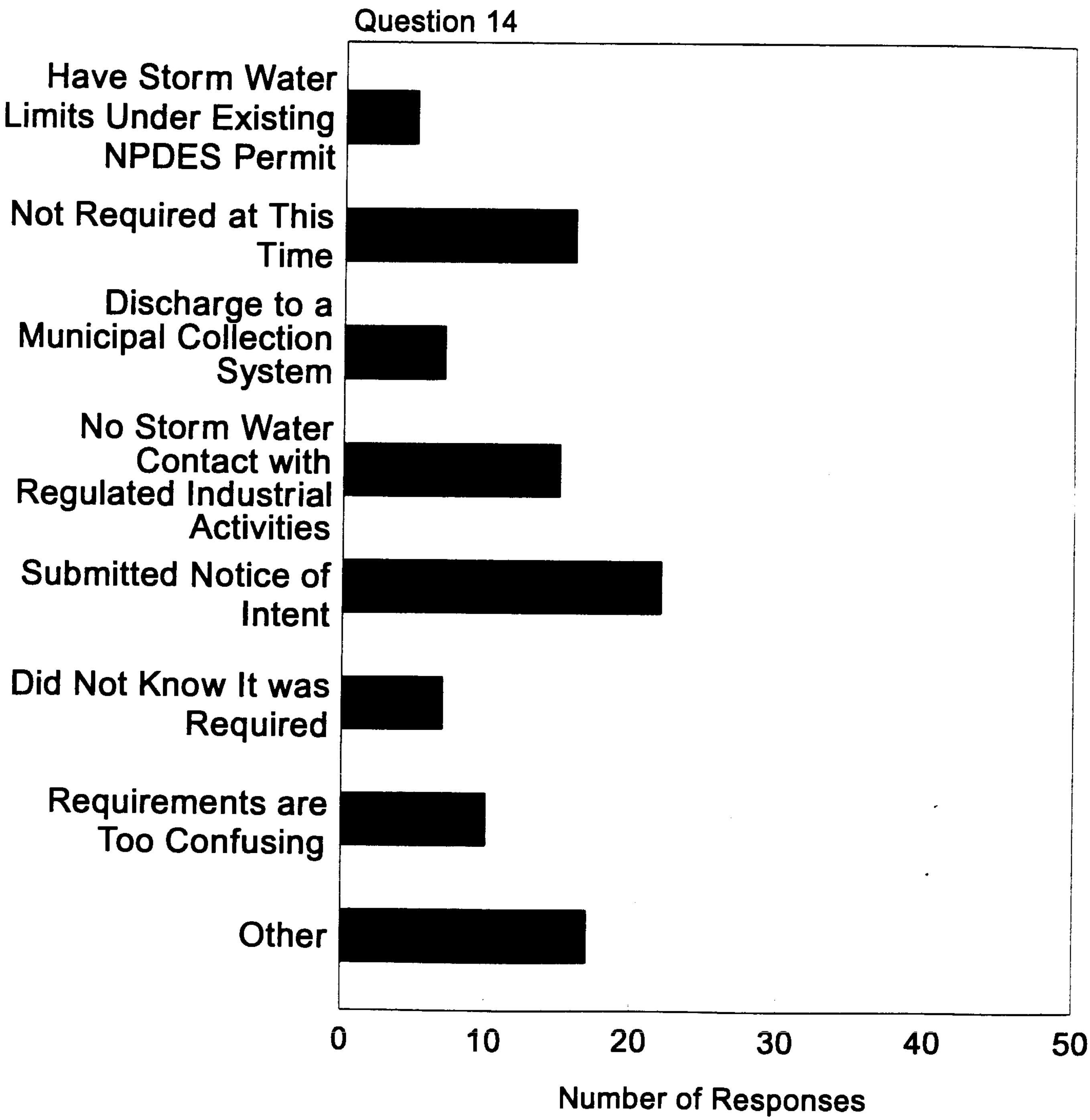
It appears based on the response to the questions in Section A and Question 10 in particular that 73 or 12.5% of regulated respondents may be out of compliance with the regulations requiring a storm water management plan. In order to determine why various industrial activities have not prepared a storm water pollution prevention plan, Question 14 was developed asking specifically, "Why have you not prepared a storm water pollution prevention plan?" The choices given were: have storm water limits under existing NPDES permit; not required at this time; discharge to a municipal collection system; no storm water contact with regulated industrial activities; submitted Notice of Intent; did not know it was required; requirements are too confusing; and other (specify).

It appears from the responses to this question that most firms are confused by the requirements. Of the 73 industrial activities that are probably required to have a plan but don't have one or don't know if they have one, 65 provided one or more reasons as to why. The most frequently chosen reason for not having a plan was that the facility had filed a Notice of Intent (22.2%). However, filing an NOI does not alleviate the firm of its responsibility to prepare a storm water management plan. While this choice perhaps technically should not have been listed, it illustrates a lack of understanding of the program requirements.

The second most frequently selected choice was "other" with 17.2%. By far the most frequently identified reason for not having a plan was that one was being prepared or reviewed or in some other intermediate stage of completion. Following this was the selection of "not required at this time" with 16.2%. Apparently, some states have established a system of priorities that give certain industrial activities more time to comply with the storm water management plan implementation. Next was "no storm water contact with regulated industrial activities" with 15.2%. These, plus the balance of reasons for not having a plan, are presented in the pie chart entitled "Reason(s) for Not Preparing a Storm Water Pollution Prevention Plan."

An analysis to determine why small businesses did not prepare a storm water pollution prevention plan revealed the following reasons as being the most frequently selected:

Reason(s) for Not Preparing a Storm Water Pollution Prevention Plan



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requirements are too confusing, one is not required at this time and there is no storm water contact with regulated industrial activities.

The final question in Section A, Question 15, asked, "Any comments?" from those industrial activities which did not have a pollution prevention plan. There were 19 comments received. The majority of these indicated that either the plant did not need a plan or one was being prepared. A few other comments questioned the value and effectiveness of the storm water permits program indicating it was a waste of time or that resources could be better spent elsewhere.

Facilities with Storm Water Management Plans

There were 458 respondents to Section B of the questionnaire relating to those industrial facilities which had storm water management plans.

Question 16 asked, "Who is the permitting authority for this facility's storm water permit?" The choices of answers were: Environmental Protection Agency - Region ______; State of _______; Local Government Authority (specify)______; and Other (Specify) _______. This question was included in order to obtain knowledge of the geographical distribution of the respondents and to have the ability to obtain correlations with responses to other questions. The distribution of permitting authority was EPA 19.0%; States 73.3%, Local governments 5.2% and other authorities 2.5%.

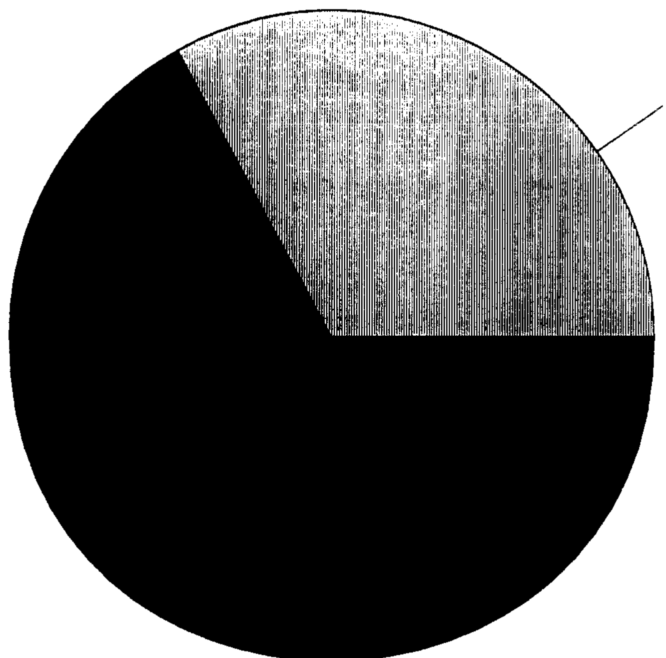
The next question was asked to determine if facilities would have had any pollution concerns with storm water had the program not existed. Question 17 asked, "prior to the Storm Water Permit Program, did this facility have any experience with either voluntary or regulation required pollution prevention plans that directly affected storm water?" The choices given were yes or no.

Only 9 respondents did not answer this question and of the 449 that did, the vast majority, 301 or 67.0% said no. When looking only at small businesses, the "no" response increased to 73.0%. This is a clear indication that the program alerted the industrial community to the fact that there is serious concern over storm water pollution. On the other hand, with148 or 33.0% responding yes to this question, there is evidence that other pollution control programs have definitely had an impact on storm water. A pie chart entitled "Prior Experience with Voluntary or Regulated Storm Water Plans" presents the distribution of the answers to this question.

The logical next question was to determine if there are apparent regulatory overlaps, and if so, specifically which mandated requirements overlap the storm water program. Question 18 asked, "Does this facility's storm water pollution prevention plan overlap with other mandated requirements?" The choices given were yes, no and don't know.

The second part of Question 18 asked, "If yes, which requirements?" The choices given were: best management practices plan (Clean Water Act - Nonpoint Source), waste

Prior Experience with Voluntary or Regulated Storm Water Plans



Question 17

minimization plan (CERCLA/SARA), Spill Prevention Control and Countermeasures (SPCC), and other (specify). Since the choices are not mutually exclusive, multiple choices were optional.

The responses to this question were observed to be somewhat inconsistent with those of Question 17. There were only 148 who said yes to Question 17 - stating there was either a voluntary or regulatory requirement for pollution prevention plans that directly affected storm water. Yet, when asked basically the same question in Question 18, nearly 100 more respondents: 257 or 56.4% answered that there was overlap. Of the remaining, 132 or 28.9% said there was not, and 67 or 14.7% said they didn't know. Only 2 respondents didn't answer this question.

A possible explanation for this inconsistency is that Question 18 gave a list of regulatory requirements that could conceivably overlap with storm water requirements; thus providing suggestions to the respondent which may not have previously been considered.

Even though the respondents may have been prompted to answer yes by making them aware of the programs which might overlap; still almost half (43.6%) said there was none or they didn't know of any. This would still indicate that many industries were not previously aware of the fact that storm water pollution was an environmental concern. A pie chart presenting these results is entitled "Does This Facility's Plan Overlap with Other Mandated Requirements". The reader's attention is drawn to the contrast between the responses to Question 17 and Question 18.

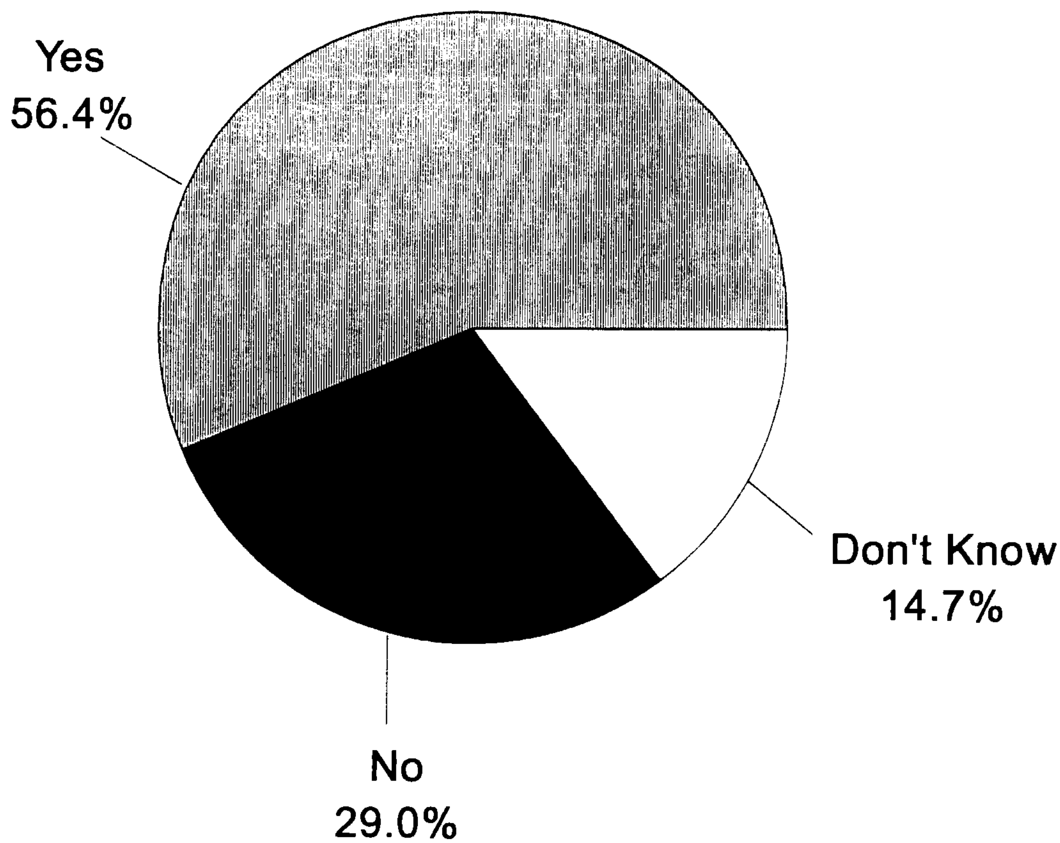
As previously described, the second part of Question 18 attempted to specifically identify possible overlapping regulatory requirements. In the presentation of the analysis of this question's results, the percentages of each selection do not total 100% because the respondents could choose more than one answer.

Of the 254 respondents who selected at least one overlapping regulation, by far the most frequently selected requirement was the Spill Prevention Control and Countermeasures (SPCC) Plan of the Clean Water Act and RCRA with 63.8%. In descending order, the others were Best Management Practices (BMP's) required under the Clean Water Act for nonpoint sources with 37.8%; followed by Waste Minimization Plans required under CERCLA/SARA with 26.8%. This was followed by "others" with 19.7%. A histogram presenting the results of this question is entitled " Requirements That Overlap."

Of the fifty respondents who specified what the "other" requirements were, about half identified them as state and local regulations. The majority of the other half can be grouped into groundwater protection plans, RCRA requirements, solid waste management plans, hazardous waste management plans, and emergency response plans.

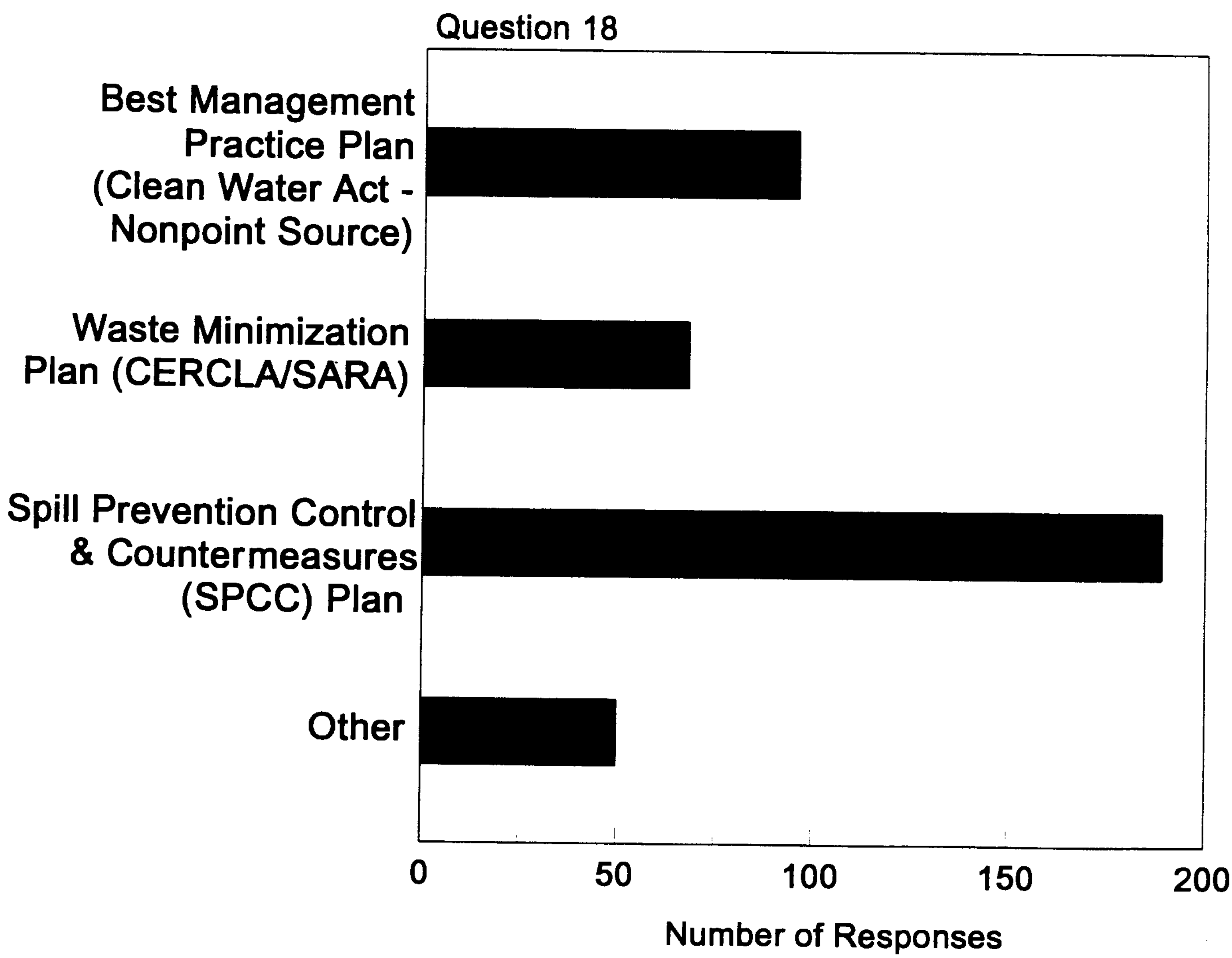
Two other parts of determining the effectiveness of the storm water permit program were assessing the ability of the industrial activities to prepare a storm water pollution prevention plan, and evaluating the usefulness of EPA and State guidance.

Does This Facility's Plan Overlap With Other Mandated Requirements?



Question 18

Requirements That Overlap



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Question 19 asked, "How was the facility's storm water pollution prevention plan developed?" The choices of answers were grouped into three areas and the respondent was requested to select all that apply. The first area was directed at who prepared the plan and the selections were: facility staff, corporate staff and/or external consultant. The second area was directed at identifying outside sources of guidance for preparation of the plan, and the selections were: used trade association guidance, used EPA guidance, and used State Agency guidance. The third area was directed at identifying internal sources of guidance for preparation of the plan, and the selections were: adapted model plan supplied by company or corporate office, adapted standard operating procedures from company, adapted plan from another pre-existing plan, and other (specify).

There were 418 responses that provided information on who prepared the plan. There were 262 responses that identified outside sources of guidance for preparation of the plan. And there were 104 responses that identified internal sources of guidance for preparation of the plan.

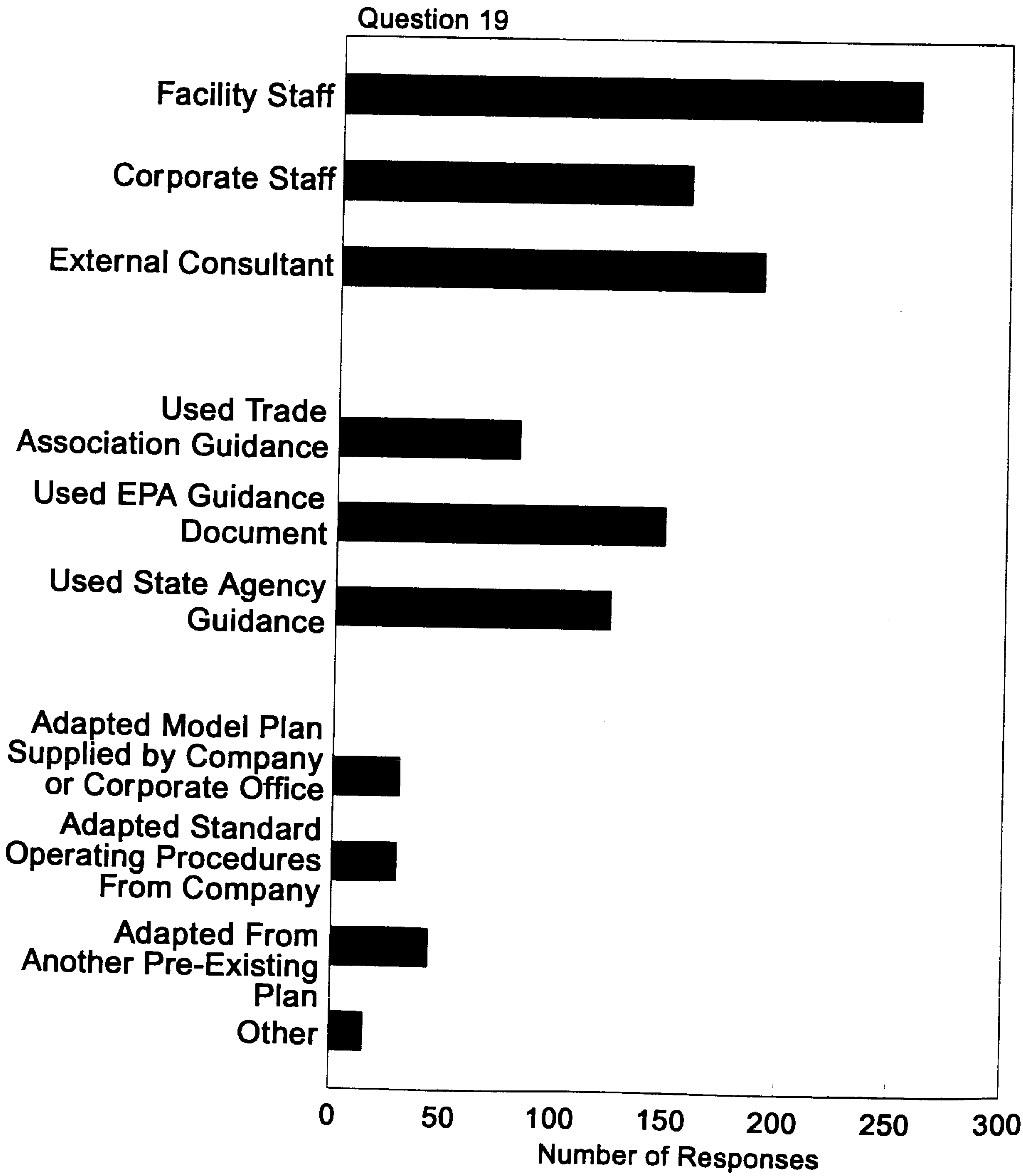
Of those respondents which indicated who they used to prepare the storm water pollution plan, 120 or 28.7% were able to prepare the plan by themselves. And of those who prepared the plan by themselves, 31.0 % used only EPA guidance and 22.8 % used only state guidance, while another 17.5% used both EPA and State guidance combined. From this response, it can be seen that 71.3% used governmental guidance exclusively and it appears that both EPA and the States have done an excellent job in providing the necessary assistance to prepare a storm water management plan. In fact, only 11.1% used neither EPA nor State guidance, relying on Trade Association guidance solely. Not determinable by the survey was the extent to which Trade Associations relied on EPA and State guidance.

If an individual facility required additional assistance in preparation of its pollution prevention plan, it relied on external consultants 63.6% of the time and then on corporate staff 21.4% of the time; while 15.0 % used both corporate assistance and consultants. If the plan was prepared by the corporate staff, it relied on external consultants much less than the individual facilities, only 23% of the time.

The data also show that 24.9 % of the industrial facilities employed internal sources of guidance for preparation of the storm water management plan. Of those which used internal sources, 42.3% adapted components from another pre-existing plan, 26.9% used company standard operating procedures and 29.8% employed a model plan provided by the company or corporate office. In addition, 14.4% used other internal sources. A histogram entitled "How Was the Pollution Prevention Plan Developed" presents the number of respondents using various resources for plan preparation.

Related questions which arise at this point are: how much did the preparation of these plans cost and how do the costs compare based on who prepared them and what source

How Was the Pollution Prevention Plan Developed?



R0016804

they used in preparation. To conduct and discuss this analysis, a jump to Question 26, which addresses costs, is necessary.

Using the results from the first component of Question 26 which provides the cost of plan preparation (excluding the three companies that reported that they had spent over $100,000 for their plan), the average cost was $7,606 per plan. Those facilities that prepared the pollution prevention plans themselves incurred an average cost of $6,950; those that used corporate staff exclusively had an average cost of $5,513 and those that used consultants exclusively had an average cost of $8,215. Those facilities that used all three sources: local staff, corporate staff and consultant assistance had the highest average cost at $12,667 per plan. An additional analysis showed that small businesses spent an average of $4,341 per plan.

Those firms that used only Trade Association guidance had an average cost of $ 8,617 for plan preparation. Those that used EPA guidance exclusively had an average cost of $7,625 while those that used State provided guidance exclusively had an average cost of $5,958 per plan.

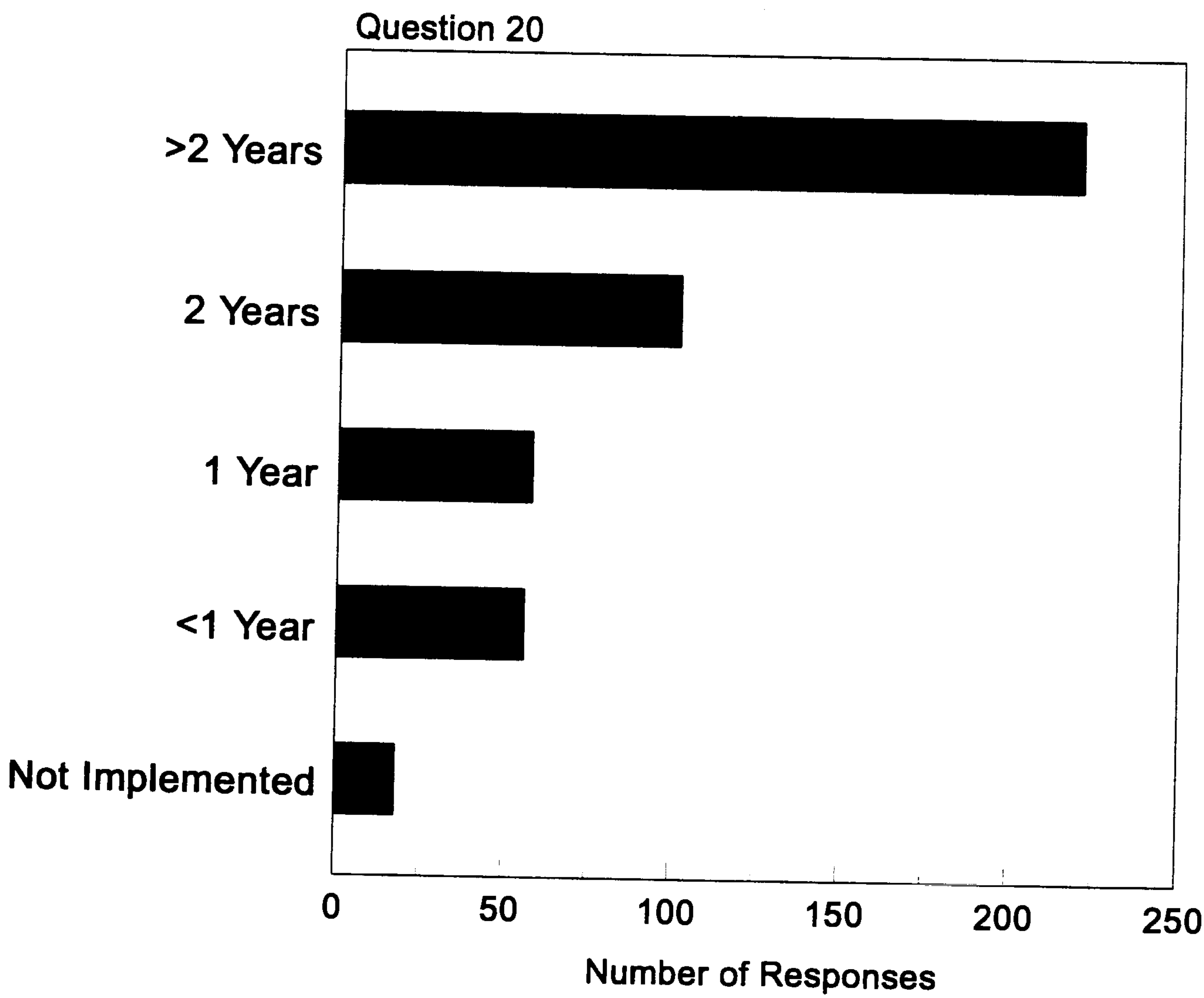
As an interesting side analysis, the three companies that spent over $100,000 each on their storm water management plans indicated that they had used completely different preparers and external sources. One used only facility staff, one used only external consultants and one used all three; facility staff, corporate staff and an external consultant. One used only trade association guidance, one used only EPA guidance and one used only State guidance. None adopted a model plan, a pre-existing plan or standard operating procedures.

The next question regarding the length of time that the storm water management plan had been implemented was requested in order to determine timing progress of this aspect of the program. Question 20 asked, "How long has the storm water pollution prevention plan been implemented?" The choices of answers provided were: not implemented, less than one year, one year, two years, and greater than two years. A histogram entitled "Length of Implementation Time for Storm Water Pollution Plan" gives the distribution of the answers to this question.

This question was answered by 455 respondents (all but three). The results indicate that after the initial surge of plan implementations (221) over two years ago, the number dropped to 102 two years ago and then to 58 last year, and 56 this year. Only 18 respondents had not yet implemented their plans. It appears that the number of new pollution prevention plans being implemented is approaching a constant 12%. This is probably due to new facilities going on line plus additional facilities that have been joining the program as enforcement activities increase.

Question 21 asked "Has water quality monitoring and analysis been performed on the storm water runoff from this facility?", in order to establish the basis for the answer to Question 22 which stated "If yes, in your opinion, did results indicate whether Best

Length of Implementation Time for Storm Water Pollution Plan



Management Practices (BMP's) are successful?" All but three respondents answered Questions 21. And of the 258 that responded in the affirmative to Question 21 only 3 did not respond to Question 22. The answers to Question 21 are presented in a pie chart. Similarly another pie chart entitled "Evaluation of Best Management Practices (BMP's)" follows and presents the respondents perception of whether BMP's are successful.

Those facilities which had performed water quality analysis represented 56.7% of the respondents. Of that 56.7%; 56.9% indicated that they felt there was water quality improvement as a result of BMP's. A sizable percentage, 36.9%, gave the opinion that either there was insufficient data (15.7%) or inconclusive data (21.2%).

The latter percentages can be interpreted in two ways; either there is more data collection required or the natural variation in water quality of the receiving waters is such that a determination of water quality improvement is not possible. However, it should be noted that if there are natural variations in the water quality of the receiving waters which make the determination impossible; there is a high probability that there are immeasurable changes in water quality in the receiving waters due to storm water controls, resulting in insignificant water quality improvement.

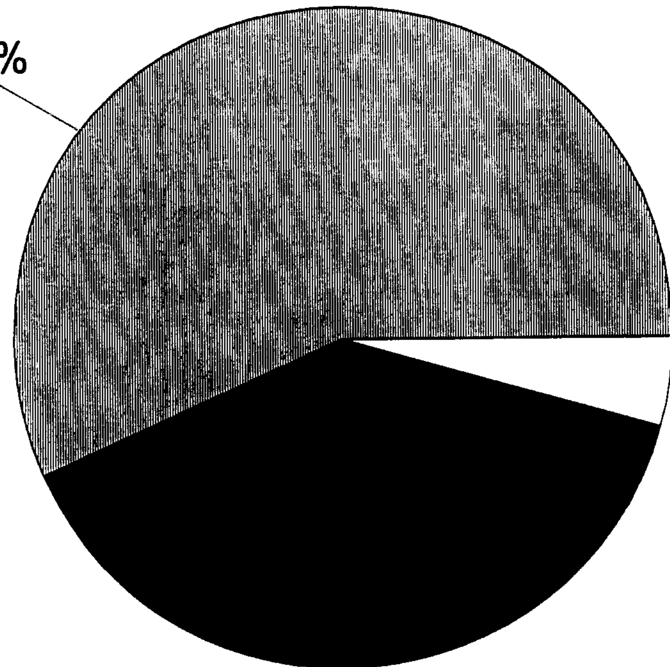
One of the most significant questions of the survey was Question 23 which asked "Whether you have conducted water monitoring or not, in your opinion, how much improvement in water quality or reduction in storm water pollution has there been or is there likely to be as a result of your storm water (or other) plan?" Only one respondent didn't answer this question. A pie chart entitled "How Much Water Quality Improvement or Reduction in Storm Water Pollution Resulted From Your Plan?" presents the results.

The results show that 9.2% believe that there is significant improvement, 20.1% moderate improvement, 38.7% minor improvement and 27.1% no improvement. The remainder, 4.8%, said they didn't know. The results of this question can be interpreted in different ways. One view is that the program is perceived as effective because a sizable majority, 68.0%, believe there is at least some improvement in water quality. Another view is that the program is perceived as ineffective because a sizable majority, 65.8%, believe there is little or no improvement in water quality.

An interesting side analysis showed those individuals who had conducted water quality monitoring and analysis on the storm water runoff from their facility, had close to the same results as the previous analysis with 12.1% determining there is significant improvement, 20.8 % moderate improvement, 40.8% minor improvement, and 23.1% no improvement. There is a slight increase in favor of those who would choose to believe the program is effective, 73.7%; verses a slight decrease for those who would choose the opposite, 63.9%.

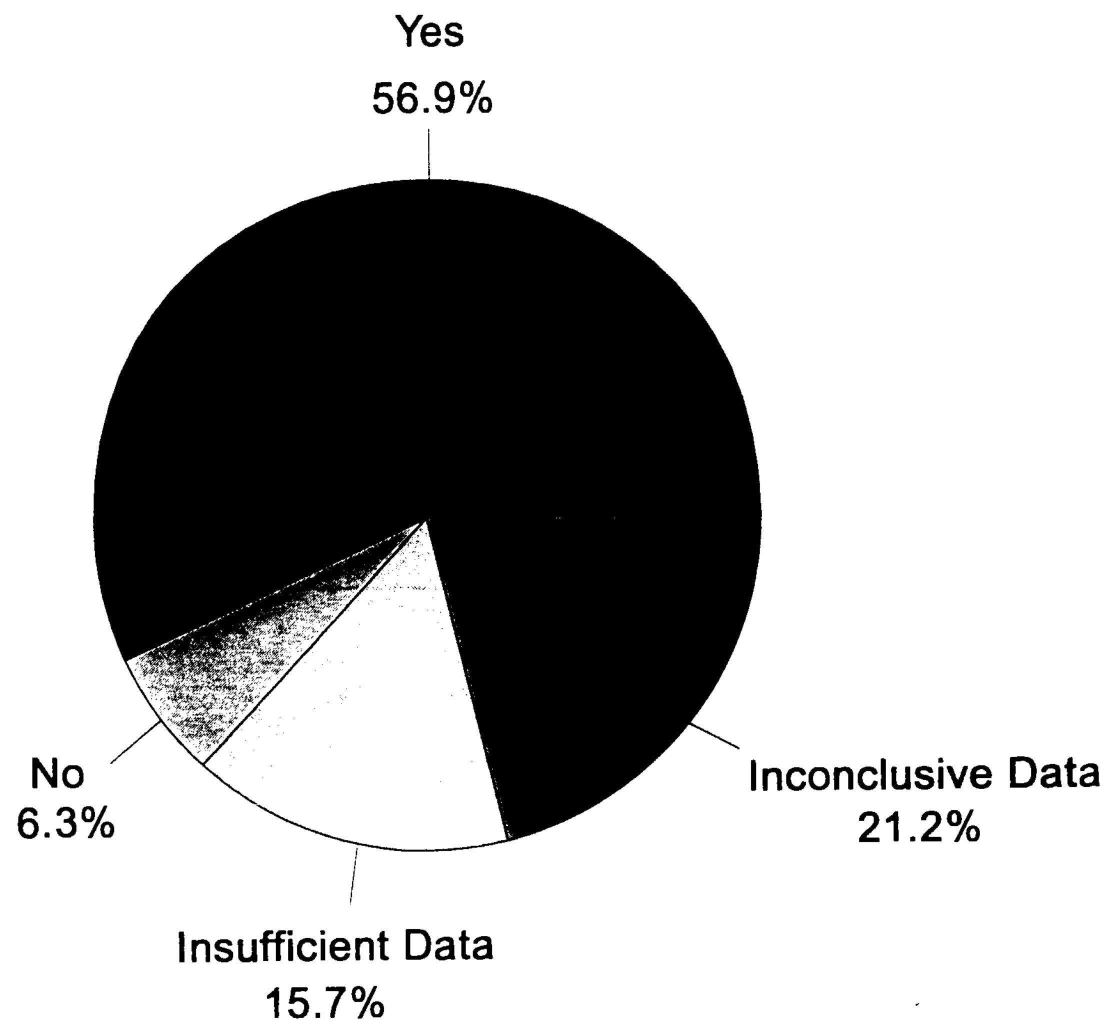
An additional analysis was made by looking only at those industrial facilities which stated BMP's were successful (i.e. those who answered yes to Question 22) and also had the water quality data to evaluate the level of improvement. Although these respondents said

Has Water Quality Monitoring and Analysis Been Performed?



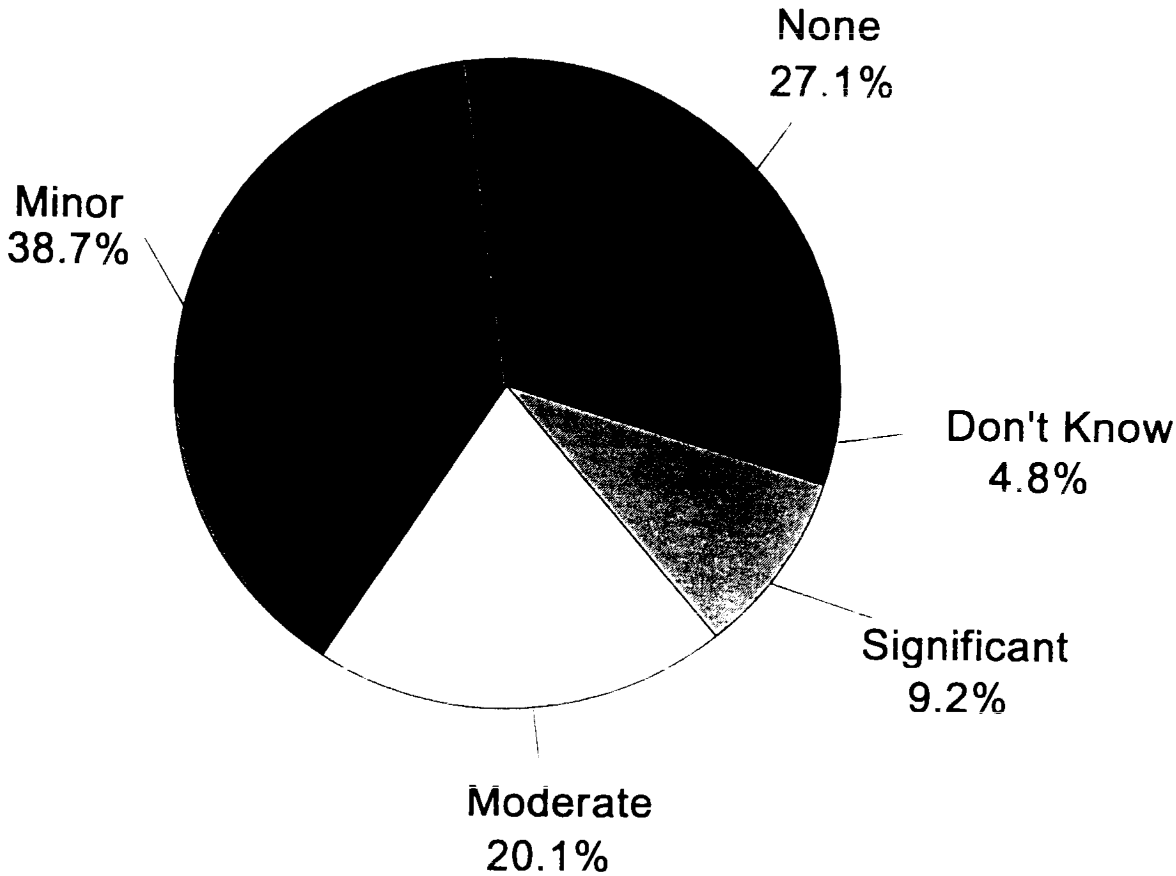
Question 21

Evaluation of Best Management Practices (BMPs)



Question 22

How Much Water Quality Improvement or Reduction in Storm Water Pollution Resulted From Your Plan?



Question 23

that BMP's were successful; 22.1% said in their opinion, there was no water quality improvement. Of the same group 31.7% said there was minor improvement, 25.5% said there was moderate improvement, 17.2% said there was significant improvement and 3.4% didn't know. Therefore, 74.4%of those with successful BMP's and water quality data have the opinion that there is at least some improvement in water quality or reduction in storm water pollution; while from the alternative viewpoint 57.2% feel there is little or no improvement.

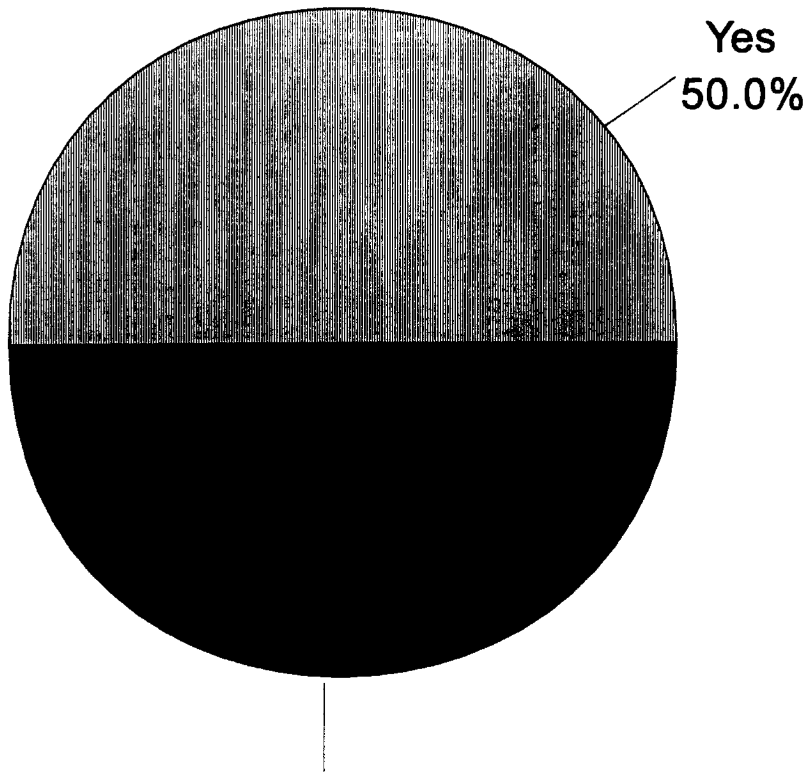
Another important question was Question 24, which simply asked, "Was any improvement to the water quality or reduction in storm water runoff possible?" The purpose of this question was to determine whether or not industry felt the existence of any type of storm water control program could result in water improvements. As shown in the pie chart with the same title as the question, the responses were split down the middle with 50.0% saying yes and 50.0% saying no. Only 9 firms did not answer this question.

The answers given to Question 24 were then compared with the answers given by the same individuals to Question 23 regarding the level of improvement likely to result from the storm water (or other) plan. Of those who said there was no improvement possible, 47.3% said that there was no improvement likely to result from the storm water plan and 37.5 % said that only minor improvement was likely. A number of individuals said no improvement to water quality was possible; yet stated moderate (7.6 %) or significant (2.7%) improvement resulted from their storm water (or other) plan. These individuals may have found Question 24 imprecise because it asked if any improvement to the water quality or reduction in storm water run-off was possible. The latter half of the option could be interpreted as flow related not pollutant related, and could have been more clearly stated as "reduction in storm water pollution" rather than reduction in run-off.

Of those who said that improvement to water quality or reduction in storm water run-off was possible 7.6% said that no improvement was likely to result from the storm water (or other) plan; while 40.0% said that minor improvements are likely. Those who said that moderate improvements are likely represented 32.9% and those who suggested significant improvements were possible were 15.6%. Those who simply didn't know represented 3.9% of the respondents.

Question 25 was developed in order to assess various impressions of the level of effectiveness of the different possible components of pollution prevention plans. The question states, "Considering actual and potential benefits and based on your impression, rate the following elements of the facility's pollution prevention plan as to their effectiveness in preventing pollution from storm water runoff." The choices of ratings were: highly effective, moderately effective, not effective or not applicable. The components presented for evaluation included: good housekeeping, preventative maintenance, elimination of industrial source discharges, sediment and erosion control, visual inspections, spill prevention and response, site mapping (operations, drainage, and runoff collection mapping), employee training, record keeping and reporting, raw material

Was Any Improvement to Water Quality or Reduction in Storm Water Runoff Possible?



Question 24

or product substitution, annual site compliance evaluation, physical facility modification (requiring construction) and other (specify).

Each item was evaluated separately and between 436 and 447 respondents addressed each component depending on the item rated. A histogram entitled "Plans Effectiveness in Preventing Runoff" presents the ratings of each component. Following that are individual histograms which present those components determined to be highly effective, moderately effective, not effective and not applicable.

Good housekeeping was assessed as the most highly effective component of a storm water management plan, with 61.5 % evaluating it as highly effective and 34.0 % determining it moderately effective. Less than 5% determined it not effective or not applicable.

The second most highly rated component of the plan was spill prevention and response. It was the only other item besides good housekeeping that had a higher rating as "highly effective" 44.2 % than it had as "moderately effective" 41.7 %. Only 6.1% rated it as not effective, while 8.0% indicated it was not applicable.

This was followed by preventative maintenance which was rated by 36.0 % as highly effective and 47.0 % as moderately effective. And it in turn was followed by visual inspections, which 33.1 % rated as highly effective and 56.2 % rated as moderately effective. And finally, of those components found to be effective, employee training was next with 30.2 % finding it highly effective and 58.6 % finding it moderately effective.

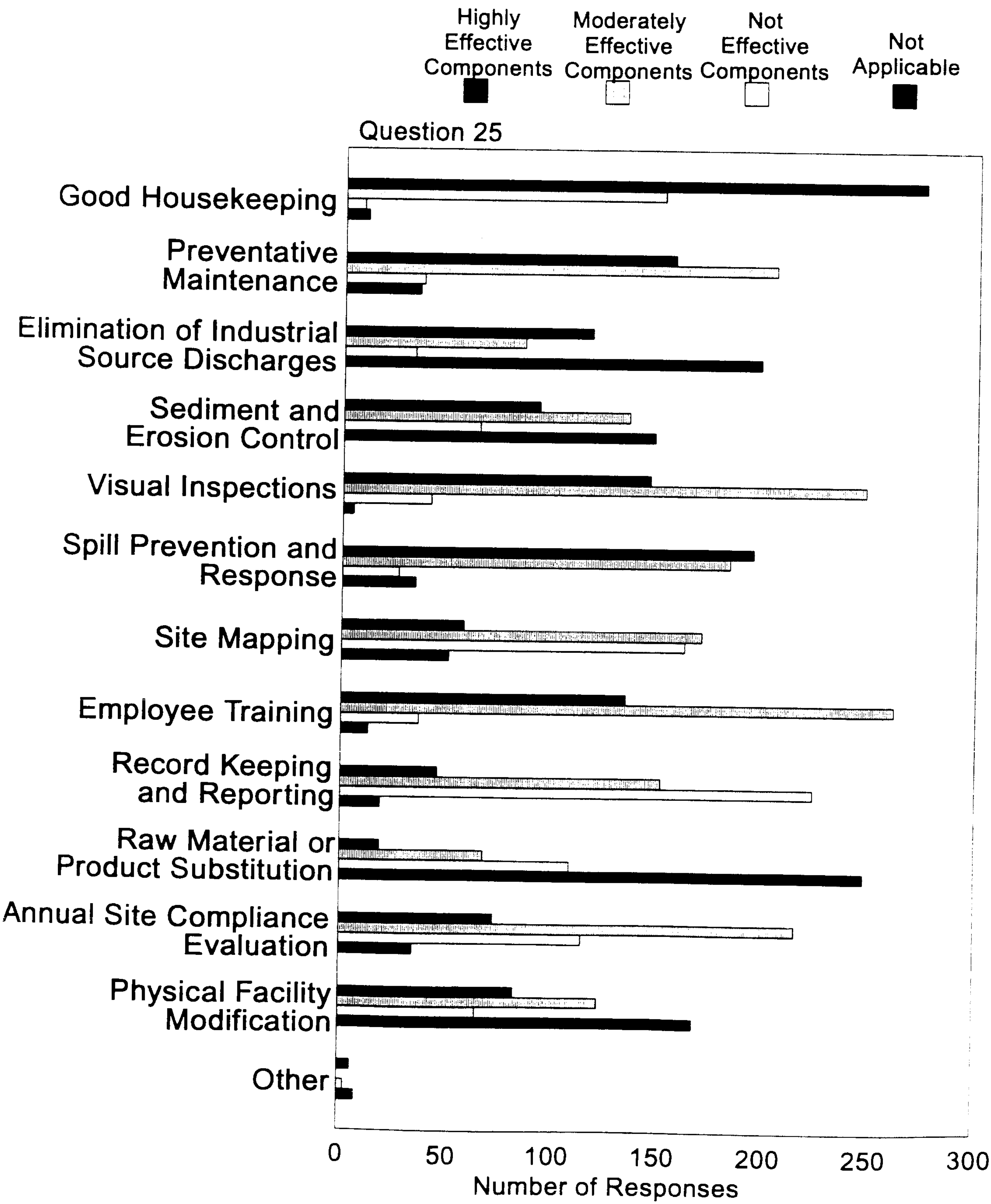
An interesting observation regarding the results of this part of the survey is associated with the relatively high number of respondents who reported that certain components were not applicable to their plan or facility. In descending order of frequency those components selected as non applicable were: raw material and product substitution, elimination of industrial discharges, annual site compliance evaluation, and sediment and erosion control.

Even though these were found to be not applicable to many facilities it does not mean that they are ineffective controls. For example, a substantial number (45.4%) rated "elimination of industrial source discharges" as not applicable; however, the vast majority for whom it was applicable, found it to be highly effective (49.6 %) or moderately effective (36.1%).

It appears that if a company has a problem with an industrial source being inadvertently discharged to a storm sewer, the elimination of this discharge was logically concluded to be highly effective in preventing pollution.

Another interesting observation is associated with that component receiving the lowest rating. A relatively large percentage of individuals determined that raw material or product substitution was not applicable to their operations (55.8%). In addition, of those 196 respondents that found it was applicable, 55.6% determined it to be not effective. It was concluded that this component is generally thought to be the least effective of the pollution prevention plan elements for storm water management.

Plan's Effectiveness in Preventing Runoff



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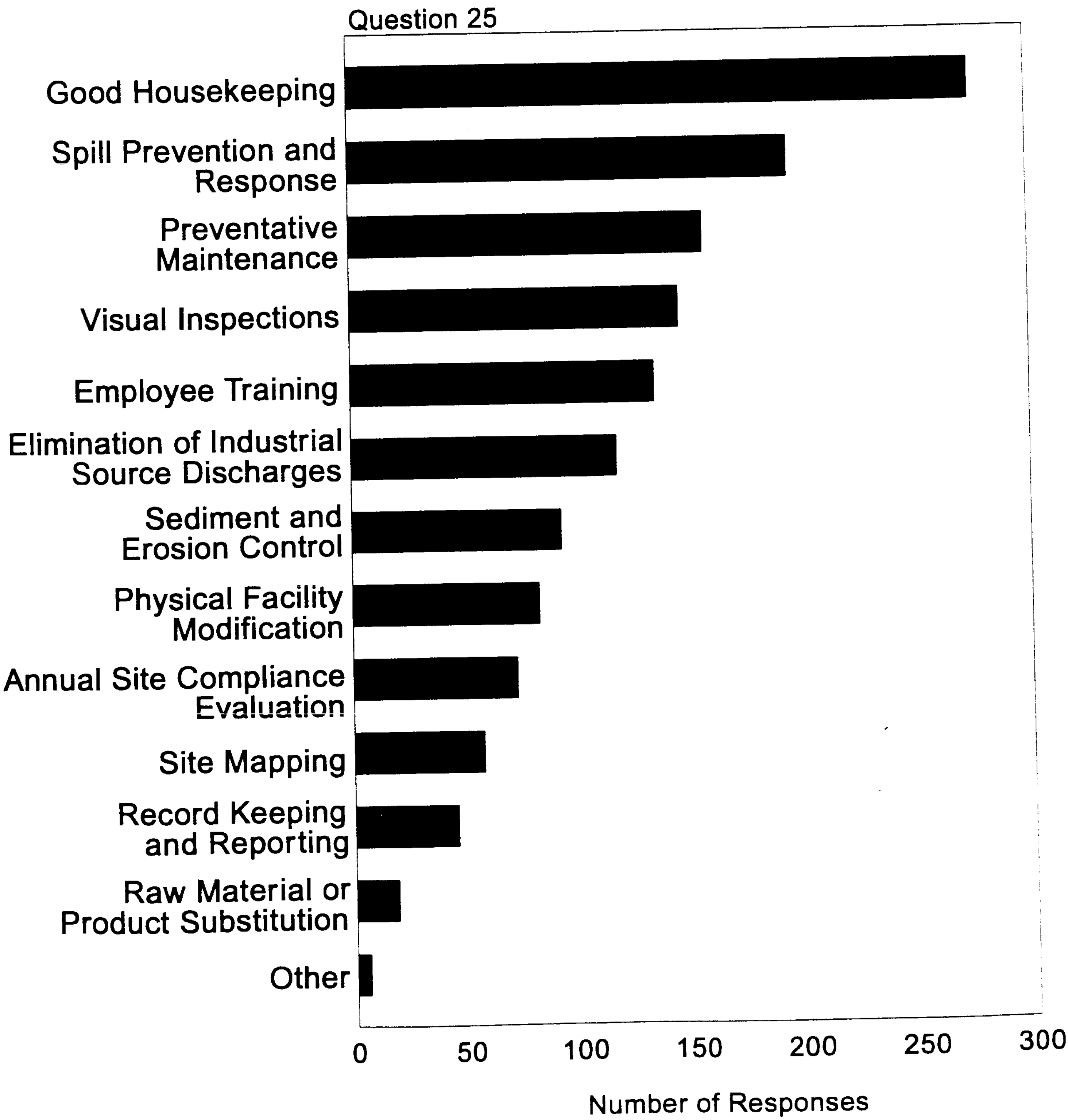
Highly Effective Plan Components in Preventing Runoff



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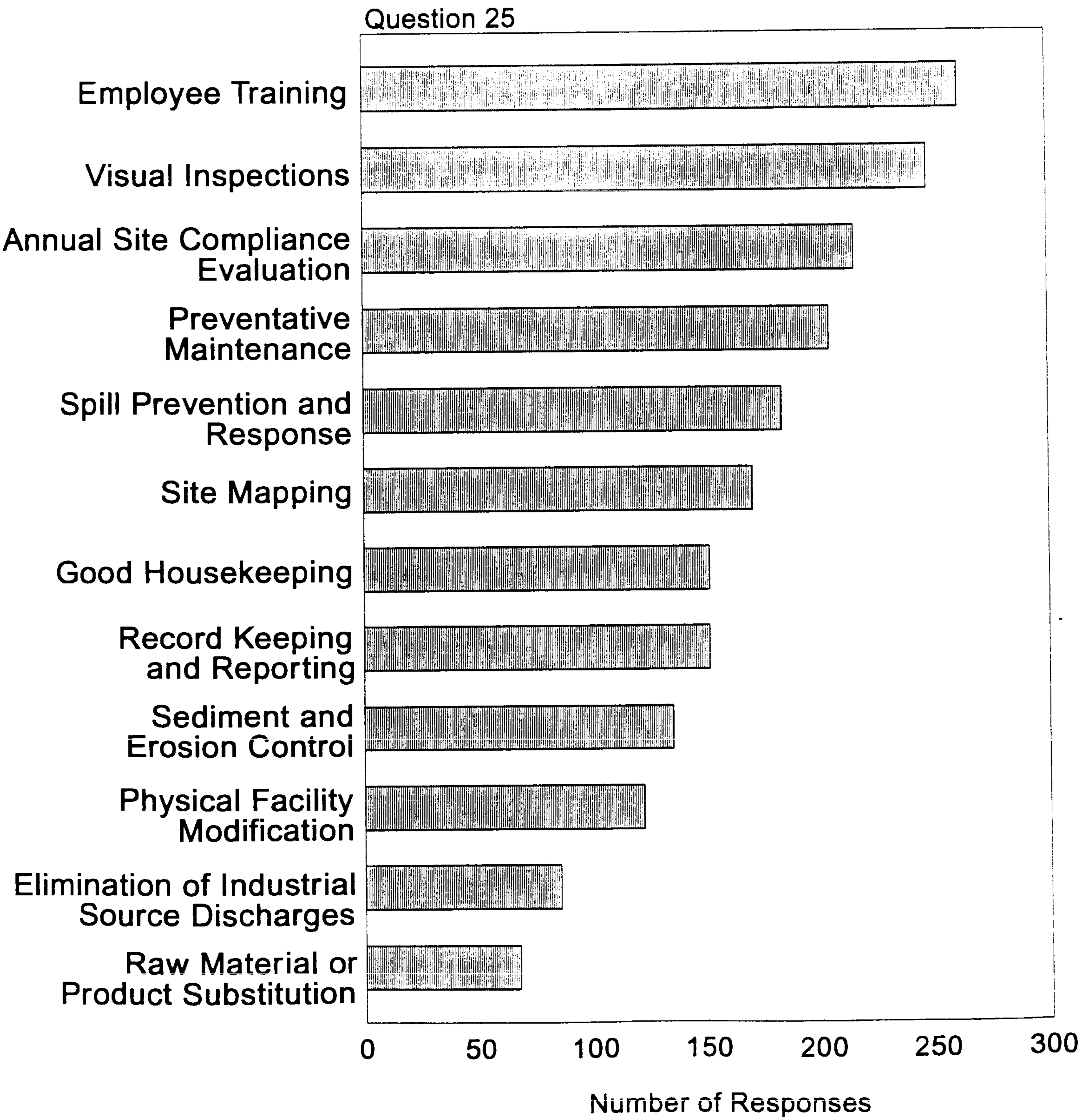
Moderately Effective Plan Components in Preventing Runoff



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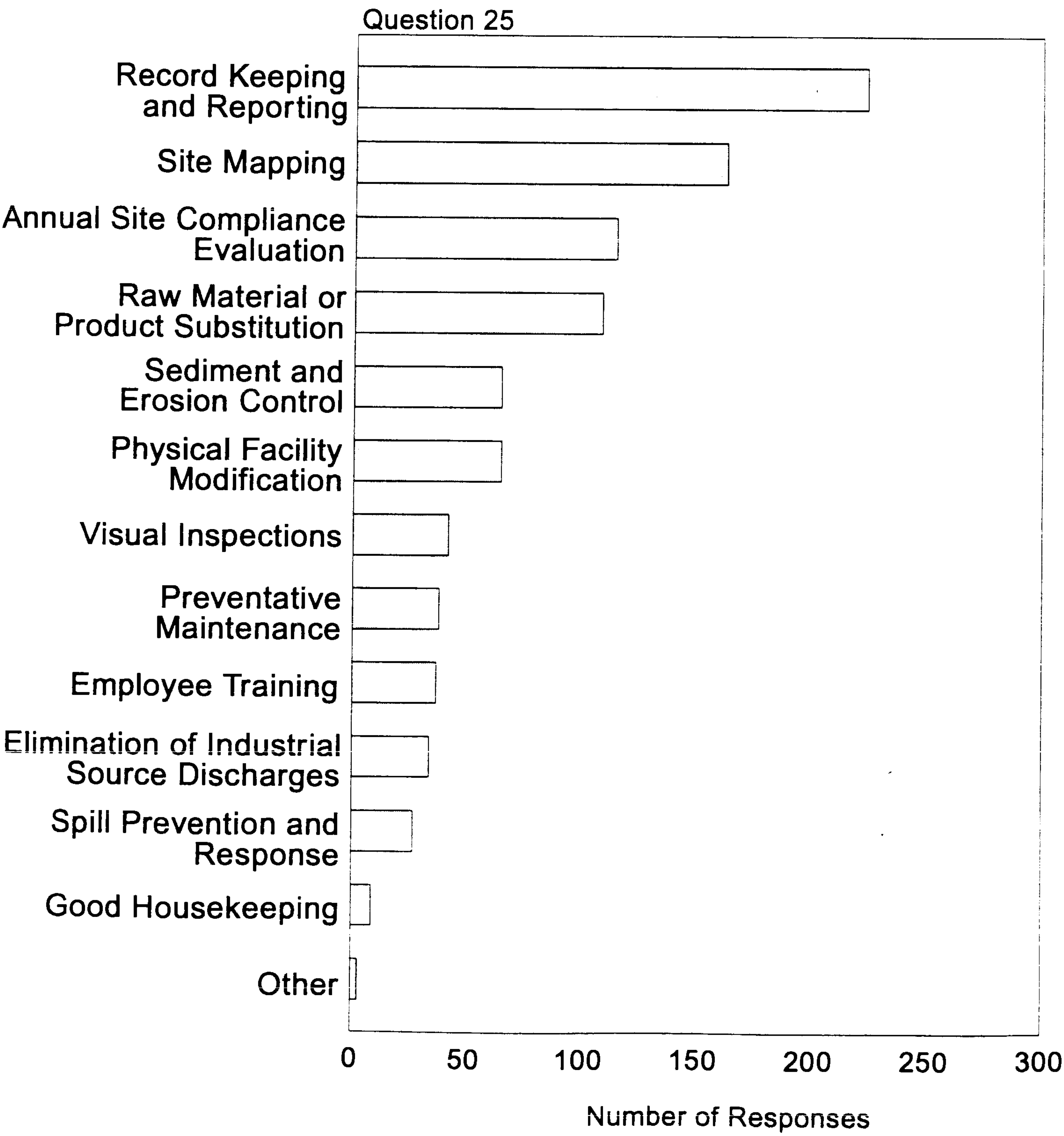
Not Effective Plan Components in Preventing Runoff



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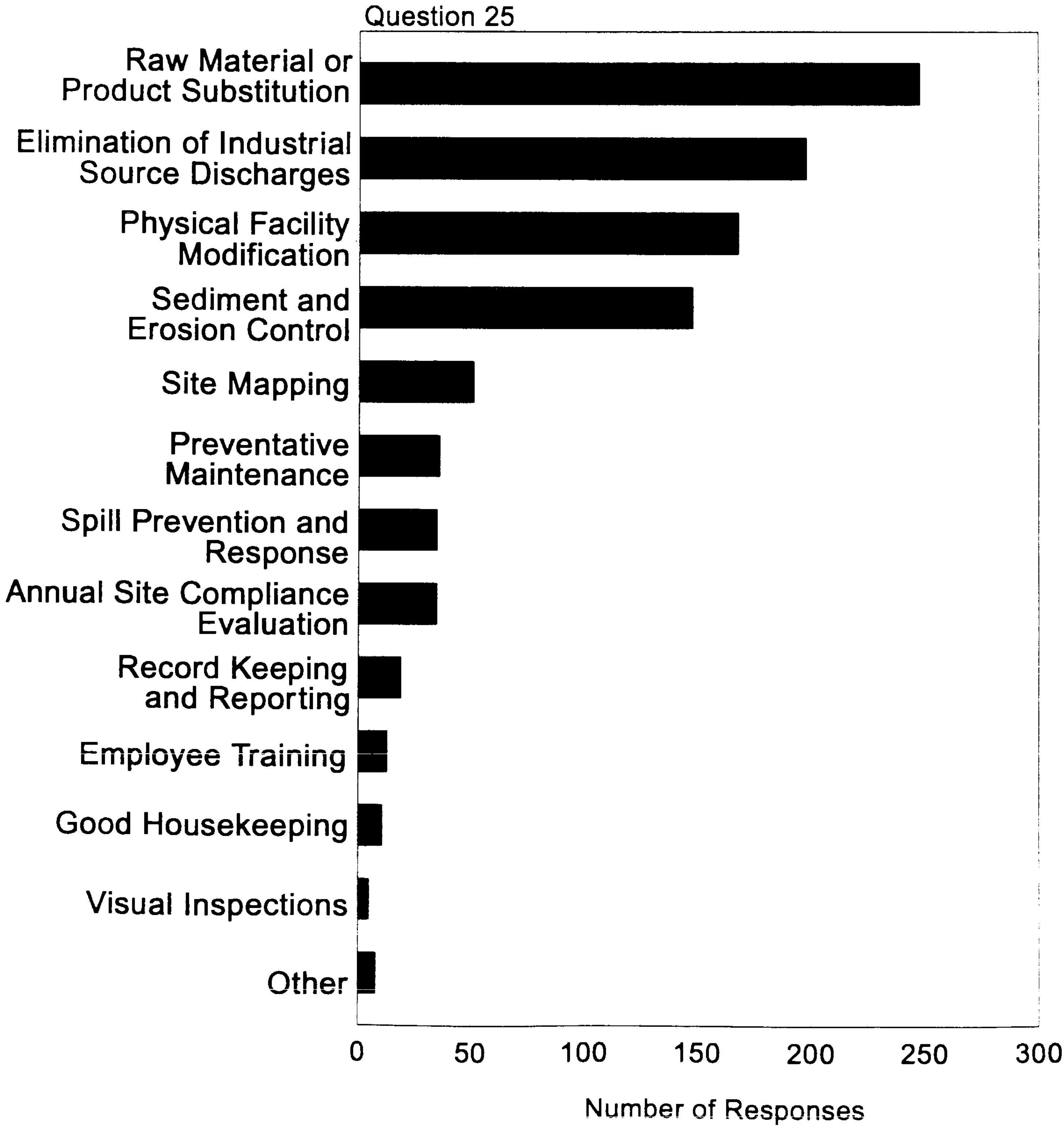
Not Applicable Plan Components in Preventing Runoff



R0016818

Of those components determined to be applicable, clearly the one perceived to be the least effective was record keeping and reporting. Of the 422 respondents that did not eliminate it as not applicable, 224 or 53.1% found this element to be not effective.

Question 26 states "How much did the development and implementation of this facility's storm water pollution prevention plan cost?" Blanks were provided to fill in the cost of plan development, the plan's implementation annual operating cost, and the capital cost of physical improvements. As part of the question, additional details were requested on the year expended or planned to be expended and the type(s) of physical improvements. Blanks were also provided for these answers.

The percentage of industrial activities providing costs dropped from 73.3% for those giving the cost of plan development, to 64.4% for those giving the cost of the plan's implementation annual operating cost, to 38.9% for those giving the capital cost of physical improvements. Many of those who did not provide costs for the plan development made the comments that the plan was prepared in house and therefore did not have an available cost.

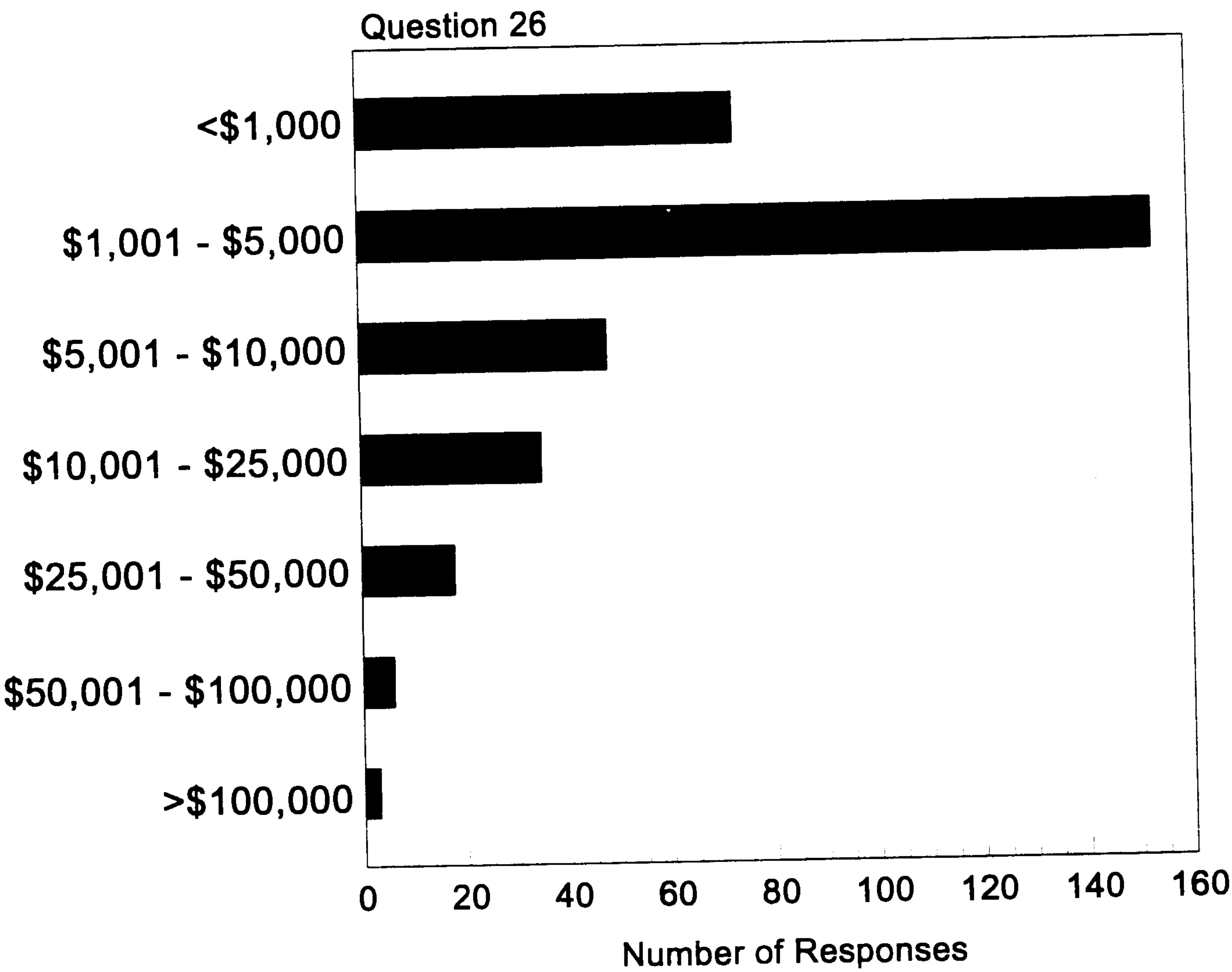
It appears from the above responses that some facilities (35.6%) which have a plan do not incur any significant annual operating costs. Additionally, it can be concluded that, of the facilities that currently have a pollution prevention plan, roughly 39% have had to expend resources for capital improvements to meet the requirements of the regulations.

The answers to the cost questions were grouped in order to be able to conveniently analyze the results. First the costs for the pollution prevention plan development were placed in the ranges of less than $1000, $1001 to $5,000; $5,001 to $10,000; $10,001 to $25,000; $25,001 to $50,000; $50,001 to $100,000 and over $100,000. Additionally, the capital costs of physical improvement were grouped in the same ranges. Because of the lower costs associated with annual operating costs, different ranges were used for this component, namely: less than $100; $101 to $500; $501 to $1,000; $1,001 to $2,500; $2,501 to $5,000; $5,001 to $10,000 and greater than $10,000. Results of these distributions are presented in histograms on the three following pages.

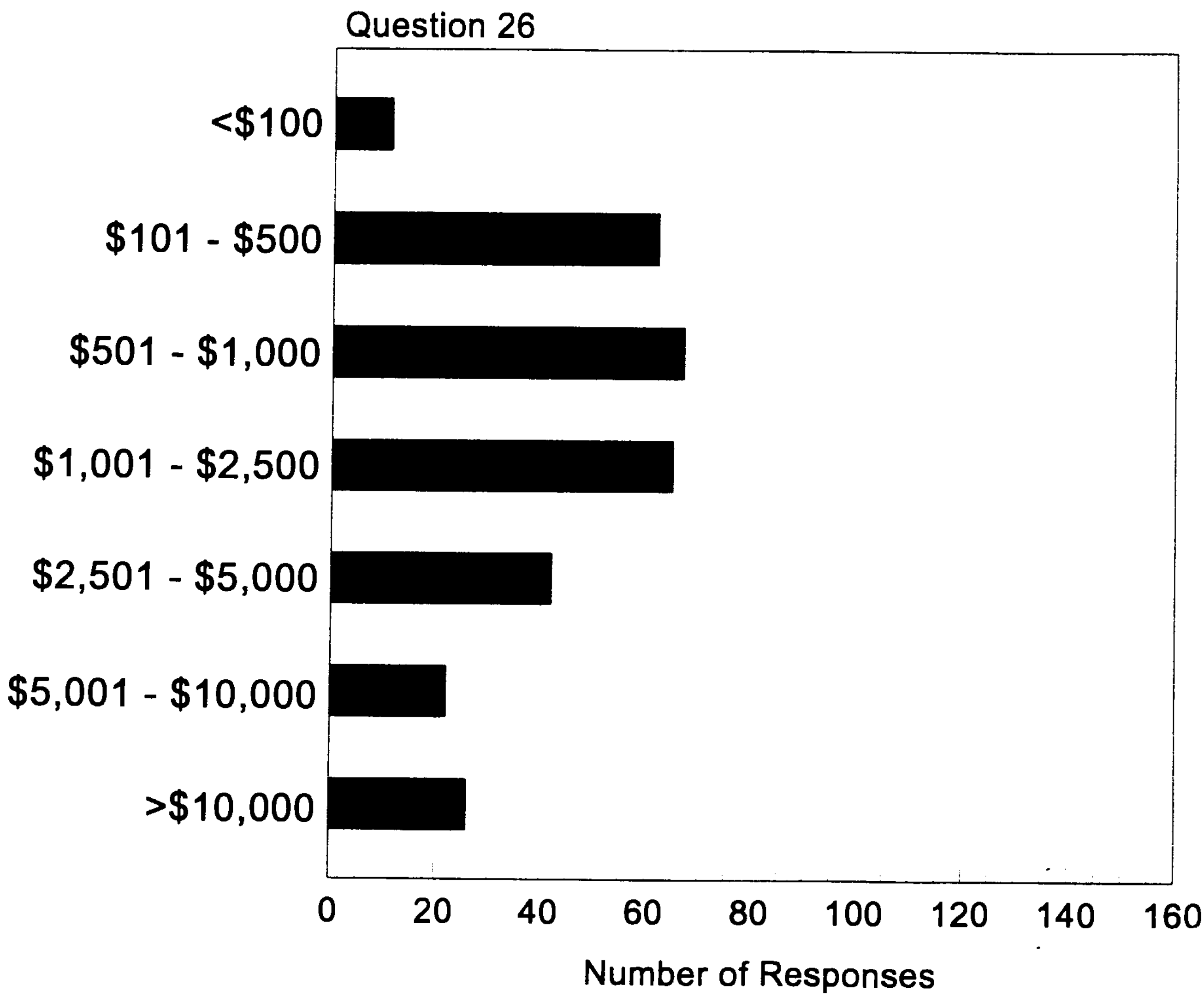
The range of costs for plan development having the highest frequency of selection, (the mode of the distribution) was between $1,000 and $5,000. This cost range represented 45.5% of the respondents. It is interesting to note that 67.2% of the survey spent less than $5,000 on plan preparation and 81.5% spent less than $10,000.

In reviewing the annual operating costs, it was determined that the vast majority of facilities (69.5%) incur annual operating costs of less that $2,500 per year. However, when adding the small number of facilities which have a very high annual operating cost, the average becomes $4,105.

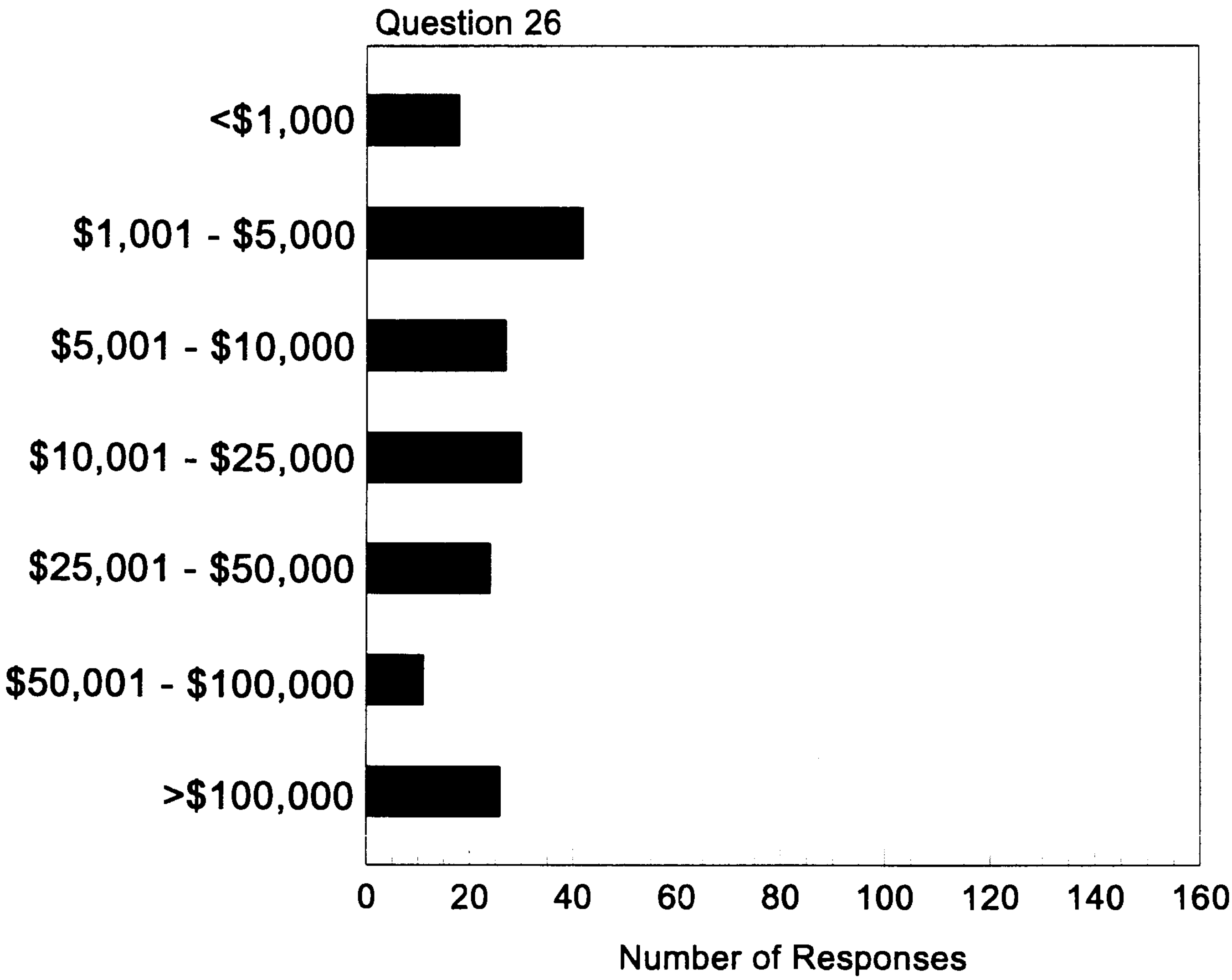
Cost of Plan Development



Plan's Implementation Annual Operating Cost



Capital Cost of Physical Improvements



It appears that roughly 39% of the facilities that have a plan had to expend resources for capital improvements to meet the regulation requirements. The capital costs of physical improvements have a trimodal statistical distribution. There were 33.7% of the facilities which reported spending less than $5000, another 45.4% spent between $5,000 and $50,000 while 20.7% spent over 50,000. Although it can be seen that almost 80% of the facilities spent less than $50,000; the average cost was $89,030, which was heavily influenced by the 22 facilities that spent over $100,000 on capital improvements. The latter group averaged $602,727.

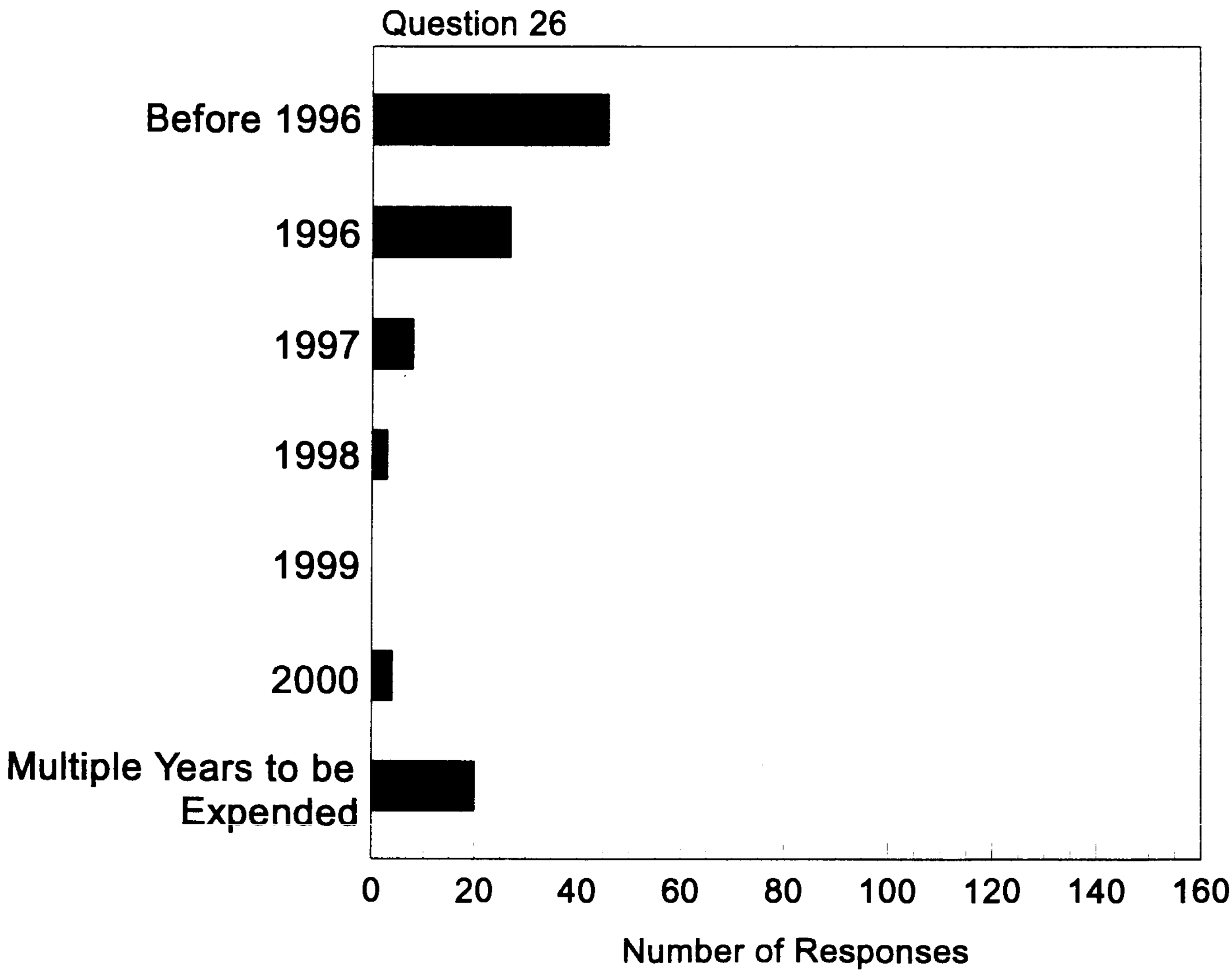
The year(s) in which the resources were either expended or planned to be expended were grouped as "before 1996" and each year from 1996 through the year 2000. However, an additional group was included to address expenditures taking place over multiple years. The numbers falling into each year are presented in the graph entitled "Year (Planned To Be) Expended". Most of the expenditures given by the respondents were in 1996 (25.0%) and before (42.6%). Only 10.5% gave cost expected to be incurred in the future and most of those were planned for 1997. Approximately 18.5% had multiple year investments.

The types of physical improvements were widely distributed primarily because the respondents were given the freedom to describe the improvements using their own terminology. But, for analysis purposes, they were grouped into the following categories: ponds and other containment structures; improved drainage, grading and erosion control, covered structures and improved storage; berms, dikes, and diversion of runoff; improved maintenance; pumping and treatment; and other physical improvements. The frequency distribution of "types of physical improvements" is presented in the histogram with the same title.

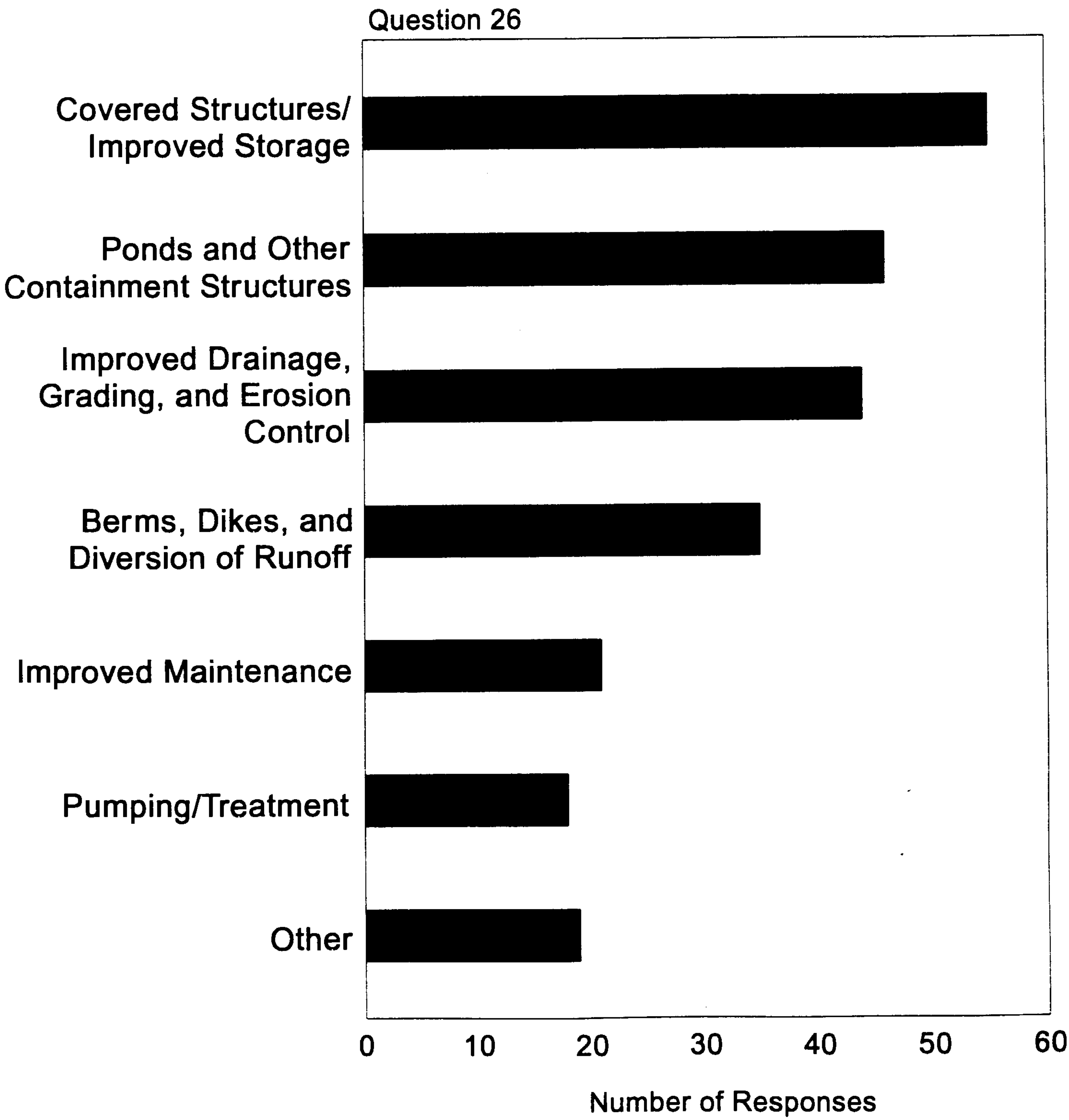
The most frequently selected type of storm water control construction project involved building covered structures and improving storage of materials and products (23.1%). The next most frequently used physical improvements were ponds and other containment structures (19.3%), followed closely by improved drainage, grading and erosion control (18.5%). The final most frequently used controls were berms, dikes and diversion structures (14.7%). Treatment was the least frequently used type of improvement and only 7.6% of the respondents employed this method of control.

Question 27 asked "Do you believe that the improvement or potential improvement in water quality is worth the corresponding expenditures?" The choices of answers were; yes, no and maybe. The purpose of this question was to obtain a subjective evaluation of whether or not those being regulated feel the storm water pollution control efforts are a worthwhile expenditure of pollution control funds. The responses to this question were about evenly split. Of the 443 respondents to this question, 30.5% said yes the improvements were worth the expenditures, 31.1% said no, they were not, and another 31.6% said maybe. The remaining 6.8% said they didn't know. The results are presented in a pie diagram with basically the same title as the question.

Year (Planned to Be) Expended

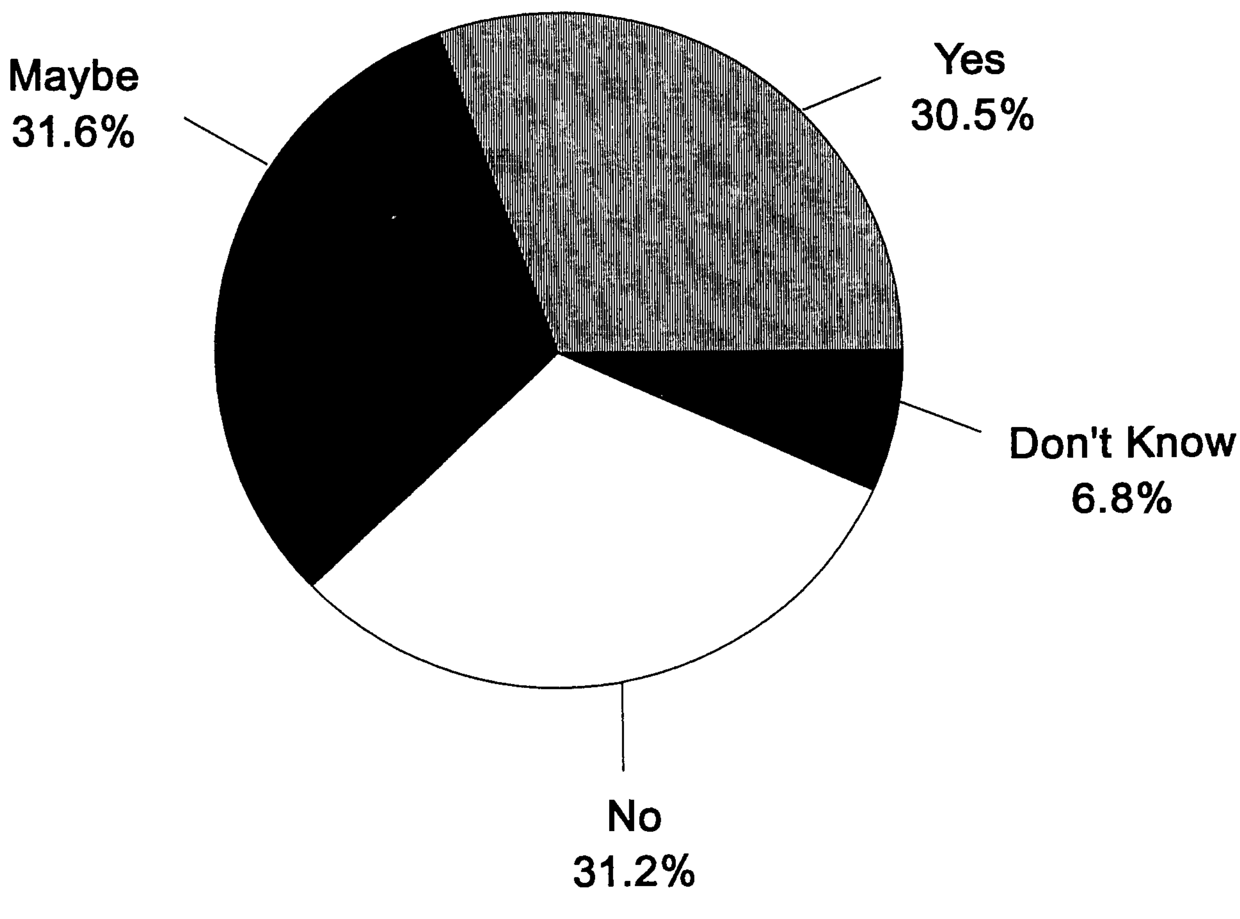


Types of Physical Improvements



R0016825

Is the Improvement or Potential Improvement in Water Quality Worth the Corresponding Expenditures?



Question 27

R0016826

In order to get a better understanding of how much expense was involved for those firms which felt water quality improvements were worth the expenditures versus those which did not, an analysis of the amount spent by firms on plans, annual operations, and construction was made. This was done by correlating those answering yes to Question 27 with the costs gathered in Question 26, and then correlating those answering no to Question 27 with the costs in Question 26.

Those in the group that felt it was a worthwhile expenditure spent an average of $6,466 on the preparation of their pollution prevention plan, had an average of $3,324 per year annual operating cost, and had expended an adjusted average of $ 47,186 in capital improvements. The latter figure was adjusted by excluding three facilities which reported to have spent $1,000,000; $1,400,000 and $4,000,000 in capital improvements. These figures are so overwhelmingly large when compared to those which fell in the normal distribution range that including them would increase the average spent by 340% to $160,436. The latter figure is clearly not representative for this analysis.

Those in the group which said it was not worth the expense spent an average of $7,537 to prepare a pollution prevention plan, had an average of $ 4,813 per year annual operating cost, and had expended an average of $ 46,873 in capital improvements. The latter figure excluded one facility as an anomaly significantly outside of the normal range which reported to have spent $800,000 in capital improvements. If it were included, it would bring the average spent to $61,589.

As can be seen, there is little difference in opinion regarding the worthwhile benefits based on the amount the respondents had to pay to improve water quality. Those who felt it was not worthwhile spent an average of $1,071 or about 16.5% more on the preparation of their pollution prevention plans than those who didn't feel it was worthwhile.

An interesting side analysis revealed 85.5% of the 138 respondents who felt it was not worth the expense provided costs, while only 70.4% of the 135 respondents who felt it was worth it didn't provide any costs. The latter analysis seems to indicate that if there were no costs or the costs were so low as to be insignificant or not memorable, the improvement in water quality was worth the expense.

In addition, the annual operating costs for those who felt it was not worthwhile was $1,489 per year or 45% more than those who felt it was worth it. In this case, 73.9% of the respondents who stated that the costs were not worth the expenditures provided costs, while only 61.5% of those who said it was worth the expense provided costs. Again, this seems to indicate that those without annual operating expenses found the improvement in water quality was worth the cost.

In the last category, that of capital improvements, the average capital cost of improvements of those who felt the improvement in water quality was a worthwhile expenditure was for all practical purposes the same as the cost for those who did not feel it was worthwhile. There was less than 1% difference in the average amount spent. In addition almost an equal number who said it wasn't, 51 (37.0 %), provided cost data as did the ones who said it was, 56 (41.5%). The facilities with the three highest expenditures, each over $1,000,000; all felt that the improvement in water quality was worth the corresponding expenditure.

One possible conclusion of this analysis is that costs in the range of $6,466, $3,324, and $47,186 for plan development, annual operating and maintenance, and capital improvements, respectively, are generally felt to be worthwhile expenditures to reduce pollution from storm water runoff and costs in the range of $7,537 for a storm water pollution prevention plan and $ 4,813 per year annual operating costs are not. In actuality, the opinion on whether it is worthwhile or not may be based more on the improvement or lack of improvement in water quality rather than the expense.

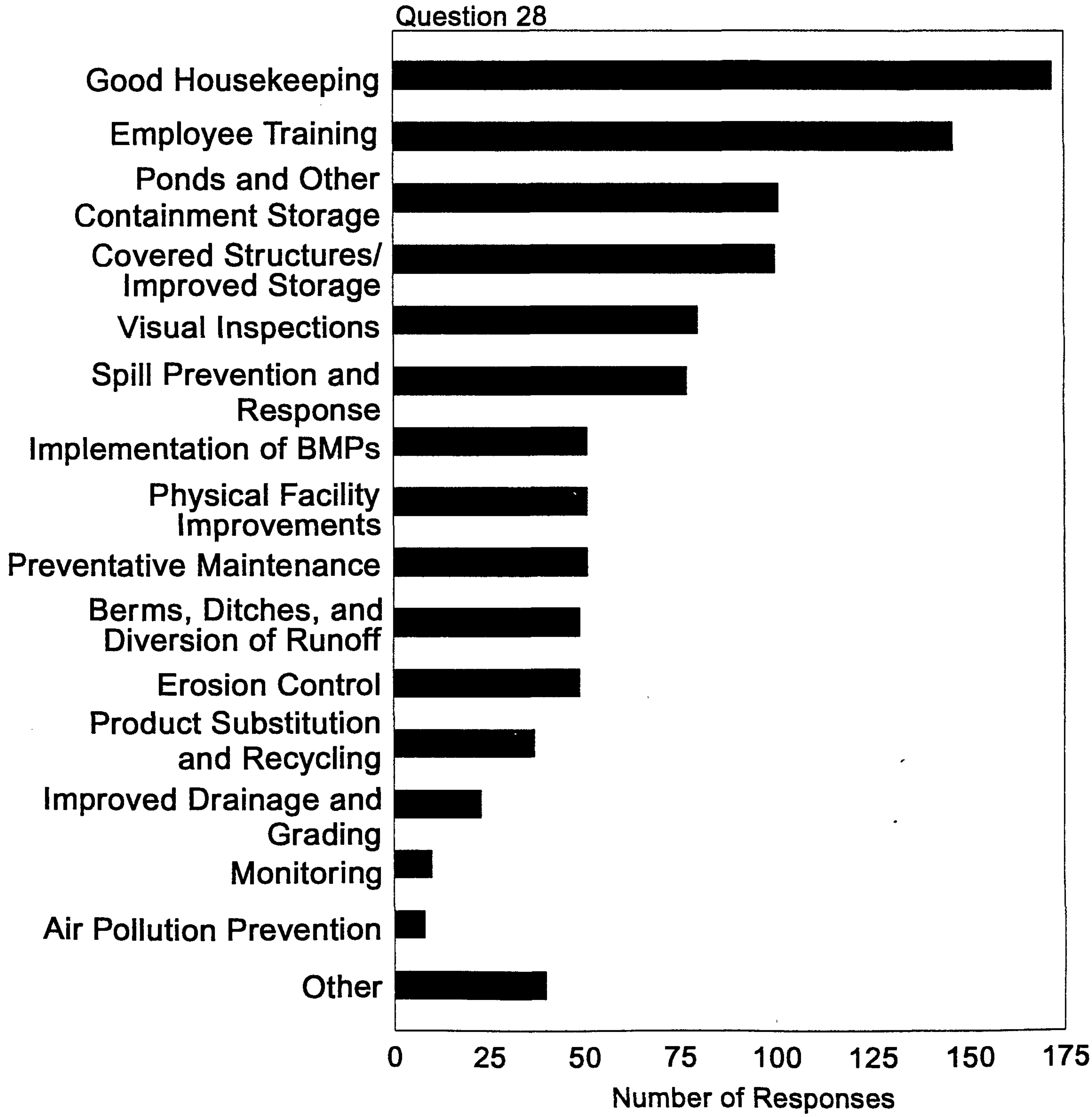
The effectiveness question was then broadened to include all actions taken to improve storm water quality and the cost factor was also brought into the analysis. Question 28 asked "What do you consider to be the three most cost effective activities that the facility has implemented or plans to implement to control storm water pollution?" The answers to this question were left wide open, i.e. the respondent was asked to simply fill in those three items which they felt to be most cost effective using whatever terms best suited the individual. The latitude permitted in terminology used to respond to this question made analysis of the results somewhat difficult. Nevertheless, groups of actions were formulated and these were analyzed. A total of 391 responded to this question.

Two major categories of activities logically evolved from the data. The first group parallels the elements of the facilities pollution prevention plan, namely: good housekeeping, preventative maintenance (of the facilities and equipment), erosion control, visual inspections, product substitution, and physical facility improvements. The second group includes specific physical facility improvements plus other miscellaneous activities. These include: ponds and other containment structures; improved drainage, grading and erosion control, covered structures and improved storage; berms, dikes, and diversion of runoff; monitoring; air pollution prevention; implementation of best management practices; and other. The frequency of selection is presented in the histogram on the following page.

The two most frequently occurring responses which industries identified as the most cost effective activities implemented to control storm water pollution were good housekeeping and employee training. These two activities, which are both critical components of a storm water pollution plan, were observed to be selected over 50% more frequently than the next two responses. The next two most frequently chosen responses both fell into the structural improvements group. These facility improvements included construction of ponds and other containment structures and improvement of storage including installation of covered storage facilities.

The next most cost effective activities, which were about 20% less frequently selected than the structural improvements described above, were two more components found in

Most Cost Effective Activities to Control Storm Water Pollution



R0016829

the typical storm water management plan. These were visual inspections and spill prevention and response activities.

While it is important to know what industry management feel are the most cost effective activities that have been implemented to control storm water pollution, it is equally important in evaluating the effectiveness of the storm water permit program to determine how many of these controls were in place prior to being required by the program.

Question 29 asked "Which of the above items were in place prior to or independent of the requirements of the storm water program?" The choices of answers were based on the responses to Question 28, that is the respondent was asked to identify each of the items in place prior to the requirements by placing a mark beside the item listed. The selections were item #1, item #2, item #3 and none. There were 397 respondents to this question. The selections are presented in the histogram entitled " Items in Place Prior to or Independent of the Requirements."

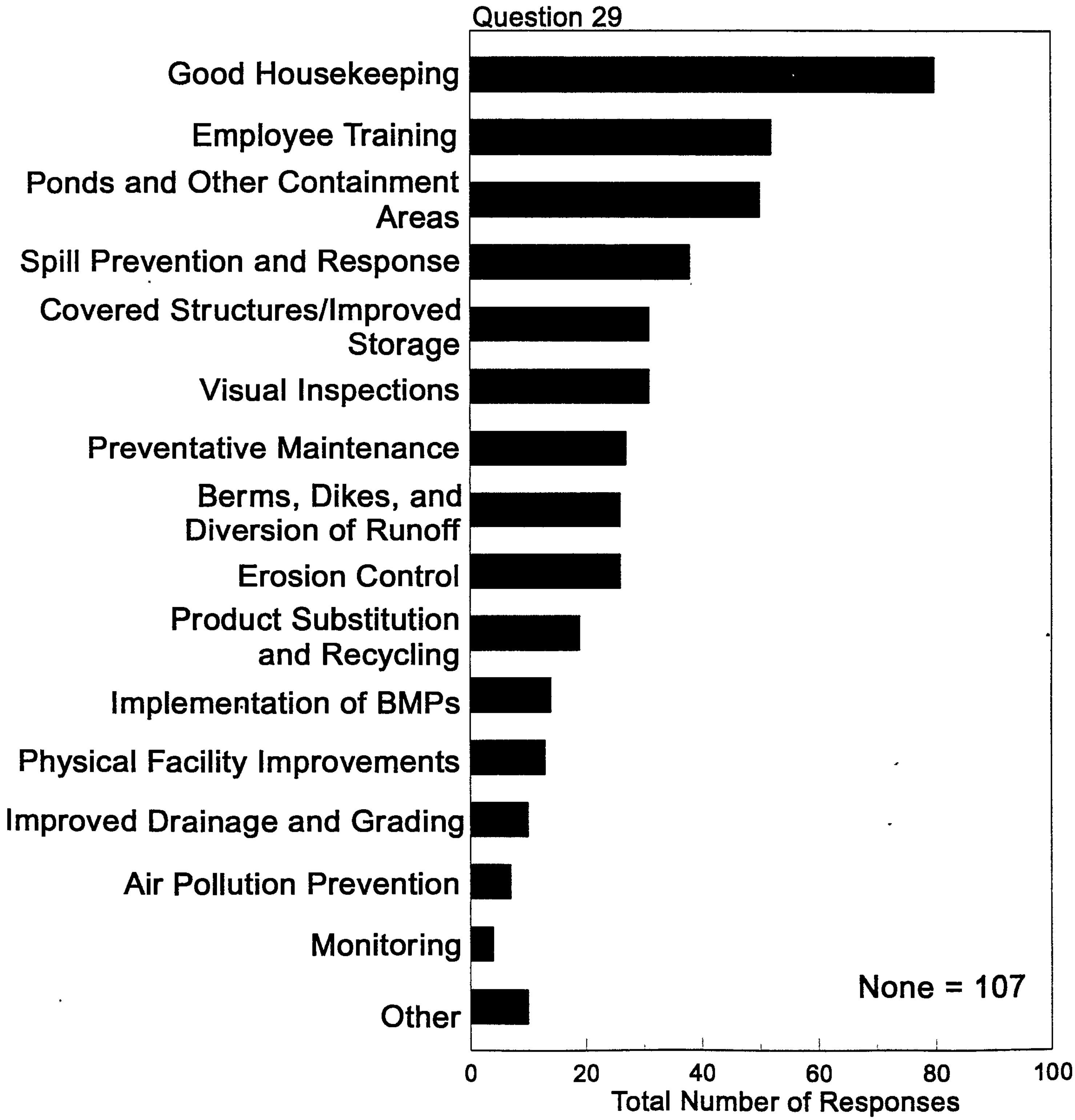
The data indicate the majority of industrial facilities (63.0%) already had instituted some level of storm water management activities even before they were required to do so by the permit program. However, in analyzing the data further, it can be concluded that a very low percentage of the most cost effective activities were in place prior to the storm water program. Specifically, 27.0% of the respondents indicated that <u>none</u> of the improvements were in place prior to the storm water permit program requirements; 18.3 % of the facilities had implemented good housekeeping practices; 11.9 % had implemented employee training, 11.4 % had implemented structural controls such as ponds and containment structures, 7.1 % had already constructed improved storage facilities, 7.1 % had instituted visual inspections and 8.7 % had spill prevention and response procedures.

There are two, not totally contradictory, ways of looking at the analysis of these data. It can be concluded that the majority of the industrial activities already had instituted some level of storm water management before they were required to do so by the NPDES permit program. It can also be concluded that a significant percentage of industries had no previous motivation to implement storm water pollution prevention techniques prior to the program.

Additionally, it can be seen from the data that about an equal number (53.4 %) of industrial activities had implemented nonstructural solutions to storm water problems as had constructed facilities to control storm water pollution (46.6%). This seems to indicate that as many operations had to construct facilities to comply with other regulations as had to implement the best management practices recommended in the storm water pollution prevention plans.

The next logical item to determine was which techniques are perceived to be the least cost effective. Question 30 asks "what do you consider to be the three least cost effective activities that the facility has implemented or plans to implement to control storm water pollution." As with Question 28, the respondent was asked to simply fill in those three

Items in Place Prior to or Independent of the Requirements



R0016831

items which they felt to be least cost effective using whatever terms best suited the individual. A total of 248 responded to this question and the results are presented in the histogram entitled "Least Cost Effective Activities to Control Storm Water Pollution."

By far the single largest response to this question and therefore the perceived least cost effective activity of the program is monitoring, or sampling and analysis. It appears that either the costs associated with monitoring are too high or the information derived from sampling and analysis is perceived as being of little value to effectively reducing storm water pollution. This is a consistent observation since no one listed monitoring or sampling and analysis among the top three most cost effective activities.

The second most frequently listed least cost effective activity of the storm water permit program was record keeping and reporting. This is consistent with the responses to Question 25 which showed that reporting and record keeping was the most frequently selected "ineffective" component of storm water pollution prevention plans by the majority of respondents.

Other activities considered to have low cost effectiveness include planning and mapping, visual inspections, and permits, fees and costs. A few respondents felt that some activities, which most people felt were highly cost effective, were the least cost effective for their facilities - namely good housekeeping and training.

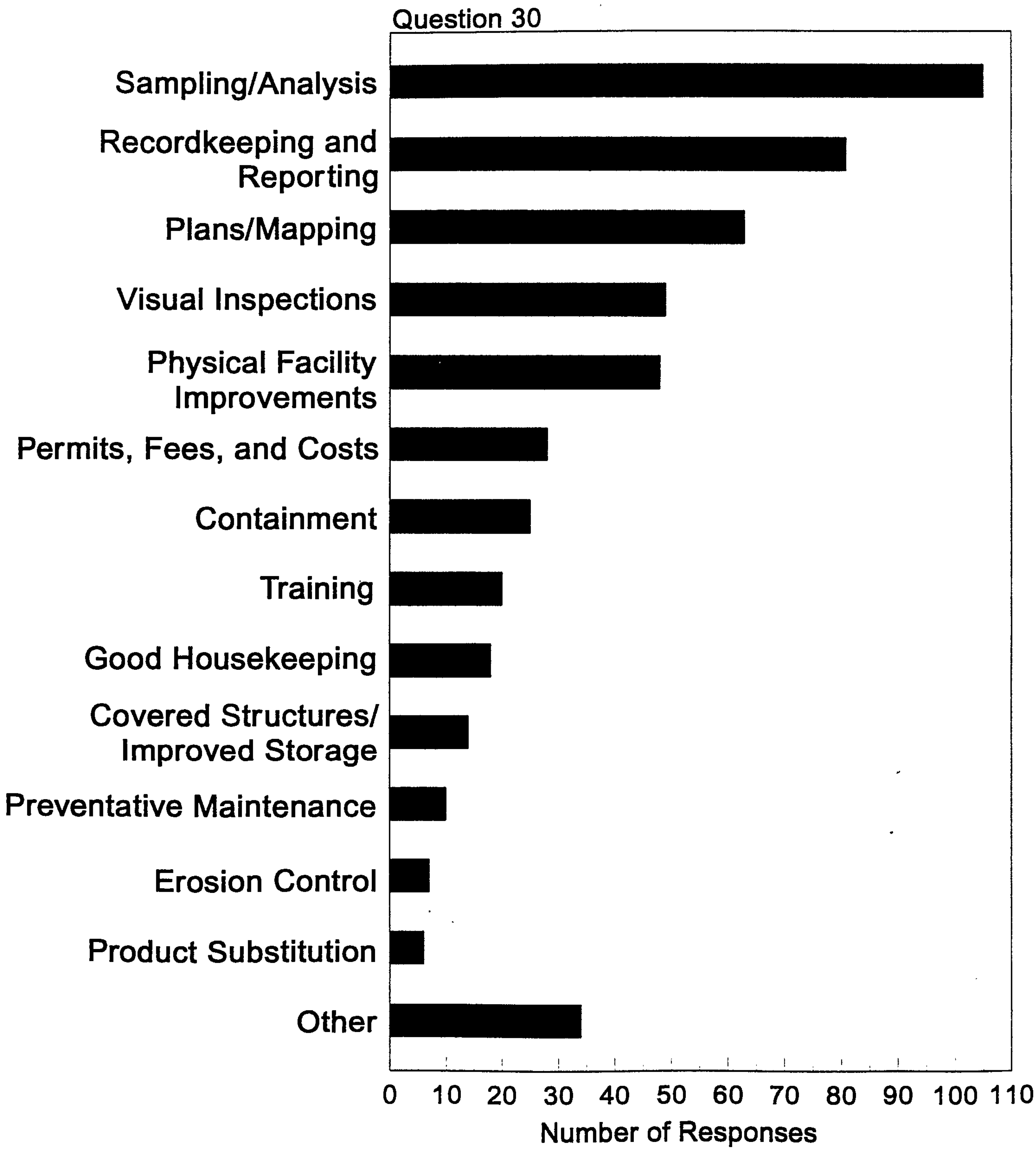
As one of the concluding questions, Question 31 asked "if you were no longer required to maintain BMP's under the storm water permit program, how much of the plan would you continue to implement?" The choices given were; all of it, some of it and none of it. A pie chart identified with the question as the title displays the results.

Of the 432 respondents to this question 42.8% said that they would retain the plan in its entirety, while 52.3% said they would retain some of it. It is interesting to note that only 4.9% or 26 respondents stated that they would retain none of it.

The follow-up question to this, Question 32, asked "if some, which would you retain?" Three blank lines were provided for the respondent to write the answer(s). The responses to this question followed very closely those of Question 25 and to some extent Question 28, relating to the most cost effective components of the pollution prevention plan and the most cost effective activities, respectively. A histogram entitled "If Voluntary, Which Practices Would Be Continued ?" presents the results. Again good housekeeping, inspections, employee training, spill prevention and response, and preventative maintenance were the leading answers.

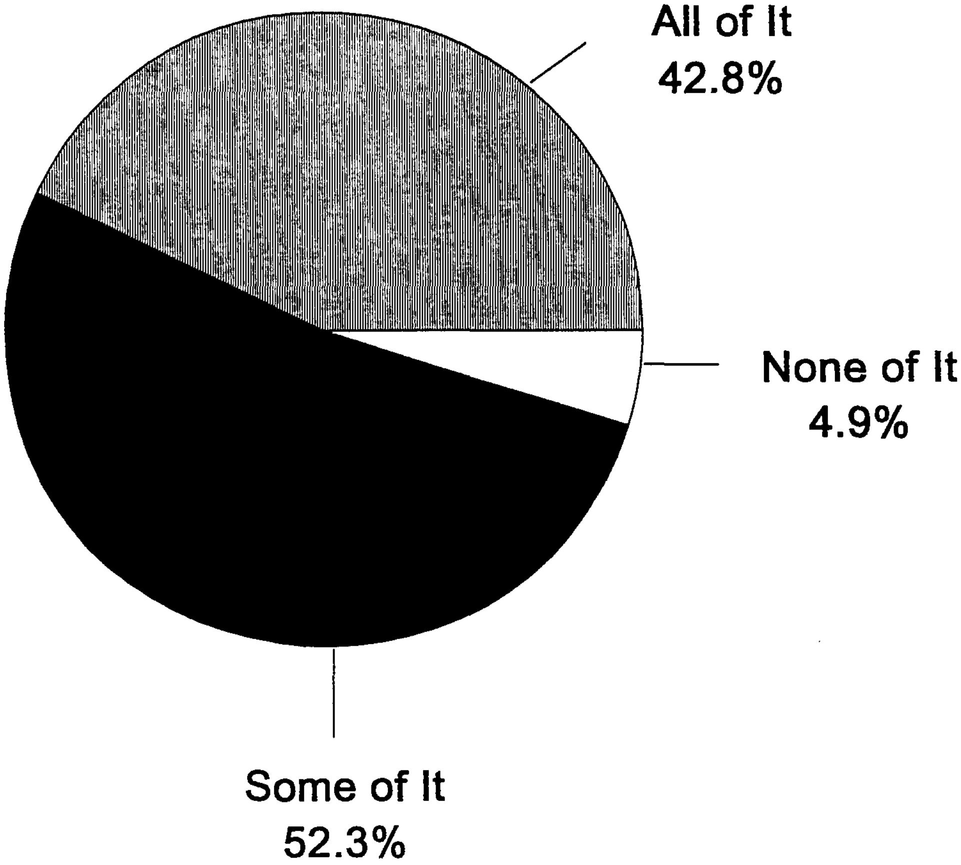
Question 33 then asks "If all or some of the plan would continue to be implemented, what are the main reasons?" The list of choices given were: required by other regulations, economic/production benefit, environmental benefit, corporate policy/procedures, and other (specify). A total of 410 industrial activities responded to this question by selecting

Least Cost Effective Activities to Control Storm Water Pollution



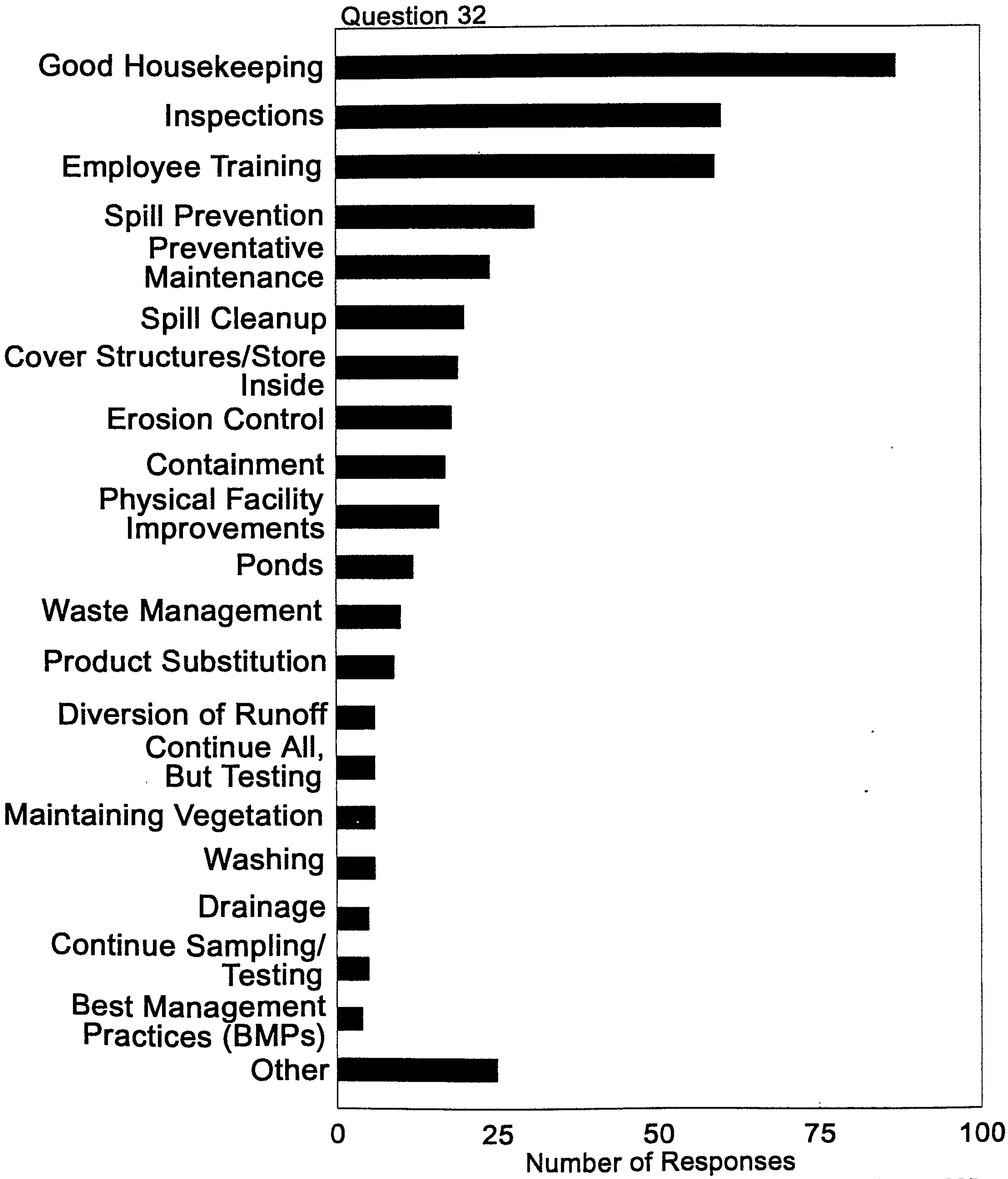
R0016833

How Much of the Plan Would be Voluntarily Implemented if BMPs Were No Longer Required?



Question 31

If Voluntary, Which Practices Would Be Continued?



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one or more from the list of choices. A histogram entitled "Reasons for Implementation of All or Some of the Plan" presents the results.

The most frequently selected choice was "environmental benefits" chosen by 80.0 % of the respondents. This was followed by "corporate policy/procedures" chosen by 59.0% and "required by other regulations" chosen by 46.3%. Substantially below this range of selected reasons were "economic benefits" selected by 23.7%. And at the lowest level were "public relations" with 2.2 % and "other" with 5.6%. It should be noted that "public relations" was not one of the given choices so it had to be filled in by the respondent.

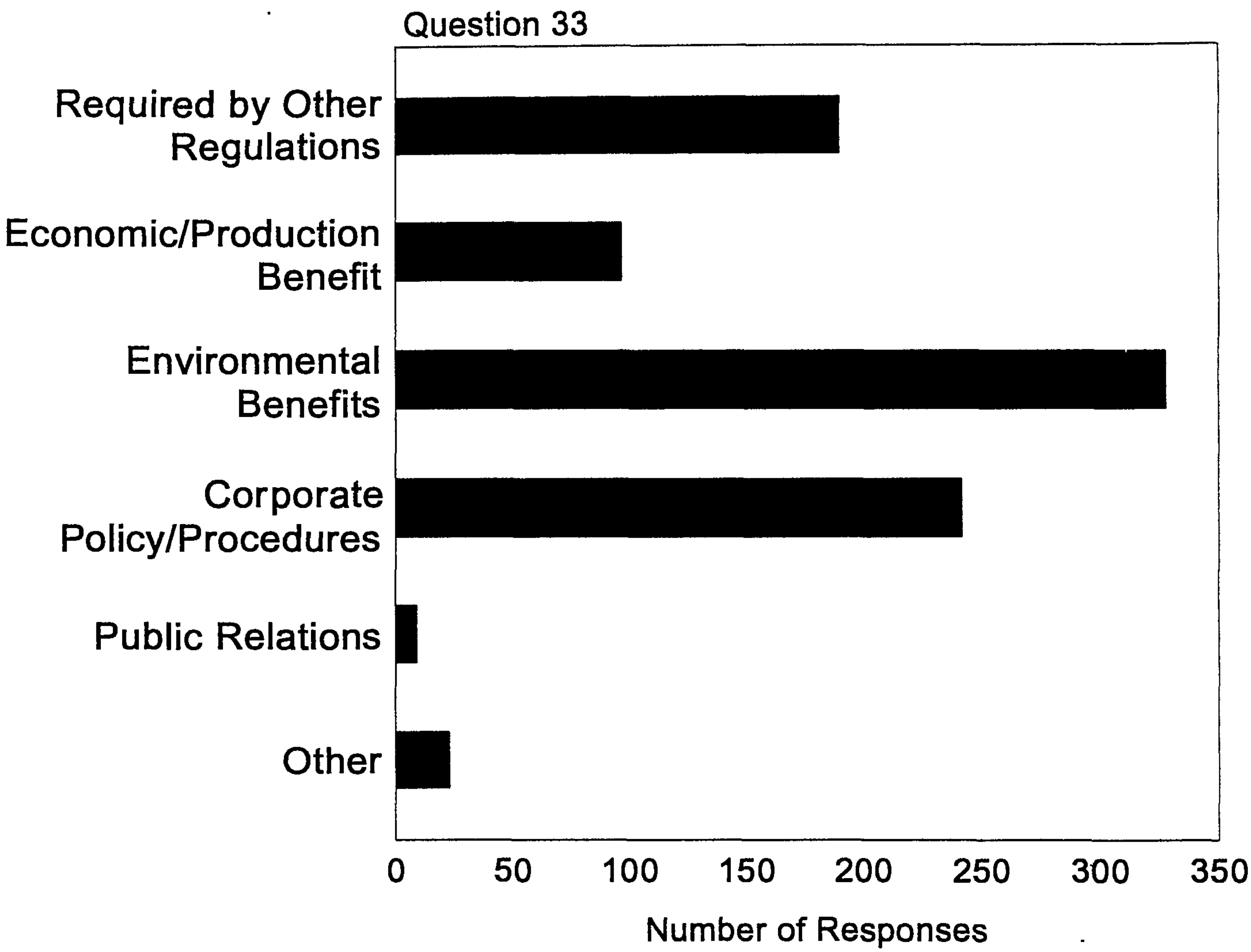
The final two questions requested the questionnaire recipients to comment. Question 34 asked "do you know of any significant obstacles which have prevented the general permits approach from being an effective component of the storm water program?" and Question 35 asked "any comments?" There were a few hundred responses to these questions, some of the most relevant of which are summarized below. An attempt was made not to repeat information which may have already been gathered in response to other questions contained in the survey.

Significant obstacles which prevent the general permits program from being effective include: costs to implement; no follow-up (i.e. lack of field inspections and enforcement); regulations are complex, confusing and burdensome; infrequent rainfall, and lack of company management concern.

A summary of other comments received includes: hassle for small businesses, redundant with other requirements, other companies and sources cause more pollution, remote and small sites should not be controlled, high costs and low water quality improvements.

The final conclusions and recommendations of the study are presented in the Executive Summary.

Reasons for Implementation of All or Some of the Plan



Appendix

January 26, 1996

Dear,

The Water Environment Federation (WEF) is a nonprofit scientific and technical organization devoted to the preservation and enhancement of water quality worldwide. WEF has cooperative agreement with the United States Environmental Protection Agency to study the effectiveness of the National Pollutant Discharge Elimination System (NPDES) Industrial Storm Water Permit Program. Under the Program, affected industries are required to develop Storm Water Pollution Prevention Plan to control the impact of storm water at their facilities. In this study, WEF is determining how well the pollution prevention plan approach is working. The overall objective of the study is to improve storm water regulations and reduce the burden on business and industry; it is **not** to use the information for compliance or enforcement purposes.

WEF, in conjunction with a number of affected industries and trade associations, had developed the enclosed questionnaire to gather information critical to the study. Due to the size and complexity of the storm water program, we are sending this questionnaire to a very limited percentage of those included in the permit program. Because our mailing is limited, we need **everyone's** help. We understand that your time is valuable, but we hope you will take fifteen minutes to complete this survey to help improve Storm Water Program, ultimately for your own benefit. If you are the best person to respond, please complete the survey as thoroughly as possible. If you know nothing about the storm water program, please forward the questionnaire to someone at your facility who does. We ask that you return the survey in the enclosed return envelope by **Friday, February 16, 1996.**

In trial survey, several companies expressed concern over anonymity. We assure you that your responses will be kept confidential by WEF, and your anonymity will be preserved. An outside firm had been contracted to handle the data and compile the final report. However, if you wish to receive a copy of an executive summary of the results, be sure to identify your firm on the separate request form provided in this mailing. You will receive a summary only if you complete the survey and identify your firm's name and mailing address.

Thank you in advance for your cooperation in this important effort. If you have any questions about the project, please feel free to include them in your response.

Very truly yours,

William R. Hancuff

Water Environment Federation®

Preserving & Enhancing the Global Water Environment

January 26, 1996

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Very truly yours,

William R. Hancuff

R0016840

Effectiveness of Industrial Storm Water Program Industry Questionnaire

MARKING INSTRUCTIONS
- Use a No. 2 pencil only, do NOT use pen.
- Completely erase any mark you change.
- Marks should completely fill in the squares.
- Make no stray marks.

CORRECT MARK ■

This survey is completely confidential. Please complete and return the enclosed survey in the prepaid envelope by **February 16, 1996**. Thank you for your help.

1. What is the primary and secondary standard industrial classification (SIC) code for your facility? Enter the SIC code in the box and fill in the corresponding squares in each column.

Primary ☐☐☐☐ Secondary ☐☐☐☐

Primary					Secondary				
0	☐	☐	☐	☐	0	☐	☐	☐	☐
1	☐	☐	☐	☐	1	☐	☐	☐	☐
2	☐	☐	☐	☐	2	☐	☐	☐	☐
3	☐	☐	☐	☐	3	☐	☐	☐	☐
4	☐	☐	☐	☐	4	☐	☐	☐	☐
5	☐	☐	☐	☐	5	☐	☐	☐	☐
6	☐	☐	☐	☐	6	☐	☐	☐	☐
7	☐	☐	☐	☐	7	☐	☐	☐	☐
8	☐	☐	☐	☐	8	☐	☐	☐	☐
9	☐	☐	☐	☐	9	☐	☐	☐	☐

2. Concerning industrial storm water run-off, how many facilities are under your responsibility? Enter the number of facilities in the box and fill in the corresponding squares in each column.

☐☐☐☐

0	☐	☐	☐	☐
1	☐	☐	☐	☐
2	☐	☐	☐	☐
3	☐	☐	☐	☐
4	☐	☐	☐	☐
5	☐	☐	☐	☐
6	☐	☐	☐	☐
7	☐	☐	☐	☐
8	☐	☐	☐	☐
9	☐	☐	☐	☐

NOTE: If you are responsible for more than one facility, answer the following questions based on only one (your primary) facility.

3. What is the size of this facility? ____________

Estimated number of full-time employees? ________

Estimated acreage of this facility? ____________

Number of environmental staff? ____________

4. Is the facility property -

☐ Owned
☐ Leased

5. Is your company categorized as a small business?

☐ Yes
☐ No
☐ Don't know

If yes, why? ____________

____

6. Does storm water run off this property? **Mark all that apply.**

☐ **Ditches**
☐ Trenches
☐ **Pipes**
☐ Other Point Sources (specify) ____________
☐ **Only Surface Flow (no point sources)**

7. What is the average annual rainfall at your location? **Mark only one.**

☐ 0-10"
☐ 11-20"
☐ 21-30"
☐ 31-40"
☐ 41-50"
☐ >50"

8. Is this facility required to meet the reporting requirements of EPCRA Section 313 regarding "water priority chemicals"?

☐ Yes
☐ No
☐ Don't Know

9. Do you have a storm water related pollution prevention plan for this facility?

☐ Yes
☐ No
☐ Don't Know

If the answer to Question 9 is **no or don't know**, please continue by completing **Section A.**
If the answer to Question 9 is **yes**, please complete **Section B** (go directly to Question 16).

R0016841

Section A

To be completed if the facility **does NOT** have a Pollution Prevention Plan

10. Is your facility regulated by the storm water permit program?

- ☐ Yes
- ☐ No
- ☐ Don't Know

11. Did you or will you modify your facilities in order to eliminate the need for compliance with regulations?

- ☐ Yes
- ☐ No

12. If the answer to Question 11 is **yes**, how much did it or will it cost? In what year?

Cost ____________

Year ____________

If the answer to Question 10 was **no or don't know,** please return the survey in the enclosed envelope. Thank you!

13. If your facility is regulated by a storm water permit program, who is the lead permitting authority?

- ☐ Environmental Protection Agency - Region # ______
- ☐ State of ____________
- ☐ Local government authority (specify) ____________
- ☐ Other (specify) ____________

14. Why have you not prepared a storm water pollution prevention plan? **Mark all that apply.**

- ☐ Meets storm water limits under existing NPDES permit
- ☐ Not required at this time
- ☐ Discharges to a municipal collection system
- ☐ No storm water contact with regulated industrial activities
- ☐ Submitted Notice of Intent
- ☐ Did not know it was required
- ☐ Requirements are too confusing
- ☐ Other (specify) ____________

15. Any comments? ____________

____

____

Thank you! Please return the survey in the enclosed envelope.

Section B

To be completed if the facility **has** a Pollution Prevention Plan.

16. Who is the permitting authority for this facility's storm water permit?

- ☐ Environmental Protection Agency - Region # ______
- ☐ State of ____________
- ☐ Local government authority (specify) ____________
- ☐ Other (specify) ____________

17. Prior to the Storm Water Permit Program, did this facility have any experience with either voluntary or regulation required pollution prevention plans that directly affected storm water?

- ☐ Yes
- ☐ No

18. Does this facility's storm water pollution prevention plan overlap with other mandated requirements?

- ☐ Yes
- ☐ No
- ☐ Don't Know

If yes, which requirements?

- ☐ **Best Management Practice Plan (Clean Water Act-Nonpoint Source)**
- ☐ Waste Minimization Plan (CERCLA/SARA)
- ☐ **Spill Prevention Control & Countermeasures (SPCC) Plan (Clean Water Act & RCRA)**
- ☐ Other (specify) ____________

19. How was this facility's storm water pollution prevention plan developed? **Mark all that apply.**

- ☐ **Facility staff**
- ☐ Corporate staff
- ☐ **External consultant**

- ☐ **Used trade association guidance**
- ☐ Used EPA guidance document
- ☐ **Used State Agency guidance**

- ☐ **Adapted model plan supplied by company or corporate office**
- ☐ Adapted standard operating procedures from company
- ☐ **Adapted from another pre-existing plan**
- ☐ Other (specify) ____________

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20. How long has the storm water pollution prevention plan been implemented?

☐ Not implemented
☐ < 1 year
☐ 1 year
☐ 2 years
☐ > 2 years

21. Has water quality monitoring and analysis been performed on the storm water runoff from this facility?

☐ Yes
☐ No
☐ Don't Know

22. If yes, in your opinion, did results indicate whether Best Management Practices (BMPs) are successful?

☐ Yes
☐ No
☐ Insufficient data
☐ Inconclusive data

23. Whether you have conducted water monitoring or not, in your opinion, how much improvement in water quality or reduction in storm water pollution has there been or is there likely to be as a result of your storm water (or other) plan?

☐ None
☐ Minor
☐ Moderate
☐ Significant
☐ Don't Know

24. Was or is any improvement to the water quality or reduction in storm water run-off possible?

☐ Yes
☐ No

25. Considering actual and potential benefits and based on your impression, rate the following elements of the facility's pollution prevention plan as to their effectiveness in preventing pollution from storm water runoff.

	Highly Effective	Moderately Effective	Not Effective	Not Applicable
Good housekeeping	☐	☐	☐	☐
Preventative maintenance	☐	☐	☐	☐
Elimination of industrial source discharges	☐	☐	☐	☐
Sediment and erosion control	☐	☐	☐	☐
Visual inspections	☐	☐	☐	☐
Spill prevention and response	☐	☐	☐	☐
Site mapping (operations, drainage, and runoff collection mapping)	☐	☐	☐	☐
Employee training	☐	☐	☐	☐
Record keeping and reporting	☐	☐	☐	☐
Raw material or product substitution	☐	☐	☐	☐
Annual site compliance evaluation	☐	☐	☐	☐
Physical facility modification (requiring construction)	☐	☐	☐	☐
Other (specify) ________	☐	☐	☐	☐

26. How much did the development and implementation of this facility's storm water pollution prevention plan cost.

Cost of plan development $________________

Plan's implementation annual operating cost $________

Capital cost of physical improvements $____________

Year (planned to be) expended ____________

Types of physical improvements ____________

____

27. Do you believe that the improvement or potential improvement in water quality is worth the corresponding expenditures?

☐ Yes
☐ Maybe
☐ No
☐ Don't Know

28. What do you consider to be the three **most** cost effective activities that the facility has implemented or plans to implement to control storm water pollution?

1. ______________________________
____

2. ______________________________
____

3. ______________________________
____

29. Which of the above items were in place prior to or independent of the requirements of the storm water program? **Mark all that apply.**

☐ None
☐ 1 above
☐ 2 above
☐ 3 above

30. What do you consider to be the three **least** cost effective activities that the facility has implemented or plans to implement to control storm water pollution?

1. ______________________________
____

2. ______________________________
____

3. ______________________________
____

31. If you were no longer required to maintain BMP's under the storm water permit program, how much of the plan would you continue to implement?

☐ All of it
☐ Some of it
☐ None of it

32. If some, which practices would you continue?

____
____
____

33. If all or some of the plan would continue to be implemented, what are the main reasons? **Mark all that apply.**

☐ Required by other regulations
☐ Economic/production benefit
☐ Environmental benefits
☐ Corporate policy/procedures
☐ Other (specify) ______________

34. Do you know of any significant obstacles which have prevented the general permits approach from being an effective component of the storm water program?

____
____
____

35. Any comments? ______________________________
____
____
____
____

Thank you for taking the time to complete this survey. Please return the questionnaire and the optional executive summary request and identification form in the enclosed envelope by February 16, 1996. If the envelope has been misplaced, send it to:

K.C. Associates
1600 Newport Gap Pike
Wilmington, DE 19808

Please return the questionnaire and the optional executive summary request and identification form in the enclosed prepaid envelope.

Water Environment Federation®
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601 Wythe Street
Alexandria, VA 22314-1994 USA

R0016845

Final Report

of the

SBREFA Small Business Advocacy Review Panel

on EPA's Planned Proposed Rule for the

National Pollutant Discharge Elimination System

Storm Water Phase II

August 7, 1997

R0016846

Report of the Small Business Advocacy Review Panel

on EPA's Planned Proposed Rule for the

National Pollutant Discharge Elimination System

Storm Water Phase II

INTRODUCTION

This report describes the review by the Small Business Advocacy Review Panel convened for the proposed rulemaking by the Environmental Protection Agency (EPA) that would revise National Pollutant Discharge Elimination System (NPDES) regulations to address currently unregulated discharges of storm water. On June 19, 1997, EPA's Small Business Advocacy Chairperson convened this Panel under section 609(b) of the Regulatory Flexibility Act (RFA) as amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA). Section 609(b)(1) requires convening of a review panel prior to publication of an initial regulatory flexibility analysis that an agency is required to prepare under the RFA. In addition to its chairperson, the Panel consists of representatives of EPA's Office of Water (the EPA program office responsible for developing the rule), the Office of Information and Regulatory Affairs within the Office of Management and Budget, and the Chief Counsel for Advocacy of the Small Business Administration.

This report provides background information on the proposed rule being developed and the types of small entities that would be subject to the proposed rule, describes efforts to obtain the advice and recommendations of representatives of those small entities, and summarizes the comments, advice and recommendations that have been received to date from those representatives. The complete written comments of the representatives are attached to this report.

Section 609(b) of the RFA directs the review panel to report on the comments of small entity representatives and make findings as to issues related to identified elements of an initial regulatory flexibility analysis (IRFA) under section 603 of the RFA. Those elements of an IRFA are:

- The number of small entities to which the proposed rule will apply.
- Projected reporting, record keeping, and other compliance requirements of the proposed rule, including the classes of small entities which will be subject to the requirements and the type of professional skills necessary for preparation of the report or record.
- Other relevant Federal rules which may duplicate, overlap, or conflict with the proposed rule.

- Any significant alternatives to the proposed rule which accomplish the stated objectives of applicable statutes and which minimize any significant economic impact of the proposed rule on small entities.

Once completed, the Panel report is provided to the agency issuing the proposed rule and included in the rulemaking record. In light of the Panel report, the agency is to make changes to the proposed rule or the IRFA for the proposed rule, where appropriate.

It is important to note that the Panel's findings and discussion are based on the information available at the time this report was drafted. EPA is continuing to conduct analyses relevant to the proposed rule, and additional information may be developed or obtained during the remainder of the rule development process. The Panel makes its report at an early stage of the process of development of a proposed rule and its report should be considered in that light. At the same time, the report provides the Panel and the Agency with a timely opportunity to identify and explore potential ways of shaping the proposed rule to minimize the burden of the rule on small entities while achieving the rule's statutory purposes. Any options the Panel identifies for reducing the rule's regulatory impact on small entities may require further analysis and/or data collection to ensure that the options are practicable, enforceable, environmentally sound and consistent with the statute authorizing the proposed rule.

BACKGROUND

In 1987, Congress amended the Clean Water Act to require EPA to develop a phased regulatory program focusing on controlling contaminated discharges associated with storm water runoff.[1] In the 1987 Water Quality amendments, Congress established a tiered approach to address certain industrial, municipal, and other storm water discharges. In the first phase of the program, Congress directed the EPA and authorized States to control discharges of industrial storm water and storm water from municipal separate storm sewer systems (MS4) serving populations over 100,000, with the intent of identifying an appropriate second tier of sources following two Congressionally mandated studies.

To implement these requirements, EPA published the initial permit application requirements (Phase I) for the priority categories of storm water discharges identified by Congress.[2] Generally, Phase I sources include storm water associated with certain industrial activities, medium and large municipalities, and large construction sites. Staggered deadlines were established for permit applications for these sources, with the last of the applications scheduled for submission by May, 1993.

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[1] CWA, § 402(p).

[2] 55 FR 47990 (November 16, 1990).

To control industrial sources, Phase I regulations cover "storm water discharges associated with industrial activity" which means the discharge from any conveyance which is used for collecting and conveying storm water and which is directly related to manufacturing, processing, or raw material storage areas at an industrial plant. EPA estimates that this definition applies to approximately 100,000 facilities nationwide (U.S. EPA, 1990a). To facilitate permitting, EPA established various permit application options for industrial activity including individual permit applications and group applications. EPA and authorized States have issued (or modified) individual permits and general permits based on these respective forms of application. Large construction sites (disturbing 5 acres or greater) are regulated in Phase I as an industrial activity, but with permit requirements that differ from those applicable to other industrial discharges.

To control municipal discharges, the Phase I rule requires NPDES permits for discharges into municipal separate storm sewer systems serving populations greater than 100,000. This universe of regulated municipalities includes 173 cities and 47 counties having large unincorporated, urbanized areas. EPA regulations require that NPDES permits for municipal storm water programs regulated in Phase I include requirements to effectively prohibit non-storm water discharges into the storm sewers and controls to reduce the discharge of pollutants to the maximum extent practicable (including management practices, control techniques, and system design and engineering methods, and other provisions appropriate for the control of such pollutants).

In March 1995, EPA completed and submitted to Congress a study entitled, *Storm Water Discharges Potentially Addressed by Phase II of the National Pollutant Discharge Elimination System Storm Water Program: Report to Congress*. As required under CWA §402(p)(5), this report identified the remaining unregulated storm water discharges, which by this time were known as Phase II. The report also characterized the nature and extent of pollutants in such discharges. The Phase II storm water report identified two major classes of potential Phase II storm water discharges: discharges from municipal separate storm sewers systems not subject to Phase I regulations and discharges from individual facilities not subject to Phase I. In a document entitled, "President Clinton's Clean Water Initiative" (February 1994), EPA summarized procedures and methods to control Phase II storm water discharges sufficient to mitigate impacts on water quality. This document responded to the requirement for an additional report under CWA §402(p)(5). This document recommended that the second phase of the storm water program focus on urbanized areas because EPA concluded that the urbanized areas that were not regulated under the Phase I requirements contributed 60 percent of the pollutant loads in storm water discharged from urban areas.[3]

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[3] Phase I of the NPDES storm water program addresses 81.7 million people in portions of 136 urbanized areas. EPA estimated that 28 percent of pollutant loads in storm water discharged from urbanized areas come from those portions of these 136 urbanized areas not subject to Phase I regulations. In addition, EPA estimated that 32 percent of the pollutant loads in storm water discharged from urbanized areas come from the 269 urbanized areas not regulated under Phase I. Storm Water Phase II Report to Congress, ES-7.

In August 1995, EPA published a final rule that established a sequential application process in two tiers for the remaining unpermitted discharges of storm water (Phase II).[4] This rule allows the NPDES permitting authority to require permits for Phase II dischargers contributing to water quality impairment, and requires all other Phase II storm water dischargers to apply for NPDES permits by August 7, 2001. The August, 1995 Phase II rule was published, in part, to protect Phase II dischargers from CWA citizen suit liability in the absence of Agency action to establish more focused regulations. The preamble to the August 7, 1995 rule explained that the Phase II regulatory program would undergo further development. The Phase II rule would replace the August 7, 1995 rule.

EPA is currently subject to a court order to propose supplemental rules under §402(p)(6) of the CWA by November 25, 1997, and finalize these rules by March 1, 1999. See Natural Resources Defense Council, Inc. v. Browner, Civ. No. 95-634 PLF (D.D.C., April 6, 1995).

OVERVIEW OF PROPOSED PHASE II RULE

EPA's current draft of the proposed Phase II storm water regulation would address storm water discharges associated with two categories of sources: small municipal separate storm sewer systems (small MS4s) and construction activities at small construction sites. Under the draft proposed rule, many of these Phase II sources would be required to obtain NPDES permit coverage under an individual or general NPDES permit to address their storm water discharges.

The small MS4s that would be covered include those located within incorporated places, counties, or other places under the jurisdiction of a governmental entity (including Tribal or Territorial governments) that are located in an urbanized area but not included in Phase I.[5, 6] Also covered would be MS4s that are connected to and contribute substantially to pollutant loadings in another covered MS4. Finally, the rule would cover small MS4s in any incorporated place, county, or other place under the jurisdiction of a governmental entity that is designated by the NPDES permitting authority as requiring a permit based on the system's potential for impacting water quality. The permitting authority would be required to evaluate places outside urbanized areas that have a population density of greater than 1,000 per square mile and a population of greater than 10,000 people against specified water

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[4] 60 FR 40229 (August 7, 1995).

[5] The existing storm water regulations ("Phase I") addresses large and medium MS4s. Generally, a large MS4 includes incorporated places with populations of 250,000 or more, while a medium MS4 includes incorporated places with populations of 100,000 or more, but less than 250,000.

[6] Excluding Federal Indian Reservations located within urbanized areas and having a population of less than 1,000 persons.

quality-related criteria[7] and determine whether these require permits. In addition, the permitting authority may designate other communities as subject to permit requirements based on their contribution to water quality impairment.[8]

Under the draft proposed rule, small MS4s would develop and implement a storm water management program designed to reduce pollutants to the maximum extent practicable and protect water quality. Such programs would include, at a minimum, measures to address requirements concerning public education and outreach, public involvement, illicit discharge detection and elimination, construction site storm water runoff control, post-construction storm water management in new development and redevelopment, and pollution prevention and good housekeeping of municipal operations.

The draft proposed Phase II storm water regulation would also address storm water discharges associated with construction activity (e.g., clearing, grading, and excavating activities) resulting in the land disturbance of greater or equal to one acre and less than five acres. In addition, sites disturbing less than one acre would be subject to regulation if they are part of a larger common plan of development or sale. Similar to MS4s, the NPDES permitting authority could designate construction activities as subject to regulation based on the potential for the activity to adversely impact water quality or be a significant source of pollutants. The NPDES permitting authority may also waive storm water discharges from construction activities that disturb less than five acres where specified conditions are satisfied.

The draft proposed rule would maintain the NPDES permitting authority's residual designation authority to require any discharge that contributes to a violation of a water quality standard or is a significant contributor of pollutants to waters of the United States to seek coverage under an NPDES permit.

The draft proposed rule also contains a "no exposure" provision that would make all classes of industrial facilities eligible for waivers from the identification as "associated with industrial activity" under the existing regulations. The draft proposal represents a significant expansion in the scope of the no exposure provision originally promulgated in the 1990 rule [55 FR 47990 (November 16, 1990)] for discharges only from facilities classified as "light industry." The intent of this provision is to provide a simplified method of complying with §402(p) for industrial facilities which are entirely indoors, such as

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[7] Under the proposed Phase II regulation, the NPDES permitting authority must develop and apply criteria to evaluate whether a storm water discharge results or has the potential to result in significant water quality impacts (including habitat and biological impacts).

[8] The Phase II rule would also provide that persons can petition the NPDES permitting authority to add an MS4 for coverage under the storm water program. And the permitting authority may waive an MS4 from coverage where specified conditions are satisfied.

within a larger office building, or at which the only items permanently exposed to precipitation are roofs, parking lots, vegetated areas, and other non-industrial areas or activities.

In order to be covered under the no exposure provision, EPA would propose that an owner or operator of an otherwise regulated facility would need to submit to the NPDES permitting authority a certification that the facility meets the no exposure requirements. The facility would need to allow the NPDES permitting authority (or operator of a municipal separate storm sewer system if the discharge occurs through a municipal system) to inspect the facility and to make such inspection reports publicly available, upon request. Finally, EPA would propose that the certification require only minimal amounts of information from the facility claiming the no exposure exemption. The NPDES permitting authority would maintain a simple registration list which should impose minimal administrative burden, but which would allow for a way of tracking which industrial facilities are exercising the exemption. EPA developed these two aspects of the proposed no exposure provision (applicability to all forms of industrial storm water discharge and certification/tracking) in order to respond to a judicial remand that found the original no exposure provision to be "arbitrary and capricious" for its distinction between types of industrial discharge and for failure of the rule to either require self-reporting of actual exposure or to require EPA to inspect and monitor such facilities.

APPLICABLE "SMALL ENTITY" DEFINITIONS

The draft proposed rule to revise existing requirements in the National Pollutant Discharge Elimination System (NPDES) storm water program may impose a regulatory burden on two types of small entities. The first type of small entities that may be affected is a "small governmental jurisdiction".[9] A governmental jurisdiction is usually, though not always, the owner or operator of a small municipal separate storm sewer system (MS4). The second type of small entity is a "small business". One class of small business is the operator responsible for the discharge from a construction activity that results in the land disturbance of between one acre and five acres. The operator of a construction activity is usually a construction contractor. The second class of small business that may be affected by this proposed rule are "light industries" in Category xi that would need to certify to the no exposure provision. The current version of the proposed rule includes a "no-exposure" provision that would provide regulatory relief to Phase I industrial/commercial facilities. This report includes tables showing the estimated numbers of small entities that may be affected by the proposed rule.

<u>MUNICIPAL SEPARATE STORM SEWER SYSTEMS (MS4s)</u>

[9] EPA uses the Regulatory Flexibility Act's definition of "small governmental jurisdiction" as the government of a city, county, town, school district or special district with a population of less than 50,000.

Regarding municipal separate storm sewer systems, the proposed rule uses the term "small municipal separate storm sewer system" to refer to all municipal separate storm sewers that are located in an incorporated place with a population of less than 100,000 as determined by the latest Decennial Census by the Bureau of Census. The owner or operator of a covered small MS4 may or may not be a "small governmental jurisdiction" as defined by the Small Business Administration (SBA). The proposed rule would affect three categories of small MS4s that are also small governmental jurisdictions that own or operate a MS4. (See Table 1)

CONSTRUCTION ACTIVITIES

Regarding construction activities, the proposed rule would not directly target individual "small businesses" but the construction activity itself. However, EPA expects most, if not all, construction activities that would be covered by this proposed rule would be performed by construction contractors in Standard Industrial Classification (SIC) Group 15 and 16. The SBA defines small business by the category of business using SIC codes and uses different cut-offs for different SIC codes. (See Tables 2 & 3)

"NO-EXPOSURE" PROVISION

The proposed rule would provide regulatory relief to many small businesses that would not have storm water discharges "associated with industrial activity" if they certify to the "no-exposure" provision. Facilities under the following SIC codes are potentially subject to regulation under Phase I of the NPDES storm water program: 10-14, 20-39, 4011, 4013, 41-42, 4221, 4222, 4225, 4226, 4311, 44, 45, 491, 5015, 5093, and 5171. Therefore, those facilities that would potentially benefit from the no exposure provision are also under these SIC code groups. (See Table 4).

Table 1:
Small Governmental Jurisdictions That May be Affected by Proposed Rule

	<u>Automatic</u> Coverage	**<u>Required</u> Watershed-based Evaluation for Potential Designation/Coverage by NPDES permitting authority**	**<u>Optional</u> Watershed-based Evaluation for Potential Designation/Coverage by NPDES permitting authority**
Coverage	MS4s < 50,000 & Located in an Urbanized Area *Approx. # = 3,031	MS4s from 10,000-50,000 & and population density > 1000/sq mi Located outside an Urbanized Area *Approx. # = 583	MS4s < 10,000 & Located outside an Urbanized Area *Approx. # = 17,540
		MS4 contributing substantially to the pollutant loadings of a regulated MS4. *Number is unknown.	
Waiver from Coverage	1. MS4s < 1,000 & Located in an Urbanized Area with 1) no water quality impacts and 2) no direct or indirect connection to a regulated MS4. *Number is unknown. 2. Indian Tribes < 1,000 are automatically waived from coverage. *Approx. # is = 8		

Table 2:
Estimated Range of Small Businesses in SIC Group 15 That May be Affected by Proposed Rule When They Undertake Construction Activities That Disturb from 1 to 5 Acres of Land

MAJOR GROUP 15**BUILDING CONSTRUCTION**GENERAL CONTRACTORS AND OPERATIVE BUILDERS				
SIC Code	**Description**	**Size Standard by Millions of Dollars**[10]	**Establish-ments with <10 million annual revenue**[11]	**Establish-ments with ≥10 million annual revenue**
1521	General Contractors -- Single-Family Houses	$17.0	107,289	206
1522	General Contractors -- Residential Buildings, Other Than Single-Family	$17.0	6,367	123
1531	Operative Builders	$17.0	16,200	789
1541	General Contractors -- Industrial buildings and Warehouses	$17.0	7,330	353
1542	General Contractors -- Nonresidential Buildings, Other Than Industrial Buildings and Warehouses	$17.0	27,871	1,868

[10] The Small Business Administration defines a small business within each of these SIC codes as a firm having annual revenue of not greater than $17 million.

[11] Data is from the U.S. Bureau of the Census's Economic Census 1992. The Bureau of the Census uses an "establishment" as the unit of data. A firm may have more than one establishment. As a result, the number of firms is less than the number of establishments listed. The Economic Census 1992 did not have data corresponding to SBA's $17 million size cut-off. The highest cut-off is $10 million in annual revenue. Therefore, the actual number of establishments that are below the $17 million cut-off is greater than the number listed in this column.

Table 3:
Estimated Range of Small Businesses in SIC Group 16 That May be Affected by Proposed Rule When They Undertake Construction Activities That Disturb from 1 to 5 Acres of Land

MAJOR 16**HEAVY CONSTRUCTION OTHER THAN BUILDING CONSTRUCTION**CONTRACTORS				
SIC Code	**Description**	**Size Standard by Millions of Dollars[12]**	**Establish-ments with <10 million annual revenue[13]**	**Establish-ments with ≥10 million annual revenue**
1611	Highway and Street Construction, Except Elevated Highways	$17.0	9,205	885
1622	Bridge, Tunnel, and Elevated Highway Construction	$17.0	878	163
1623	Water, Sewer, Pipeline, and Communications and Power Line Construction	$17.0	9,882	351
1629	Heavy Construction, N.E.C. EXCEPT, Dredging and Surface Cleanup Activities (where size standard cut-off is $13.51)	$17.0	15,311	505

[12] The Small Business Administration defines a small business within each of these SIC codes as a firm having annual revenue of not greater than $17 million.

[13] Data is from the U.S. Bureau of the Census's Economic Census 1992. The Bureau of the Census uses an "establishment" as the unit of data. A firm may have more than one establishment. As a result, the number of firms is less than the number of establishments listed. The Economic Census 1992 did not have data corresponding to SBA's $17 million size cut-off. The highest cut-off is $10 million in annual revenue. Therefore, the actual number of establishments that are below the $17 million cut-off is greater than the number listed in this column.

Table 4:
Estimated Number of Facilities[14] That Could Potentially Benefit from the "No-Exposure" Provision

Part 1	**Total Facilities Nationwide**	
	Number of Facilities	Source
Total Number of Facilities Nationwide (including Category xi facilities) Potentially Subject to Regulation under Phase I[15]	636,454	Census Bureau; Dunn & Bradstreet
Percentage Range of Facilities That Could Potentially Benefit from the "No-Exposure" Provision	30% - 60%	EPA estimate
Estimated Range of All Facilities (including Category xi facilities) That Could Potentially Benefit from the "No-Exposure" Provision	**210,030 - 388,237**	
Mean	**299,133**	
Part 2	**Category xi Facilities Nationwide**	
Total Number of Category xi Facilities Nationwide Potentially Subject to Regulation under Phase I[15]	394,983	Census Bureau; Dunn & Bradstreet
Percentage of Category xi Facilities That Could Potentially Benefit from the "No-Exposure" Provision	40% - 75%	EPA estimate
Estimated Number of Category xi Facilities That Could Potentially Benefit from the "No-Exposure" Provision	**161,943 - 300,187**	
Mean	**229,090**	

[14]Given the complexity, there has been no attempt to calculate the number of facilities that are both 1) a "small business" as defined by the Small Business Administration and 2) could potentially benefit from the "no-exposure" provision.

[15]Facilities under the following SIC codes are potentially subject to regulation under Phase I: 10-14, 20-39, 4011, 4013, 41-42, 4221, 4222, 4225, 4226, 4311, 44, 45, 491, 5015, 5093, and 5171. The number of facilities was obtained from individual State County Business Patterns 1993, Bureau of the Census, U.S. Dept. of Commerce. Data for SIC codes 4011 and 4013 was obtained from Dun & Bradstreet's database (data run on 7/18/96).

SUMMARY OF SMALL ENTITY OUTREACH

Tribes, States, local governments, industries, and environmental groups have provided extensive input throughout the development of the NPDES Storm Water Phase II proposed rule's draft language. Since 1992, EPA has made a consistent effort to reach out to all stakeholders regarding this proposed rule.

First, EPA provided Tribes, States, local governments, industries, and environmental groups with the opportunity to comment on alternative approaches for the Phase II regulations through publishing a notice requesting information and public comment on the approach for the Phase II regulations required under §402(p)(6) of the Clean Water Act (See 57 *FR* 41344; 9/9/92). The September 9, 1992, notice presented a range of alternatives on a variety of issues in an attempt to illustrate, and obtain input on, the full range of potential approaches for the regulation of unregulated sources to protect water quality. EPA received more than 130 comments on the September 9, 1992, notice. Approximately 43 percent of the comments came from municipalities, 29 percent from trade groups or industries, 24 percent from State or Federal agencies, and approximately 4 percent from other miscellaneous sources. These comments are summarized in Appendix J of *Storm Water Discharges Potentially Addressed by Phase II of the National Pollutant Discharge Elimination System Storm Water Program: Report to Congress* (March, 1995). EPA considered these comments in developing many of the provisions in today's proposed rule, including reliance on the NPDES program framework (including general permits), providing State and local governments with flexibility in selecting Phase II sources, focusing on high priority polluters and providing certain waivers for facilities that do not pollute, focusing on pollution prevention and BMPs, and incorporating watershed-based concerns in targeting.

Second, in early 1993, EPA and the Rensselaerville Institute held public and expert meetings to assist in developing and analyzing options for identifying unregulated storm water sources and possible controls. These meetings again allowed participants an opportunity to provide input into the Phase II program development process. The proposed rule reflects several of the key concerns identified by these groups, including provisions that provide flexibility to the States and other permitting authorities to select sources to be controlled in a manner consistent with criteria developed by EPA.

Third, EPA convened the Urban Wet Weather Flows Advisory Committee (the "FACA Committee"), including the Storm Water Phase II Subcommittee, to assist EPA in the development of cost-effective solutions for controlling the environmental and human health impacts of wet weather flows with a minimum of regulatory burden. The Phase II proposed rule was discussed in the overall UWWF FACA committee. The UWWF FACA committee has been developing the framework and language of the no exposure provision for two years. Consistent with the Federal Advisory Committee Act, the membership of the Phase II Subcommittee was balanced among the EPA's various outside stakeholder interests, including representatives from municipalities, industrial and commercial sectors, agriculture, environmental and public interest groups, States, Indian Tribes, and EPA. As of February 1997, the Storm Water Phase II Subcommittee has met 11 times for two-day periods, approximately every other month between September 1995 and February 1997. In addition to the FACA Subcommittee meetings, other meetings, conference calls, and correspondence, Subcommittee members were provided three opportunities to comment in writing on the preliminary draft approaches to the Phase II proposed rule. EPA distributed to Subcommittee members three preliminary drafts approaches of the Phase II proposed rule on September 30, 1996, November 15/22, 1996, and February 14, 1997. This resulted in three rounds of written comments from Subcommittee members. These comments were taken into consideration as EPA revised the preliminary draft language to respond to the Subcommittee's concerns. The 32 FACA Subcommittee members have utilized these numerous opportunities for input to shape the development of the Storm Water Phase II proposed rule. The Agency intends to continue to meet with the Phase II Subcommittee in the development of this rule.

Recently, EPA conducted additional outreach to representatives of small entities that would be affected by the proposed rule as required by the Regulatory Flexibility Act, as amended by the Small Business Regulatory Enforcement Fairness Act (SBREFA). EPA, in consultation with the Small Business Administration, invited 29 small entity representatives and streamlining representatives to participate in this outreach. Many of these small entity representatives have been working closely with EPA in developing this proposed rule through the FACA process.[16] Small entity representatives included the following Phase II Subcommittee and Urban Wet Weather Committee members: Dr. Roy Cameron, Mr. Tom Delaney, Ms. Beth Gotthelf, Mr. Roger James, Mr. Stephen Jenkins, the Honorable David Kubiske, the Honorable Jean Michaels (alternate: Ms. Diane Shea), Mr. Don Moe, the Honorable Jim Naugle (alternate: Ms. Carol Kocheisen), the Honorable Jeffrey Wenneberg, and the Honorable Annabeth Surbaugh. Although Ms. Shea and Ms. Kocheisen are alternate small entity representatives, they are full fledged FACA members.

EPA's Office of Wastewater Management distributed a briefing package to each representative and prepared additional documents in response to requests from the representatives. EPA conducted two telephone conference calls on May 14 and May 15, 1997 to brief representatives on the draft proposed rule. In addition, an all-day meeting was held at EPA Headquarters on May 22, 1997, with representatives. OMB and SBA officials participated in the conference calls and all-day meeting. In addition, EPA's Small Business Advocacy Chairperson participated in the all-day meeting. As of June 13, 1997, EPA received 12 sets of written comments from representatives. These comments as well as all documents distributed to representatives were presented to the Panel for its review. On June 23, 1997, EPA's Small Business Advocacy Chairperson sent a letter to each small entity and streamlining representative requesting any additional or remaining comments that they would like to communicate directly to the Panel. In his letter, the Chairperson included a summation of the comments that representatives had submitted to EPA's Office of Wastewater Management for their review and comment.

The Chairperson received one comment. This comment was a re-submission of a comment that had been previously received by EPA's Office of Wastewater Management during its outreach. A summary of all comments is attached to this report.

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[16] EPA has concluded that the RFA does not require an agency to conduct an initial regulatory flexibility analysis for a rule that significantly reduces the regulatory impact on a substantial number of small entities. RFA sections 603 and 604 both require an agency in conducting regulatory flexibility analyses to identify and consider regulatory alternatives that would "minimize" any significant economic impact on a substantial number of small entities. Since it would make no sense to minimize the beneficial impacts of deregulation, EPA interprets the RFA as requiring analyses of only new or additional regulatory requirements. However, EPA has agreed in the case of this rule to include in the Panel's outreach efforts representatives of small entities that might benefit from the rule's deregulatory aspects. In this document, EPA refers to the representatives of these small entities as "streamlining representatives."

SMALL-ENTITY REPRESENTATIVES

EPA, in consultation with the Small Business Administration, invited the following 12 small entity representatives to participate in its outreach efforts on the Storm Water Phase II proposed rule. Many of these representatives also submitted written comments.

Indian Tribes

Dr. Roy Cameron
Tribal Advisor
Representing–Certain New England Indian Tribes

Municipalities

Mr. Stephen Jenkins
Director, Env. & Engineering Dept.
City of San Marcos

Ms. Carol Kocheisen-ALTERNATE
National League of Cities

The Honorable David Kubiske
Supervisor
Ida Township, MI

The Honorable Jean Michaels
Chair, Board of County Commissioners
Olmstead County, Minnesota

The Honorable Jim Naugle
Mayor, City of Ft. Lauderdale

Ms. Diane Shea-ALTERNATE
National Association of Counties

The Honorable Annabeth Surbaugh
County Commissioner
Johnson County Board of Commissioners

The Honorable Jeffrey Wenneberg, Mayor of Rutland, Vermont

Construction

Ms. Lee Garrigan
Associated General Contractors of America

Mr. Don Moe
National Assoc. of Homebuilders

Mr. Michael Wilson
Associated Builders and Contractors

STREAMLINING REPRESENTATIVES

EPA, in consultation with the Small Business Administration, invited the following 17 streamlining representatives to participate in its outreach efforts on the Storm Water Phase II proposed rule. Many of these representatives also submitted written comments.

Industrial/Commercial

Mr. Brian Bursiek
American
Feed Industry Association

Mr. Tom Delaney
Professional Lawn Care Assoc. of America

Mr. Clay Detlefsen
International Dairy Foods Association

Mr. John DiFazio Jr.
Chemical Specialties Manufacturers Association

Ms. Beth Gotthelf
National Association of Metal Finishers

Mr. Steve Hensley
American Trucking Associations

Mr. John Huber
Petroleum Marketers Assoc of America

Mr. Roger James
American Public Works Assoc.

Mr. Jeffrey Longsworth
American Car Rental Association
Independent Lubricant Manufacturers Association
National Association of Convenience Stores
Society of Independent Gasoline Marketers of America

Ms. Tracy Alaimo Mattson
Automotive Recyclers Association

Mr. Mark Morgan
Petroleum Transportation and Storage Association

Mr. John Oliver
Porcelain Enamel Institute, Inc.

Mr. Russ Snyder
Roof Coatings Manufacturers Association
Asphalt Roofing Manufacturers Association

Mr. William Sonntag
National Association of Metal Finishers
American Electroplaters and Surface Finishers Society
Metal Finishers Suppliers' Association

Mr. Jack Waggener
Resource Consultants Inc.

Ms. Robin Wiener
Institute of Scrap Recycling Industries

Mr. John Whitescarver
National Stormwater Center

INPUT FROM REPRESENTATIVES

The Panel received 12 sets of written comments from representatives. In addition, oral comments were submitted during the two telephone conference calls on May 14 and 15, 1997 and during the all-day meeting on May 22, 1997, at EPA Headquarters. A summary of the written comments and those oral comments that raise issues not raised in the written comments is attached as Appendix A. The complete written comments of representatives are attached at the end of this document as Attachment A. A summary of the telephone conference calls and a record of the all-day meeting are found on pages 91-105 of Attachment B.

Table 5:
SBREFA Outreach Written Comments Received
on the Storm Water Phase II Proposed Rule

Number	Name	Organization	Date Received	Number of Pages
1	John Huber	Petroleum Marketers Association of America	5/28/97	1
2	Municipal Representatives a. Jim Naugle b. Jean Michaels c. Scott Tucker d. Carol Kocheisen e. Diane S. Shea f. Susan Gilson	a. National League of Cities b. National Association of Counties c. Nation Association of Flood & Stormwater Management Agencies d. National League of Cities e. National Association of Counties f. Nation Association of Flood & Stormwater Management Agencies	6/5/97	11
3	Steve Hensley	American Trucking Associations	6/6/97	2
4	Stephen Jenkins	City of San Marcos, Texas	6/6/97	2
5	Lee D. Garrigan	Associated General Contractors of America	6/6/97	2
6	Donald Moe	National Association of Home Builders	6/6/97	14
7	Michael E. Wilson	Associated Builders & Contractors	6/6/97	4

Number	Name	Organization	Date Received	Number of Pages
CONTINUATION OF TABLE 5				
8	John Whitescarver	National Stormwater Center	6/6/97	2
9	Industrial Representatives a. Brian Bursiek b. John E. DiFazio Jr. c. John Huber d. Tracy Alaimo Mattson e. John Oliver f. William Sonntag g. Jack Waggener h. Clay Detlefsen i. Steve Hensley j. Jeffrey S. Longsworth k. Russell Snyder l. Tom Tyler (for Robin Wiener) m. John Whitescarver	 a. American Feed Industry Association b. Chemical Specialties Manufacturers Association c. Petroleum Marketers Association of America d. Automotive Recyclers Association e. Porcelain Enamel Institute, Inc. f. American Electroplaters and Surface Finishers Society Metal Finishers Suppliers' Association National Association of Metal Finishers g. Resource Consultants, Inc. h. International Dairy Foods Association i. American Trucking Associations j. American Car Rental Association Independent Lubricant Manufacturers Association National Association of Convenience Stores Society of Independent Gasoline Marketers of America k. Asphalt Roofing Manufacturers Association Roof Coatings Manufacturers Association l. Institute of Scrap Recycling Industries m. National Stormwater Center	6/6/97	10
10	Dave Kubiske	Ida Township, Michigan	6/10/97	3
11	Mark S. Morgan	Petroleum Transportation & Storage Association	6/11/97	4
12	Jack E. Waggener	Resource Consultants	6/13/97 (re-submitted 6/27/97)	3

PANEL FINDINGS AND DISCUSSION

The Panel's findings and discussion are arranged below according to the elements of the IRFA and the category of activity that would be regulated by the proposed rule, where appropriate.

The Types and Number of Small Entities to Which the Proposed Rule Would Apply

As indicated earlier in the report, the types of small entities to which the Storm Water Phase II proposed rule would apply include small governmental entities that own or operate a municipal separate storm sewer systems and small businesses. Small businesses include small construction firms and small industrial facilities. The Panel considers the ranges that EPA has provided (listed in this report as Tables 1, 2, 3, and 4) as reasonable indicators, given the available data, of the number of small entities that would be affected by the proposed rule.

The Panel notes that small entities raised comments concerning the existing permit requirements applicable to storm water discharges from Category xi facilities in general. In addition, the Panel also received small entity comments on the issue of whether the proposed rule increases burden on Category xi facilities with no exposure. EPA has stated that it believes all Category xi facilities are currently subject to NPDES coverage. Category xi facilities with exposure to storm water were required to obtain a permit by October 1994 [57 FR 60446]. Category xi facilities where there is no exposure to storm water are required to obtain permit coverage effective August 2001 [60 FR 17953]. The Panel finds that the proposed rule would not affect Category xi facilities with exposure. However, the Panel also finds that, as a practical matter, the proposed rule would represent additional burden for Category xi facilities with no exposure. [see Classes of Small Entities below]

Projected Reporting, Record Keeping, and Other Compliance Requirements of the Proposed Rule, Including the Classes of Small Entities Which Will Be Subject to the Requirements and the Type of Professional Skills Necessary for Preparation of the Report or Record

The above section entitled, "Overview of Proposed Phase II Rule" describes the basic elements of the proposed rule. The record keeping, reporting, and other compliance requirements associated with the construction component of the proposed rule would be similar to those required by currently regulated Phase I construction activities. However, EPA anticipates that the best management practices (BMPs) that typically would be implemented on construction sites below 5 acres to achieve compliance would be less sophisticated and less expensive than those BMPs implemented on a Phase I site. The proposed rule would provide the NPDES permitting authority with the discretion not to require notices of intent (NOIs) in general permits for storm water discharges from Phase II construction activities. NOIs are required of Phase I construction activities. The record keeping and reporting requirements for the municipal component of the proposed rule would be substantially less than those required for municipalities under the Phase I program. Currently regulated Phase I facilities that claim no exposure would need to file a self-certification form to document their exemption from otherwise applicable permit requirements.

Projected Reporting, Record Keeping, and Other Compliance Requirements

The Panel received many comments stating that the proposed rule would impose administrative and compliance burdens on small entities. The Panel supports EPA's efforts to explore ways to reduce these burdens on small entities while protecting water quality.

<u>No Exposure:</u>

Municipal representatives questioned the need for facilities with no exposure to so certify if they are not required, as a matter of law, to obtain an NPDES permit anyway. Industrial representatives stated that a five year certification and a one-time notice of termination (NOT) would be an acceptable burden for the small businesses they represent. However, industrial representatives and other commenters had significant concerns regarding the language in the "no exposure" self-certification form itself. They believe that to determine if there is an "interference" with water quality standards would require significant financial costs, for example, the need to hire a qualified engineer to make a determination. Additionally, both municipal and industrial representatives stated that there should be no requirement to assess flow impacts in the certification form. [see Type of Professional Skills below]

The Panel notes that, since the discussion in the first Panel meeting, EPA has responded to some commenters' concerns by deleting the requirement for "self-certifiers" to determine "no interference" with water quality standards in the no exposure self-certification form, thus, also removing any requirement to assess flow impacts. EPA has substituted a new question to ask whether actions to qualify for no exposure result in increased impervious surface area. Answering "yes" to this question would not disqualify a facility from the no exposure exemption. The answer to this question and other information, however, would enable the NPDES permitting authority to determine if the discharge would be likely to interfere with attainment of water quality standards, in which case, the permitting authority could exercise its existing authority under the Clean Water Act to disallow the no exposure exemption and require coverage under either a general or an individual permit, as appropriate.. The Panel supports this revision to the earlier draft of the self-certification form and expects that it would reduce the administrative and financial burden on small industrial facilities wishing to make use of the no exposure self-certification provision. [see Type of Professional Skills below]

Classes of Small Entities

As noted above, the Panel received comments stating that Category xi facilities are not currently subject to NPDES coverage and that therefore this proposed rule would expand coverage to a new class of small entities. EPA disagrees with these comments and maintains that Category xi facilities are currently covered under the NPDES program and that in fact many Category xi facilities with actual exposure have sought coverage under NPDES permits. Under EPA's interpretation of the current regulations, Category xi facilities with no exposure are required to obtain NPDES permits by August 2001.

The Panel notes that the proposed rule does not include any regulatory requirements applicable to Category xi facilities except the no exposure self-certification provision and therefore imposes no regulatory burden on Category xi facilities other than those wishing to make use of this provision. However, as a practical matter the Panel also finds that the proposed rule would represent additional burden for Category xi facilities claiming no exposure and considers this group to be a newly regulated class of small entities. At the same time, the Panel notes that EPA has attempted, both through consultation with its Stormwater Phase II Subcommittee and in response to comments from small entity representatives, to structure the no exposure self-certification provision in a way that minimizes the burden on facilities making use of it. In addition, by expanding the availability of the no exposure provision to all Phase I facilities that meet its requirements, EPA would provide significant regulatory relief to a large number of currently regulated entities, both large and small.

Type of Professional Skills

Municipal Program:

Municipal representatives stated, and the Panel agrees, that implementation of some program elements would not necessarily require staff with education beyond a high school diploma. However, municipal representatives also stated that some of the minimum control measures would definitely require a person with advanced education or significant work experience beyond high school. Specifically, these municipal representatives referred to the minimum control measures for: (1) post-construction storm water management, (2) pollution prevention, and (3) evaluation and effectiveness.

EPA has stated its commitment to develop guidance materials and training to ensure that the level of professional skills required to implement the municipal program would be kept to a minimum. The Panel supports EPA's efforts in providing guidance materials and training to assist in the implementation of the proposed program.

No Exposure:

The Industrial Representatives expressed concern that, as previously drafted, the no exposure provision would require someone with an advanced degree in engineering, chemistry, and/or water hydrology to properly determine whether actions taken to satisfy the no exposure requirements would result in "interference" with water quality standards. As indicated above, the Panel notes that EPA has made revisions to the no exposure self-certification provision that address this concern.

Other Relevant Federal Rules Which May Duplicate, Overlap, or Conflict with the Proposed Rule

The Panel received comments that the proposed rule may conflict with the requirements of the Clean Air Act, the Endangered Species Act, the Great Lakes Initiative, and Section 404 of the Clean Water Act as administered jointly by the EPA and the Corps of Engineers. Municipal representatives indicated that street sweeping activities designed to reduce pollutants in urban run-off may create "dust" or "soot" that could cause a violation of the National Ambient Air Quality Standards for particulate matter.

The Panel recommends that the Agency further evaluate in its regulatory flexibility analysis whether the proposed rule would conflict with those federal rules identified by commenters and revise the rule to address such conflicts as appropriate.

Any Significant Alternatives to the Proposed Rule which Accomplish the Stated Objectives of Applicable Statutes and Which Minimize Any Significant Economic Impact of the Proposed Rule on Small Entities

Before addressing specific alternatives suggested by commenters during the SBREFA outreach process to minimize the impacts of the rule on small entities, the Panel wishes to note and commend EPA's efforts over the past two years to work with stakeholders, including small entities, through the Stormwater Phase II Subcommittee of its Urban Wet Weather Flows Advisory Committee, as described above. Because of the extensive outreach already conducted and the Agency's responsiveness in addressing stakeholder concerns, commenters during the SBREFA process raised fewer significant concerns than might otherwise have been the case. However, the Panel did receive comments on the following issues.

Municipal Coverage

Municipal representatives expressed concern that the waiver provision for municipalities in urbanized areas with populations under 1,000 would be difficult to use in practice because these are exactly the municipalities that would be unlikely to have the resources to demonstrate that their activities have no water quality impacts. Furthermore, they raised concerns that tying the waiver provision to TMDL or watershed assessments will make it even more difficult to use. The Panel notes that where EPA or a State has conducted such the watershed assessments and developed any necessary TMDLs (as the Agency fully anticipates will occur), the municipal concern should prove unwarranted. In such cases, a municipality would not need to make any such demonstration but merely certify that a TMDL (or watershed plan) applies and does not assign any responsibilities to reduce pollutant loads. In cases where such assessment work is not completed by EPA or a State, however, the Panel shares the concern and recommends that the preamble invite comment on the concern.

The municipal representatives also questioned the rationale for treating Tribes under 1,000 differently from municipalities under 1,000. OMB and SBA recommend that the preamble invite public comment on whether both municipalities and Tribes under 1,000 located within an urbanized area should be treated like MS4s under 10,000 located outside an urbanized area, which is the approach EPA is proposing for Tribes under 1,000. That is, the preamble should invite comment on whether both municipal separate storm sewer systems serving a population of less than 1000 and urban Tribes with a population of less than 1000 should be exempt unless either (1) they contributed significantly to the pollutant loadings of a covered MS4 or (2) the permitting authority determines that they have a significant impact on water quality. This alternative would place the burden of proof for coverage on the permitting authority, which would have better resources for making the appropriate water quality impact determinations than the very small municipality or small urban Tribe. EPA believes that the rationale for inclusion of very small municipal separate storm sewer systems differs from the rationale for exclusion of small urban tribes. EPA believes that small urban tribes should be treated differently because it believes the population density should be much lower than the very small municipal separate storm sewer systems and because small urban tribes cannot rely on a State in the same way as a very small municipal separate storm sewer system (a political subdivision of a State).

Construction:

The Panel received many comments questioning the need to regulate construction activities that result in land disturbance of 1 to 5 acres. Several of the small entity representatives noted that there are many local control programs already in place. They stated that regulation below 5 acres would have significant economic impact on small businesses and that the proposed rule would greatly increase the number of affected small businesses. Several commenters also questioned whether regulation of such activities would provide significant water quality benefits.

Some of the commenters provided advice and recommendations. One commenter suggested an exemption for "routine maintenance" activities such as repairing potholes, clearing out drainage ditches, and maintaining fire breaks because these activities often involve rights-of-way extending across multiple regulatory jurisdictions. The commenter suggested that, at most, these activities be required to adhere to generic best management practices. A number of commenters encouraged EPA to adopt a voluntary program, including guidance and perhaps incentives, for construction sites below 5 acres. One commenter stated that many small operators may lack the resources to put together a good site plan.

Municipal commenters stated that regulation of construction sites below 5 acres will create a major burden to local governments and should be at the discretion of the permitting authority. Another commenter suggested that construction sites, regardless of size, that are located within a Phase I regulated MS4 be required only to comply with the requirements of the municipality. Several commenters suggested that if EPA does regulate construction sites under 5 acres, NOIs should not be required for these sites.

While the Panel has not thoroughly evaluated the merits of each of the small entity concerns, the Panel recommends that the preamble to the proposed rule invite comments on alternatives to the proposed requirements for regulation of construction sites that result in the disturbance of 1 to 5 acres.[17] The request for comments should include a discussion of concerns expressed by small entity representatives and suggestions they have made for addressing them. The request should ask for comment on the extent to which a nonregulatory voluntary program, or one that relies on the discretion of the permitting authority or covered MS4, would provide adequate protection against water quality impairment due to run-off from small construction sites, and on any specific experience commenters may have had in the past with voluntary regulation of discharges from such sites based on best management practices. The Panel also encourages EPA to consider revisions to the proposal itself that address some of the technical concerns raised by small entity commenters, such as the difficulty of obtaining permits for routine right-of-way maintenance involving multiple jurisdictions.

The Panel also received comments from municipal and industrial representatives suggesting that construction activities undertaken by municipalities or industrial facilities could be covered under these entities' existing stormwater permits, provided that such existing permits detail soil and erosion controls. Municipal representatives also recommended that any industrial facility operated by the municipality be covered by its MS4 permit and that the municipality be allowed to determine if there is exposure for these facilities as part of its MS4 plan without filing a separate no exposure self-certification. The Panel recommends that the preamble to the proposed rule explore and request comment on the ideas discussed in this paragraph. The Panel believes that the option for construction sites may be appropriate for municipalities or industrial facilities with individual NPDES permits but may be administratively difficult to implement under NPDES general permits. The Panel also supports and encourages efforts to minimize paperwork burden on municipalities, which are ultimately responsible for the success of their stormwater plans.

No Exposure:

The Panel received comments suggesting that the no exposure self-certification provision as written would not allow facilities that undergo a "temporary operational change" or transportation facilities that provide "non-pollutant generating outdoor maintenance of vehicles" to make use of the provision. One commenter suggested that concern over temporary operational changes could be addressed through the requirement of a management practice designed to prevent exposure as a result of a tempory change in operations. Commenters were also concerned about the requirement that there

[17] In order to avoid unnecessary regulatory duplication, the Small Business Administration recommends that EPA consider a regulatory option that would allow permit authorities to rely solely on the local program where the local program exceeds reasonable minimum criteria for program effectiveness. Many localities and states have sediment and erosion control programs that target the primary pollutants of construction sites. These local programs are often specifically designed to address the watershed specific issues and resources of those local areas. SBA also suggests that EPA relax the stringency of some of the draft minimum criteria of the proposed regulatory option, or SBA's suggested option, where applicable. In SBA's view, the minimum criteria would not necessarily require regulation for sites smaller than five acres in size. An NPDES permit would not be required to be issued for each site. Regular inspections of these small sites would not be required as part of the minimum criteria.

be no exposed containers that "might leak," since any container "might leak," and suggested that the provision should only prohibit exposed containers that are actually leaking.

The Panel is aware that EPA has been developing the no exposure language with extensive stakeholder involvement through the Urban Wet Weather Flows Federal Advisory Committee for the past two years. The Panel suggests that EPA examine these comments and discuss them with the Advisory Committee. The Panel hopes that the no exposure language can be revised to allow, to the extent possible, all facilities with no actual discharge of pollutants to make use of the no exposure self-certification provision.

Appendix A: Document: "Summary of Written Comments"

Attachment A: Complete Written Comments Received from Representatives

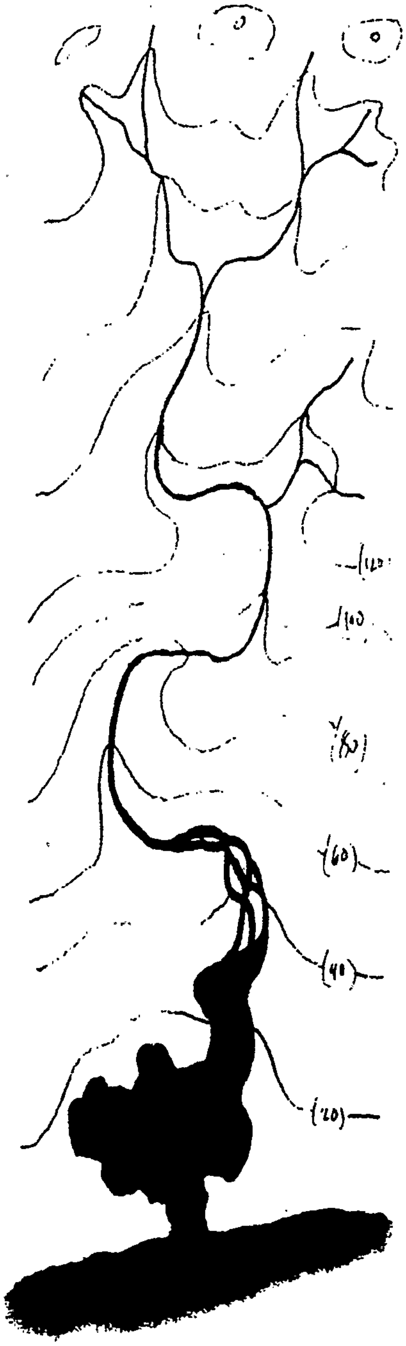
Attachment B: All Documents that Were Distributed to Representatives

DR

The Malibu Creek Watershed:

A Framework for Monitoring, Enhancement and Action

The Malibu Creek Watershed:
A Framework for Monitoring, Enhancement and Action



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August 1998

ACKNOWLEDGMENTS

This project was made possible with the assistance and support of many organizations and individuals. Our gratitude goes out to our clients Mark Gold, D.Env.,and Alix Gerosa of Heal the Bay for their review, support and suggestions, and Lisa Dobbins for making this project a reality. Special thanks to Patsy Heasly of the California State Coastal Conservancy for her guidance, review, and suggestions about the project, and Julia McIver for recognizing the need to involve citizens in the protection of the Malibu Creek Watershed. We wish to thank Gwen Starrett of the State Water Resources Control Board and Dominic Gregorio from Southern California Marine Institute for providing technical review and suggestions about the monitoring procedures. We would like to thank Rex Hanson of ESRI for providing computer assistance and Bradley Owens of Cal Poly Pomona for his work on the runoff analysis. We would also like to acknowledge the National Park Service, the California Department of Parks and Recreation, Los Angeles County Department of Public Works, Ventura County Public Works Agency, Las Virgenes Municipal Water District, Metropolitan Water District, and the Resource Conservation District of the Santa Monica Mountains.

We would like to acknowledge the 606 Studio faculty, Joan, Jeff, Joan, and Kris for their advice and guidance. We also thank our classmates for their support, encouragement and humor during the past few years.

We especially thank our families and friends for their unfailing support and understanding despite the fact that they have been unappreciated and virtually ignored during the life of this project.

Finally, we dedicate this project to the memory of Professor John Tillman Lyle who nurtured the 606 Studio since its inception. The success of the 606 Studio over the years is due in large part to his dedication and commitment.

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Section 1

Introduction

Vision for the Watershed

It's late November 2018. The rains have begun and so has the annual steelhead migration from the ocean upstream into the Malibu Creek Watershed. The fish are in search of the perfect gravelly area to spawn. People are sitting on blankets in the dappled sunlight beneath the giant sycamores and alder trees, watching their kids. Children walk along the stream waiting to catch a glimpse of the shiny silver green bodies of steelhead trout as they leap out of the water and announce their presence. The peaceful sound of a rushing stream is periodically interrupted by the excited shouts of children as they follow the steelhead trout upstream.

The streams in the watershed have returned to their natural state, the water is clean and cool, the vegetation is flourishing and the wildlife is abundant. People have also returned to the stream. Swimming holes, on perennial streams, are crowded with kids during the hot dry summers. Bird watchers flock to the lagoon to catch a glimpse of the incredible diversity of migratory birds. Surfers enjoy the excellent surf break and clean water at Surfrider Beach, and people can be seen hiking, picnicking, and enjoying the beauty that is the Malibu Creek Watershed. This is quite a contrast to twenty years earlier when the watershed was a very different place.

In 1998, the health of the watershed, especially water quality, began to improve. Most visible were the teams of volunteers who began to monitor the streams within the Malibu Creek watershed. They walked many miles, surveyed stream reaches, tested water quality and sampled macroinvertebrates. The information was collected and distributed to various local and state agencies, which in turn, led efforts to make changes in policy.

Through the efforts of these volunteers, agencies and local governments have responded to the environmental concerns of citizens in the Malibu Creek Watershed. Zoning and building regulations are far different from what they were twenty years ago. Now, parking lots are smaller, greener, and the paving is porous, allowing storm water to infiltrate into the soil below. Vibrant, tree lined pedestrian-friendly shopping streets have replaced strip malls. The water that drains from parking lots flows into bioswales that filter out pollutants before they can enter the streams. Today, if you look at the Malibu Creek Watershed, there is a sense of community that celebrates the beautiful natural surroundings that attracted residents to this area in the first place.

Purpose

This project is a step towards achieving the above vision for the Malibu Creek Watershed. The purpose of this project is to design a citizen volunteer monitoring program, that over the long term can evaluate the water quality of the entire Malibu Creek Watershed and target areas for future studies, protection, restoration, and enhancement. The ultimate hope for this project is that citizens and agencies will work together to protect the Malibu Creek Watershed, identify problems, and implement measures to correct these problems.

The information collected by citizen volunteer monitors can be used to better understand the unique physical, biological, and recreational resources of the area. This information can hopefully be used to balance the need for human development while maintaining the ecological integrity and unique natural character of the Malibu Creek Watershed. It is the hope of the project team that private sector developers and local planning agencies work together for increased cooperation in implementing the recommendations that improve ecological functioning within the watershed.

This project document is intended for active use by citizens, local, state, and federal agencies and non-profit organizations concerned about the Malibu Creek Watershed. This project document begins with goals and objectives to explain the background of the project. The second section gives an overview of the natural processes and the history of settlement in the Malibu Creek Watershed. Key issues affecting ecological functions within the watershed are then discussed in Section 3. Section 4 details the monitoring element of the project, including the structure, organization and the flow of data. The fifth section describes the in-depth analysis and modeling that was used to select monitoring sites. It also presents a framework for other agencies that wish to monitor in the watershed. The final section, Section 6, considers design recommendations and alternatives that directly address the key issues identified in Section 3.

Background

Heal the Bay, a non-profit organization, and the California State Coastal Conservancy have contracted the 606 Studio, a team of landscape architecture graduate students and faculty members from the Department of Landscape Architecture at California State Polytechnic University, Pomona, to design a volunteer monitoring program. This program is to be used to evaluate the water quality and overall ecological health of the Malibu Creek Watershed. The monitoring program was designed to adjust to changes in volunteer participation and capabilities and be flexible to address new issues as they arise in the future.

To meet this contract, the 606 Studio has prepared two documents: *The Malibu Creek Watershed, Stream Team Field Guide* (a field guide to be used to train volunteer water quality monitors), and this document, *The Malibu Creek Watershed: A Framework for Monitoring, Enhancement and Action.*

The California State Coastal Conservancy and Heal the Bay are actively involved in issues of water quality. The California State Coastal Conservancy is a unique state resource agency that uses innovative techniques to purchase, protect, restore, and enhance coastal resources and to provide access to the shore. They work in partnership with local governments, other public agencies, nonprofit organizations, and private landowners. In funding and support of this project, the California State Coastal Conservancy has formed a partnership with Heal the Bay, a non-profit environmental group dedicated to making the Santa Monica Bay and the Los Angeles County coastal waters safe and healthy for people and marine life. Both organizations have a long history of successful projects throughout the State.

Objectives

Monitoring Program Structure and Process

Research

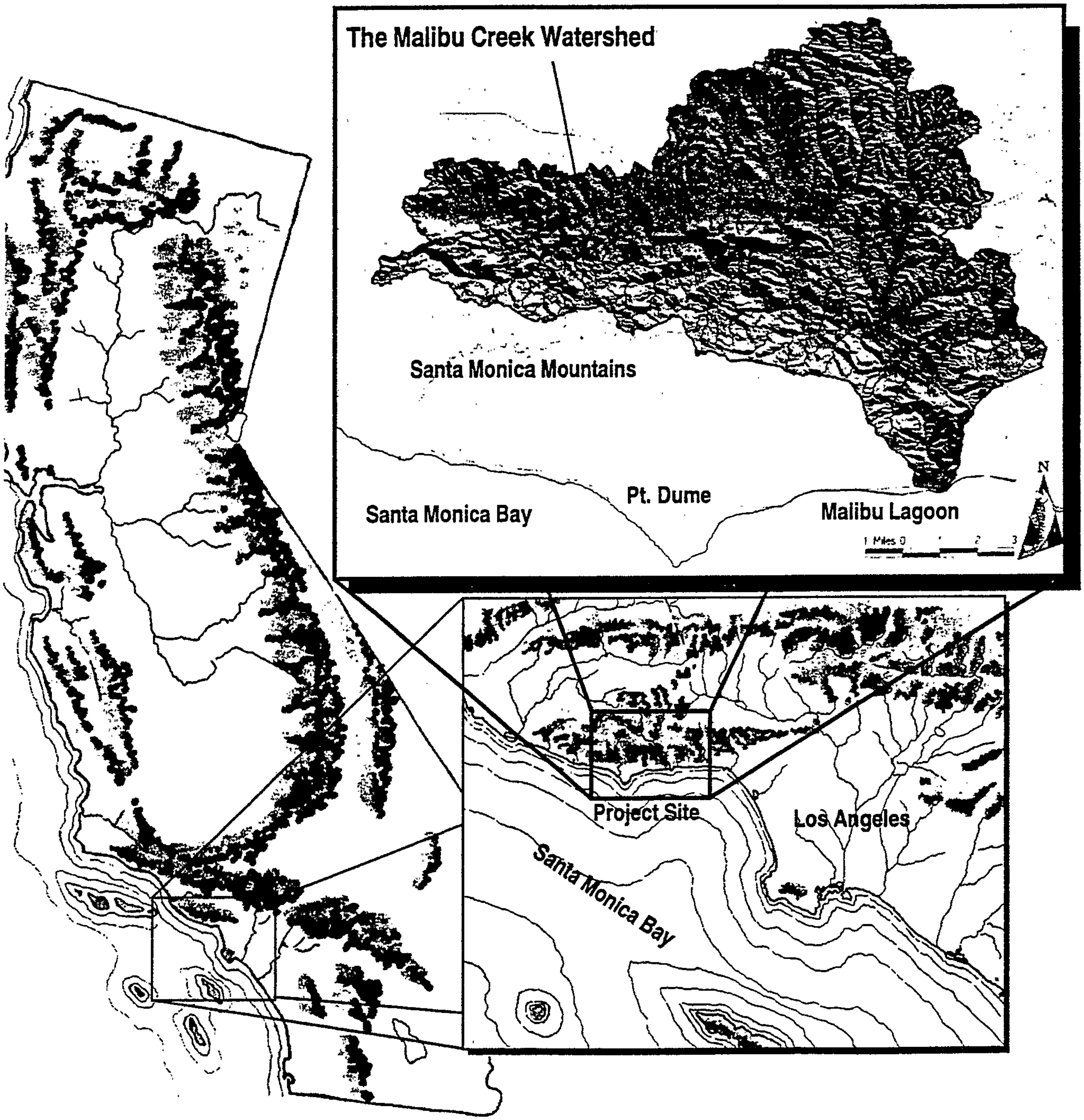
- Conduct a watershed inventory of the Malibu Creek Watershed. This involves collecting and analyzing past studies of the watershed and identifying the major ecological issues of concern.
- Study existing monitoring programs and the strategies used to collect and distribute information.

Design

- Design a volunteer monitoring program that addresses the specific issues and needs of the Malibu Creek Watershed. This program will provide information needed by private and public agencies to identify opportunities to improve the overall ecological health of the Malibu Creek Watershed.
- Create a field guide volunteers can use in conjunction with hands on training to collect and record pertinent information about the Malibu Creek Watershed.

Planning & Management Framework

- Develop an overall strategy that can be used to coordinate current and future individual monitoring efforts within the watershed, to maximize the quality of information collected and utilize the limited resources of these programs.
- Design a monitoring program framework that can be used by Heal the Bay to organize and train volunteers to collect information about the Malibu Creek Watershed. This framework will be designed so that the monitoring program can adapt to changes in levels of volunteer participation.
- Create a framework that Heal the Bay can use to organize, store, and distribute the information collected by volunteers to the numerous local, state, and federal agencies that are charged with protecting the Malibu Creek Watershed.
- Provide a tool box of design recommendations and references for improving the Malibu Creek Watershed ecosystem. As volunteers identify areas that are degraded or in trouble, decision-makers will be armed with strategies to enhance these areas.



te Context, the Malibu Creek Watershed

Section 2
Natural Processes and the History of Settlement

Context

The Malibu Creek Watershed, at 109.9 sq. miles, is the second largest watershed draining into the Santa Monica Bay (Figure 2-1). Rain falling within its boundaries eventually reaches the Pacific Ocean via the system of surface streams and groundwater. The watershed is located approximately 35 miles to the west of the City of Los Angeles in the Santa Monica Mountains and Simi Hills. Approximately 65% of the watershed is located in Los Angeles County with the remaining 35% in Ventura County. Within its boundaries are the cities of Agoura Hills, Westlake Village, and portions of Malibu, Calabasas, Thousand Oaks, Hidden Hills, and Simi Valley.

The topography varies throughout the watershed. In the uppermost region, the Simi Hills roll gently. In contrast, the steep, rugged Santa Monica Mountains cover the remaining majority of the watershed. The Malibu Creek Watershed can be divided into seven smaller subwatersheds. These are Hidden Valley, Westlake, Agoura, Las Virgenes, Malibou Lake, Malibu Creek, and Cold Creek. A major tributary drains each subwatershed, eventually joining Malibu Creek. The creek flow south into the Malibu Lagoon, one of the few remaining coastal wetlands in southern California. Here the freshwater mixes with the Pacific Ocean at Malibu Surfrider Beach.

Natural Processes

Climate

The climate of the Malibu Creek Watershed is generally characterized as a Mediterranean type with mild wet winters, hot dry summers, and coastal fog occurring in spring and mid summer between the months of May and July. The area is frost-free 275 to 325 days on average. Spring temperatures range from 65 to 85 degrees Fahrenheit during the day and can drop as low as 45 to 65 degrees at night.

The phenomenon known as the "Pacific High" diverts storms away from southern California, causing the warm dry summers. Inland summer daytime temperatures generally remain around 85 degrees and will occasionally exceed 100 degrees with low temperatures dipping into the mid-fifties. Coastal temperatures are generally 15 degrees cooler than those of inland valleys (Jorgen 1995, p. 6).

Fall temperatures range from 65 to 90 degrees inland during the day and can dip down between 20 to 60 degrees at night. Fall is usually associated with the warm, dry Santa Ana winds that blow in from the deserts. Due to these dry summer and fall conditions, fire has become an integral part of the local ecosystem.

Winter is characterized by periodic rainfall, which accounts for nearly all the precipitation in the area. The majority of rainfall occurs between November and April averaging 25 inches over the mountainous regions to the north and along the coast, to rainfall averages of about 13 inches in the inland valleys. Measurable precipitation occurs on average 35 days per year with December and January usually the wettest months (Jorgen 1995, p. 7). Average winter temperatures reach highs in the mid-60s with average lows in the mid-40s. Freezing temperatures sometimes occurs at the higher elevations of the Santa Monica Mountains. Snow falls very rarely but has occurred within the watershed.

Geology

The Santa Monica Mountains and Simi Hills are part of the Transverse Ranges. They were formed through a process of deposition, erosion, volcanic activity, and tectonic forces. 135 million years ago, the ocean covered the area where the Santa Monica Mountains are located. Over millions of years, sediments settled on the ocean bottom, and eventually, through pressure and chemical processes, were transformed into sedimentary rocks–shale and sandstone–that compose most of the area (Jorgen 1995, pp. 7-8).

The greatest volume of rock mass in the Malibu Creek Watershed is composed of young sandstone, shale, and volcanic flows that occurred between 10 to 20 million years ago during the Miocene Epoch (Warshall, et al. 1992, p. 18). The distinctive black-gray and reddish volcanic rocks in the central and upper western portions of the watershed are known as the Conejo Volcanics. It was not until four million years ago that northward pushing tectonic forces caused the Santa Monica Mountains to thrust their way out of the ocean (Warshall, et al. 1992, p. 18). Erosion of the volcanic and sedimentary rocks created sediments which were deposited by flowing water, filling valleys and streambeds with alluvial soil (Figure 2-2). This alluvial layer is 30 feet deep in streambeds and canyon bottoms and tapers off rapidly to less than four feet thick up canyon slopes (USDA NRCS MCWNRP 1995, p. 8).

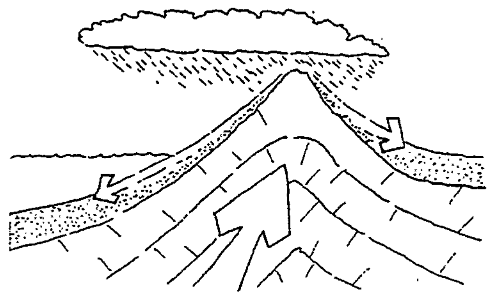


Figure 2-2: Uplift and erosion

Soils

The soils of Malibu Creek Watershed are susceptible to high erosion rates. This is due to a combination of climate, topography, vegetation and soil structure. Mediterranean climates provide the highest sediment yields in the world (Levy, Korkosz 1997, p. II-9).Soils in the area are derived from sandstone, shale, volcanic and igneous rock, and from alluvium composed of a mixture of rock sources that compose the Santa Monica Mountains. Soil types determine the amount of water storage and the ability to absorb and filter runoff within the watershed. The Malibu Creek Watershed contains 40 soil mapping units in the Los Angeles County portion, and 38 soil mapping units in the Ventura County portion of the watershed (USDA NRCS MCWNRP 1995, p.13).

Vegetation

The Malibu Creek Watershed is covered with plants that have evolved to fit the unique soils and climate of the region. Chaparral and Coastal Sage Scrub are two plant communities that dominate the Santa Monica Mountains. These plant communities are adapted to wet winters and dry summers. For example, many of these plants have small, waxy leaves to retain moisture, as well as the ability to drop their leaves in times of drought.

Vegetation plays a critical role in the watershed. It helps control erosion by holding the soil together with its roots and by breaking the force of rainfall with its canopy of leaves and branches (Figure 2-3). This slows the flow of water and allows more water to percolate into the soil. Runoff is minimized and less water flows all at once into streams. It also provides food and shelter for a wide variety of animals.

Vegetation within the Malibu Creek Watershed can be categorized into plant communities based upon similar characteristics. Figure 2-4 shows some of the various dominant plant communities found within the watershed and their approximate locations.

Riparian Zone

The Riparian Zone is the vegetative corridor on either side of a body of water (Figure 2-5) (US EPA 841-B-97-003 1997, p. 203). This area is unique because it is where the land-based (or terrestrial) and aquatic ecosystems interface (Murdoch, Cheo, and O'Laughlin 1996, p. 60). Riparian zones contain an important plant community that helps to maintain

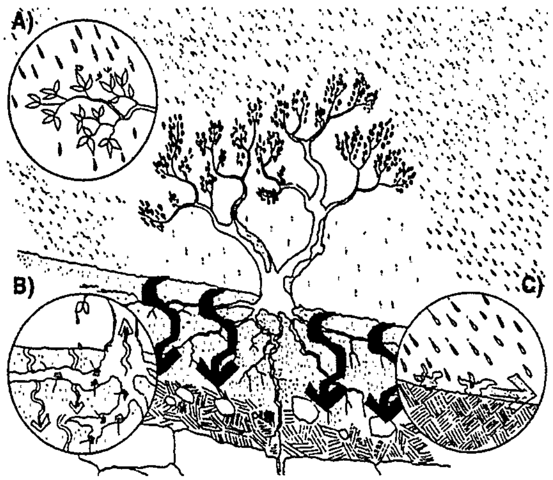


Figure 2-3: Vegetation aids infiltration and prevents erosion by A) intercepting the rain and slowing down water flow, B) roots creating pore spaces for water to infiltrate and C) rain impacting exposed soils, picking up sediments, carrying them into waterways.

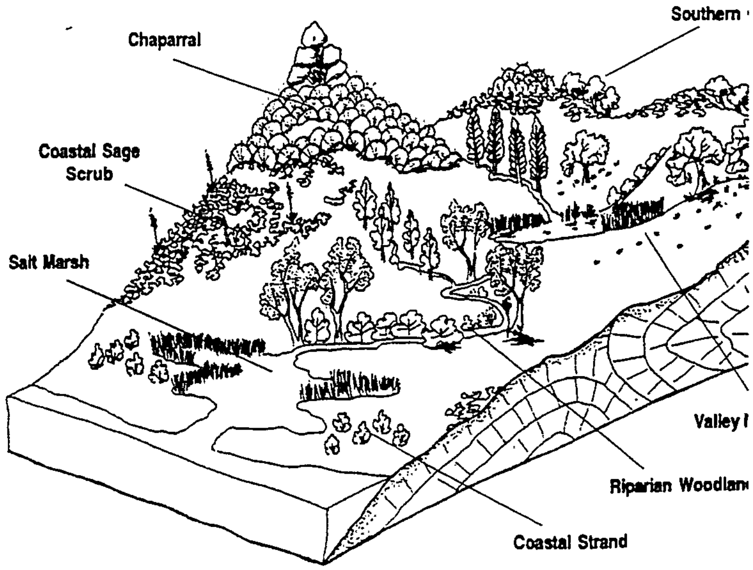


Figure 2-4: Plant communities and their approximate locations within the watershed

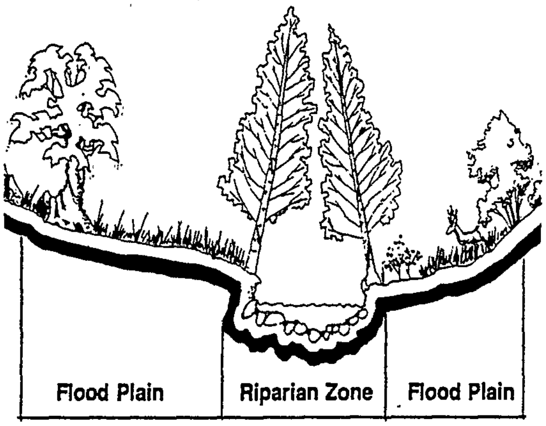


Figure 2-5: The riparian zone

water quality and stream health. Riparian vegetation generally has a higher need for water, thus occurs in drainages or areas with a high water table. The plants of a healthy riparian corridor are diverse and can include trees such as oaks, sycamores or willows, and various shrubs and groundcovers.

A healthy riparian zone supports birds, aquatic life, and additional diverse wildlife. According to the Washington State Department of Wildlife, more than 85% of wildlife inhabit riparian areas at some time during their life cycle to find water, shelter, and food. Trees provide shade for the stream, maintaining cooler water temperatures that are important for certain fish species like the steelhead trout. Shade also minimizes evaporation, providing water for the long, hot summer season. Trees and other vegetation drop leaves, twigs, and branches that provide food for aquatic organisms located at the bottom of the food chain. This debris also accumulates in the streams, providing habitat for fish and other aquatic organisms.

Nutrients

Natural sources of nitrates include soil, animal wastes, and decomposing plants that are washed off the surface of the landscape and eventually into the streams (Figure 2-6). Phosphorous is an essential nutrient for plant growth and for the metabolic reactions in plants and animals (Behar, Dates, and Byrne 1996, p. 130). Phosphates are considered a limiting factor, because they are the least available of all nutrients for plant growth. If phosphate is added to a freshwater system, even in small quantities, the plant growth will usually increase substantially (Behar, Dates, and Byrne 1996, p. 130). Natural sources of phosphates include soil, decomposing plants, rocks that contain phosphate, and animal wastes.

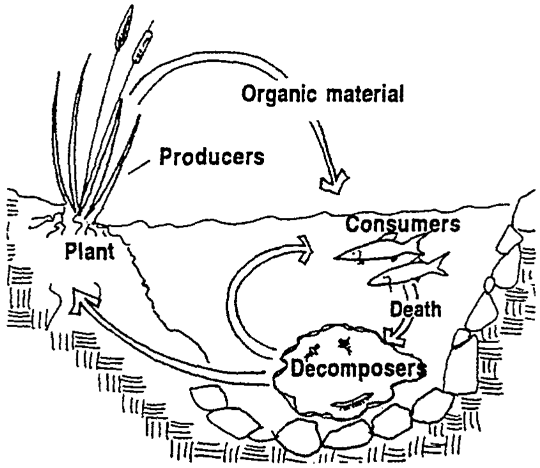


Figure 2-6: Basic aquatic nutrient cycle

Fire

Fire is an essential part of the natural processes in the Malibu Creek Watershed. Chaparral plants such as Toyon and Chamise, and Coastal Sage Scrub plants such as Black Sage and California Sagebrush

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are fire-adapted and depend on regular burning to remove old growth and rejuvenate the plants. Fires mineralize organic matter into potash, which provides nutrients to the soil and stimulates new plant growth

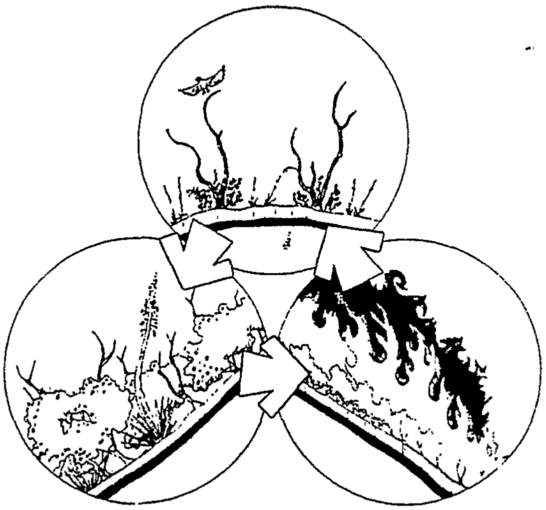


Figure 2-7: Chaparral fire cycle

(Jorgen 1995, p.16). Many of these plants have seeds that need fire to stimulate them to germinate, or have the ability to crown sprout from their roots after a fire (Figure 2-7). Animal populations decrease following a fire because of limited shelter and available food, but these populations soon return when the fire- dependent seeds germinate providing tender young shoots for browsing animals to eat. Fires were believed to have started from lightning strikes in the San Fernando Valley and the San Gabriel Mountains prior to recent human settlement. Santa Ana winds fanned these flames over the hills and into the Santa Monica Mountains (Jorgen 1995, p. 16). The watershed is most susceptible to fires beginning in early May and lasting through October, when annual grasslands dry out and temperatures are higher. Fire within the Santa Monica Mountains occurs at natural intervals between 10 to 50 plus years (Levy, Korkosz 1997, p. II-9).

Wildlife

The Malibu Creek Watershed is home to a diverse range of wildlife. This includes about 50 species of mammals, over 380 bird species, 25 species of reptiles, 11 species of amphibians, 5 species of fish, and a large number of invertebrates (USDI 1993). There are also several listed endangered species within the watershed.

Hydrologic Cycle

The hydrologic cycle is a closed loop system driven by the energy of the sun, which continually transports water between the atmosphere and the earth's surface (Figure 2-8). The three main processes of the hydrologic cycle are precipitation, evaporation, and transpiration. Once precipitation falls onto the land, approximately two-thirds is evaporated back into the atmosphere. The remainder is either absorbed into the ground and soils, or flows over the land as surface water. Transpiration occurs when energy from the sun draws water from the leaves of plants back into the atmosphere in the form of water vapor. The total amount of water on the earth's surface is finite, and in essence, it is the same water cycling over and over again.

The hydrologic cycle process can be explained beginning with surface water. Surface water stored in lakes, streams, lagoons, and oceans, is heated by the sun's energy and turned into vapor through the process of evaporation. Transpiration begins

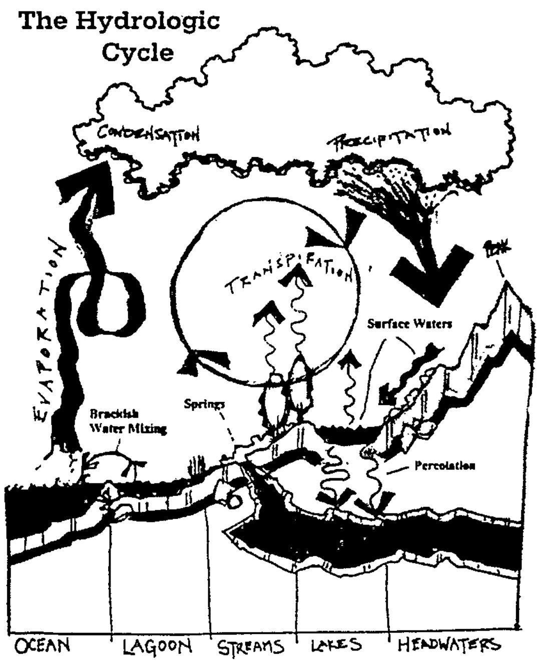


Figure 2-8: The Hydrologic Cycle

when plant roots absorb water stored in the soil. The water migrates up the stem or trunk until it eventually comes out of thousands of tiny holes on the bottom of leaves. A large oak tree transpires approximately 39,578 gallons per year (Leopold 1997, p. 5). The warmer the air temperature, the more water vapor the air can carry. When this air is cooled, the water vapor exceeds the carrying capacity of the air. This vapor turns back into its heavier liquid form, and falls to earth as precipitation. The rain is trapped by the leaves of plants, stored in the soil, or flows over the land and into the streams and eventually into wetlands, lakes, and the ocean.

Infiltration

One important aspect of the hydrologic cycle in terms of watersheds, is the process of infiltration, the rate at which water is absorbed into the ground. Infiltration is influenced by two main factors: the characteristics of the soil material, and the type and density of the vegetation growing or lying on the ground (Leopold 1997, p. 10). Soil is composed of millions of tiny particles that have air spaces, or pores, separating each particle. Precipitation that falls onto the land is absorbed, or infiltrated, through these pores. Soils with bigger pores, like sand, allow precipitation to infiltrate more quickly. Conversely, soils with smaller pores, like clay, infiltrate water more slowly. When rain falls faster than the pores can absorb, or when soil becomes saturated, the excess rain flows onto the surface of the land. This surface runoff flows over the ground and eventually into streams.

Vegetation plays an important role in the infiltration of rain by reducing the velocity of water flow over the landscape, and minimizing rapid sheet flows of water into streams and creeks. The roots of plants and burrowing insects that live near plants loosen compacted soils and create additional pore spaces that help to infiltrate water. Studies conducted on plots of land with varying amounts of vegetation reveal the benefits of vegetation on the infiltration process. On one plot, 37% of the land was covered with grass or other vegetation, and the other plot was bare ground. The land with 37% vegetative cover infiltrated water at six times the rate as bare ground (Leopold 1997, p. 12).

Groundwater

Another important element of the hydrologic cycle is groundwater (Figure 2-9). Once water has infiltrated into the soil, three results can occur: the water can be absorbed by plant roots and transpired back into the atmosphere, move laterally into streams as subsurface storm runoff, or move downward into the groundwater zone (Murdoch, Cheo, and O'Laughlin 1996, p. 5). Water is able to seep lower into the earth through

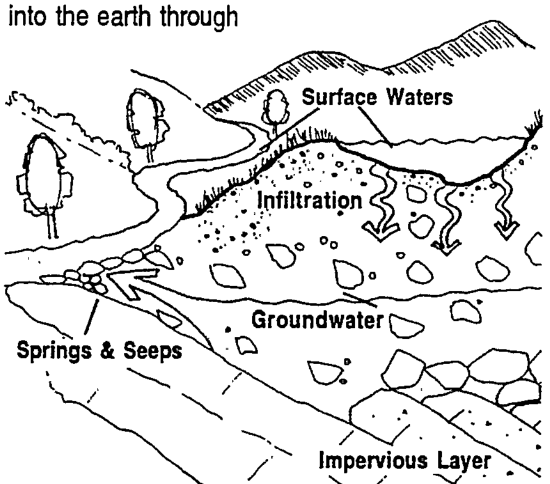


Figure 2-9: Infiltration of water into the groundwater

fractures, cracks, and pore spaces in rocks and soil material that are numerous towards the surface and become less abundant at greater depths (Leopold 1997, p. 18). Natural pore spaces may exist among the rocks. Sandstone and other sedimentary rocks that compose the geology in the Malibu Creek Watershed are excellent examples of porous rock.

Water will eventually find a level where it can sink no farther, and will begin to fill the same voids and pores that allowed it to penetrate into the earth. Eventually, the height of the groundwater zone will reach a level where it re-emerges as surface water through a seep or spring. This area where groundwater resurfaces is called a "discharge area" (Murdoch, Cheo, and O'Laughlin 1996, p. 5). Discharge areas are found in topographically low spots, usually the deepest cut in a stream channel (Leopold 1997, p. 20). The contribution of groundwater to surface water systems is called "baseflow" (Murdoch, Cheo, and O'Laughlin 1996, p. 5). This is one reason that streams continue to flow long after the last rain.

Surface Water

Streams are dynamic forces, both reflecting and changing the character of the surrounding landscape. There are three types of streams in the Malibu Creek Watershed (figure 2-10). The first type of stream is ephemeral, flowing only during

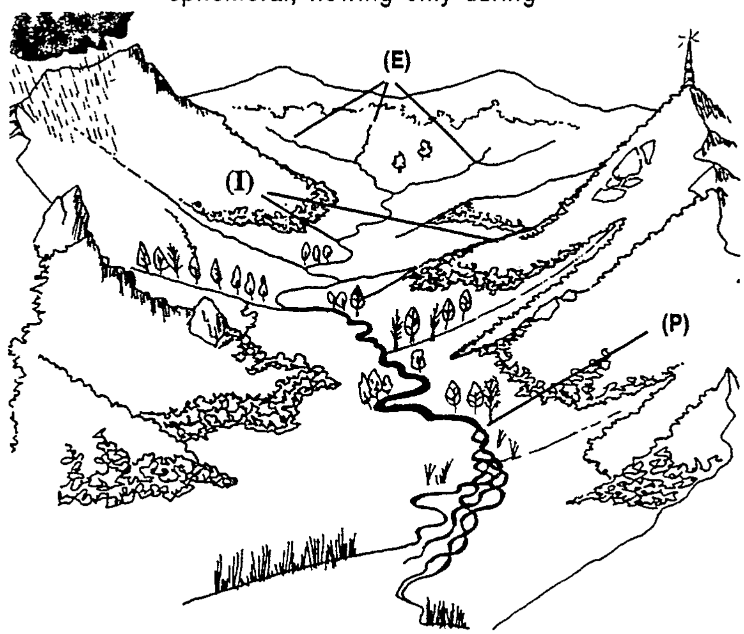


Figure 2-10: The Three types of streams within the watershed: (E) ephemeral, (I) intermittent, (P) perennial.

storms. Many of the streams in the upper watershed are ephemeral. The second is intermittent, a type of stream that has surface flows during the wet season, but still may be flowing subsurface during drier periods. Intermittent streams are the most dominant stream type in the Malibu Creek Watershed. Lower in the watershed, streams converge and the water table remains high enough to maintain the year round flows of the third type of streams, perennial streams. Historically, much of the flow that occurs during the summer season originates from springs, seepage areas, and areas of stored groundwater (Trim 1994, p. 1).

The Stream Continuum

A watershed drainage network continuously attempts to establish a balance between the shape of its stream channels and the amount and force of water running off the hillsides (Murdoch, Cheo, and O'Laughlin 1996, p. 63). Healthy streams have reached a state of equilibrium when the amount of sediments and water that enter the stream are the same amount that leave the stream. This process of equilibrium occurs as sand and gravel is scoured from the outside bend of a curve, and are then deposited on the inside of the curve (Figure 2-12). The meandering pattern of streams forces water to travel over a longer distance and dissipates the erosive power of the water. Unusual natural events or permanent alterations in the stream continuum caused by development can upset the balance of erosion and deposition of stream sediments.

Lining each stream are materials such as sand, cobbles, or boulders, making up the substrate of the stream. The type of substrate is a direct result of many factors including elevation, soils, geology, and slope. Substrate material, in general, is larger in size in the upper reaches of a stream. Headwater streams are narrow with stable substrates consisting of large cobble, boulders, or bedrock. In middle stream sections, the substrate will generally be composed of medium-sized cobbles and gravel. Heading downstream, the bottom material becomes finer, and is composed of sand and silt. The insoluble soil particles are carried in the water as suspended solids. Suspended solids remain in the water as long as the flow is significant enough to hold these particles in the water (Figure 2-11). At the base of the watershed,

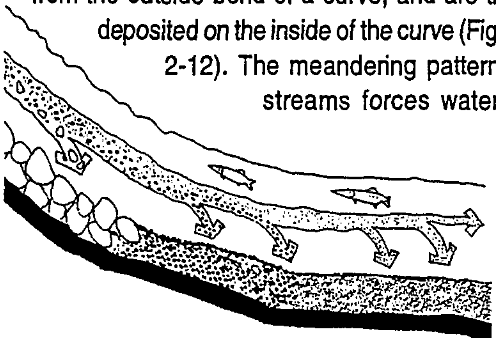


Figure 2-11: Sediment transport, as the stream gradient and velocity decrease, smaller particles are deposited.

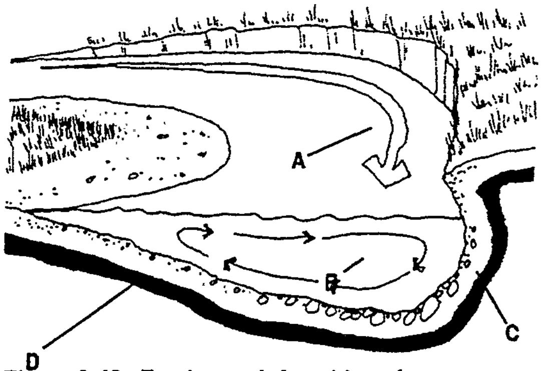


Figure 2-12: Erosion and deposition along stream curves: A) path of current around curve, B) circulatory current in water flowing around curve, C) area of erosion, and D) area of deposition (from figure 28, Leopold. Water, Rivers and Creeks 1997).

the amount of water continues to increase while the gradient flattens out, resulting in slower flowing, wider stream channels. The slower flowing water loses the ability to transport suspended solids, and may deposit them as sediments. These deposits create large sandbars that give the stream a braided appearance. In the natural process, much of the sediment washed into the waterways are deposited during intense storm events. This is why the streams and ocean look muddy after a large storm.

The Lagoon

At the bottom of every watershed is an outlet, either into another watershed, or into a large body of water. The outlet for the Malibu Creek Watershed is the Malibu Lagoon within the Santa Monica Bay. Lagoons act as large natural water filters, with plants and animals absorbing and breaking down nutrients, purifying the water. The maze of channels, the wetland plants, the tidal action, and the aquatic life contribute to the filtering and cleansing of water. The Malibu Lagoon is where freshwater and seawater interface. The Santa Monica Bay Watershed, which contains Malibu Lagoon, is recognized as one of four estuaries in California currently included in the U.S. EPA's National Estuary Program, which is aimed at improving or maintaining coastal water quality (USDA NRCS MCWNRP 1995, p. 7).

Sandbars are a key feature of the lagoon ecosystem. During the summer months, the closed sandbar separates the lagoon from the ocean. This is because less freshwater reaches the lagoon, due to the decreased flow of ephemeral or intermittent streams. As the freshwater flows diminish, sediments build up and close off the lagoon from the ocean.

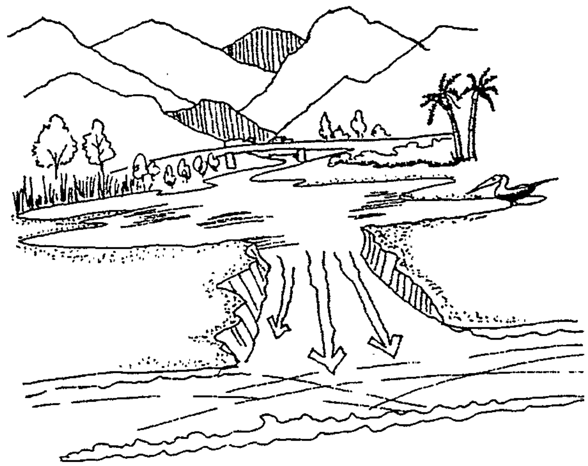


Figure 2-13: Increased flows of water during the winter months cause the lagoon's sandbar to breech.

This creates an important brackish or partially saline wetland condition that supports a large diversity of terrestrial and aquatic life. In the wet winter months, the high quantity of water flowing into the lagoon breaches or breaks open the sandbar (Figure 2-13).

The lagoon is a critical estuarine habitat. Currently it houses a population of the endangered Tidewater Goby that was reintroduced into the lagoon from the Ventura River Estuary (Figure 2-14). Migrating birds use the Malibu Lagoon as a rest stop on their long journey. The lagoon also supplies a critical rearing habitat for the endangered Southern Steelhead Trout. Steelhead use the lagoon to make the transition from salt water to fresh water before they begin their spawning runs up the Malibu Creek. Young steelhead use the brackish waters of the lagoon to adjust to saline conditions as they leave freshwater streams and migrate into the ocean.

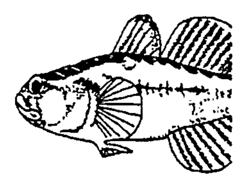
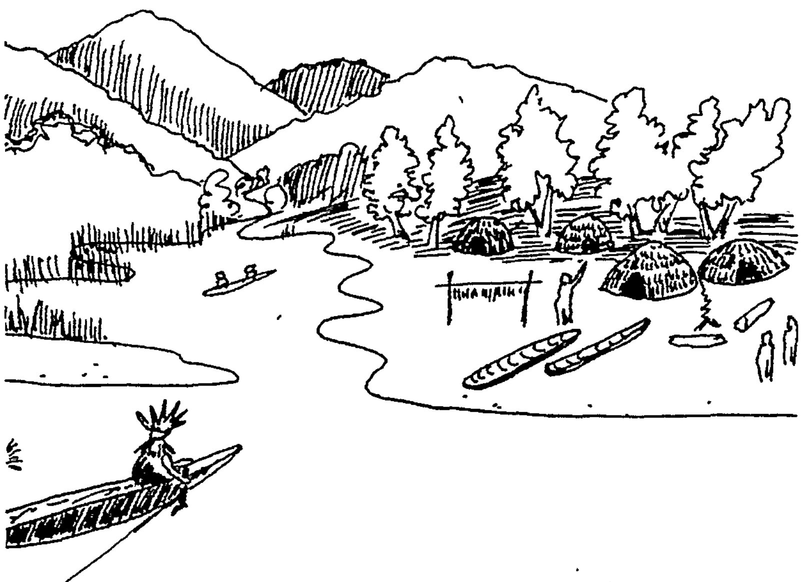


Figure 2-14: Tidewate

History of Settlement

The earliest evidence of human habitation in the Malibu Creek Watershed dates back over 7,500 years ago. These inhabitants were the predecessors of what would eventually develop into the Chumash culture. Malibu Canyon is located along the interface between the Chumash and the Gabrielino (Tongva) peoples. The Chumash inhabited the area from Malibu Canyon west and then north into San Luis Obispo County. Many Chumash archaeological sites have been found in the Santa Monica Mountains. These mountains were a plentiful source of game and plants were used for making shelter and for providing food. An extensive foot trail system was established throughout the mountains to facilitate traveling, trading, and hunting and gathering of food.



· *Malibu Lagoon was thought to be the location of a trading village of the*

Within the Malibu Creek watershed, Malibu Creek and its tributaries served as a major north-south travel route through the mountains. A major Chumash village was located along the ocean at the base of Malibu Canyon (Figure 2-15). The Chumash are believed to have used the Malibu Lagoon as a launching area for their canoes (Ambrose, Suffet, and Hee 1995, p. 9). Fish and shellfish were some of the abundant resources available to the Chumash at this site. The watershed supported a viable and rich Native American culture.

Spanish explorers traveled through this area starting in the 1500s, but it wasn't until the late 1700s that Spanish settlers and missionaries started coming to the Santa Monica Mountains. This had a profound impact upon the lives of the Chumash people. The community of villages fell apart under the influence of the mission system, the introduction of European diseases, and the assimilation of the Chumash culture into the Spanish, and later on into the Mexican and American, cultures.

During the 1800s, settlement and ranching activities started to take hold throughout southern California, including the Santa Monica Mountains. Under Mexican authority, land grants were made for private ownership of land and large ranchos were established. These privately held ranchos continued after California became part of the United States in 1850. Over time, these have been sold and subdivided until today we see a patchwork of privately and publicly held land with a mixture of land uses and development within the Santa Monica Mountains.

In the early 1800s, cattle grazing started in and around the Malibu Creek Watershed. The Rindge Ranch, a cattle and grain raising operation, occupied much of the area in the latter half of that century (Doyle et al. 1985, p. 39). In 1908, a railroad was built which spanned 15 miles of coast including the Malibu Lagoon. This Rindge line began near Las Flores Canyon and went all the way to Yerba Buena Road in what is now Ventura County. In 1928, the Rindge Dam was constructed in Malibu Creek to store water for irrigation to be used on the ranch (Doyle et al. 1985, p. 39). Construction of the Roosevelt Highway was completed and opened to the public in June of 1929. It was later renamed the "Pacific Coast Highway", and, as with the railroad, crosses over Malibu Lagoon.

Development in and around the watershed continued, and in the late 1950s and early 1960s growth was fueled by the rapid expansion around the Los Angeles area. In 1965, the Tapia Wastewater Treatment Plant (Tapia) was built to accept wastewater from the growing community within the watershed.

Recreational Opportunities

The Malibu Creek Watershed has some of the best recreational opportunities within the Santa Monica Mountains, and perhaps some of the best within southern California. Close to and easily reached from the Los Angeles metropolitan area of over 13 million people, the Santa Monica Mountains is a popular destination for those wanting to find high quality recreational activities.

Creation of parklands within the Santa Monica Mountains began in the 1940s by the State of California. At the national level, the need to preserve and protect the unique resources of the Santa Monica Mountains was recognized by Congress in 1978 when it established the Santa Monica Mountains National Recreation Area under the National Park System. Various governmental agencies and private groups have joined in the effort to preserve land within the Santa Monica Mountains. The result is an evolving system of parklands that not only protect the natural resources of the mountains, but also offer many opportunities to recreational users.

There is a wide range of sites where the public can visit and learn about the unique natural and cultural resources within the Malibu Creek Watershed. These include Tapia Park, Malibu Creek State Park, Rocky Oaks Park, Peter Strauss Ranch, Cheseboro Canyon, and Malibu Lagoon State Park. Adjacent to the lagoon is Malibu Surfrider Beach, one of the most heavily used beaches in southern California. It is world-renowned for its excellent surf break and is used year-round. Throughout the watershed is an extensive trail system. Most trails are limited to hikers, but others are designated for use by mountain bikers and equestrians. Additional activities enjoyed by visitors include, biking, horseback riding, birdwatching, swimming, picnicking, scuba diving, fishing, whale watching, and beach going.

Section 3

Issues and Analysis

Settlement in the area has altered the natural hydrologic regime and ecological functioning within the watershed. This section details issues of concern in the Malibu Creek Watershed due to settlement. Of primary concern are the influences of imported water, the increased acreage of impervious surfaces, accelerated erosion and sedimentation, and increased levels of nutrients flowing into the receiving waters. Further, settlement has altered the natural fire regime, the distribution of vegetation, loss of wildlife habitat, and the size and function of the lagoon within the Malibu Creek Watershed.

Imported Water

In response to the demand of a growing domestic, commercial, and industrial community, water has been imported into the watershed since the 1960s. Approximately 20,000 acre-feet, or 6.6 billion gallons a year, is imported into the watershed primarily from the California State Water Project, which collects and transports water from northern California. Imported water and any pollutants it may carry enter the stream system in three ways: by discharges into Malibu Creek from Tapia, by surface runoff via the storm drain network, and through groundwater. Increased water quantity and decreased water quality have altered chemical, biological, and physical characteristics of the streams and lagoon.

Tapia receives wastewater from households and businesses within and beyond the watershed, and services an estimated population of 90,000 people. By the year 2020, the population serviced by Tapia is predicted to rise to 160,000 (Bauer Environmental Services March 1996, p. 54). Tapia is located along Malibu Creek approximately five miles north of the Malibu Lagoon. Tapia filters and treats the wastewater, reclaiming it to a condition that allows it to be reused safely for irrigation (Figure 3-1). Tapia also composts the solid waste into fertilizer for fodder crops at their Rancho Las Virgenes Compost Facility (Las Virgenes Municipal Water District 1994, p. 36).

Tapia has increased its capacity since it opened in 1965, and now has the capacity to handle 16 million gallons per day (mgd). Current inflows average 7.75 mgd, or 8,680 acre-feet per year. Tapia sells

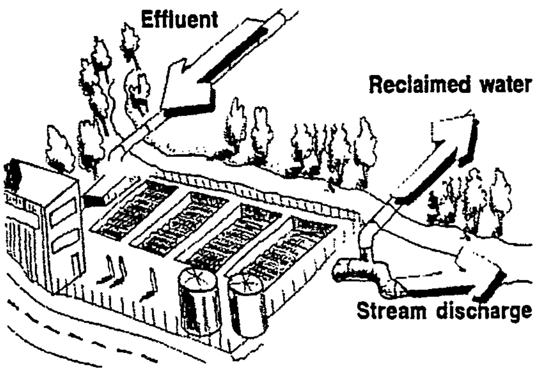


Figure 3-1: The Tapia Wastewater Treatment Facility

approximately 4,000 acre-feet of reclaimed water each year for use in irrigating open space and landscaping. The additional 4,680 or so acre-feet is treated and discharged to Malibu Creek (USDA NRCS MCWNRP 1995, p. 35). Reclaimed water has higher than normal levels of nutrients that can enhance the growth of algae. When these algal blooms die, the decomposition process may rob the water of the oxygen that fish and other aquatic life need to survive. Tapia is the only such facility in the watershed.

2: Overview of runoff associated with development.

The use of imported water for a variety of purposes outdoors, including landscape and agricultural irrigation, has altered the quantity, quality, and seasonal flow of water within the watershed. Runoff from overwatering or improperly designed and installed irrigation systems can flow onto streets and into the storm water drainage network. In addition, water can enter stormdrains from the hosing down of driveways, sidewalks, and streets as well as from washing cars in areas where water can not be absorbed into the soil. Unlike water that enters the sewage system, this water is conveyed directly into a nearby receiving water body without any form of treatment.

Runoff associated with landscape and agricultural irrigation may carry herbicides and pesticides, and nutrients from fertilizers. Water that is used to wash cars and hose down driveways and streets may wash metals, nutrients, oil, and grease into receiving waters (Figure 3-2).

Imported water can also reach the streams through groundwater. Water that is not absorbed by plants may move laterally into streams as subsurface storm runoff, or move downward into the groundwater zone (Murdoch, Cheo and O'Laughlin 1996, p. 5). Water from landscape irrigation or from septic systems is infiltrated through the soils. This water can carry nutrients from the over fertilization of lawns and agriculture, and improperly functioning septic systems. The watershed has an estimated 2,300 septic tanks (USDA NRCS MCWNRP 1995, p.16).

Impervious Surfaces

Impervious surfaces are constructed surfaces that do not allow water from rainfall or other sources to be effectively absorbed or infiltrated directly into the soil. Examples include rooftops, roads, parking lots, driveways, and sidewalks, usually made out of asphalt, concrete, brick or other types of paving materials, but they may also be areas with compacted soils, such as dirt roads. Such surfaces replace vegetation and soils, thereby affecting the area's ability to clean and infiltrate surface runoff. Storm water rushes off of the impervious surfaces, into the storm drain network, and eventually into a channel or creek (Figure 3-3).

Impervious surfaces collect and accumulate pollutants from a variety of sources, including those from the atmosphere, oil from cars, tossed debris, and fecal matter from animals. These accumulate over time until they are eventually washed away into the watershed's drainage network via the storm drain system. This runoff concentrates in creeks and streams, and eventually flows through the watershed and out into the Santa Monica Bay at Surfrider Beach. Storm water runoff is normally at its highest level of contamination during the "first flush" which is the first significant storm event of the rainy season after pollution has had a chance to accumulate during the long, dry summer period. A health effect study conducted by the University of Southern California, reported that people swimming within 100 yards of a flowing storm drain reported increased incidents of becoming sick. The amount of pollution washed into the riparian system can be directly related to the amount of impervious surfaces in the watershed (Schueler 1995, p. 24).

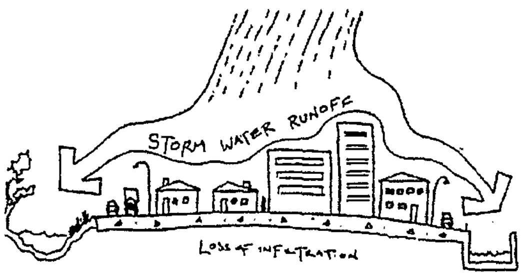


Figure 3-3: Impervious surfaces prevent infiltration, dramatically increasing stormwater volume and peak intensity.

The runoff of pollutants into streams and the accelerated rate of soil erosion that impervious surfaces cause can drastically alter the vegetation along streams. Decreased amounts of vegetation that shades the stream can increase water temperature and decrease the available dissolved oxygen needed by aquatic organisms. This, along with a variety of pollutants, can cause a decrease in the health of aquatic animals, including amphibians and fish.

Besides accumulating pollutants, impervious surfaces increase storm water runoff and cause accelerated erosion of soil. Accelerated erosion is due to the greater rate and volume of runoff during storm events. Studies have shown that runoff from a one acre parking lot can be about 16 times the amount of runoff from a one acre undeveloped meadow. The increased volume of storm water runoff into the riparian system also increases the frequency of bankfull conditions in creeks and streams, resulting in streambank erosion and greater degradation of riparian habitats. The threshold for maintaining good quality urban stream habitats is about 10% to 15% impervious surfaces. An increase in the percentage of impervious surfaces above this level results in the decline of predevelopment water quality and stream habitat (Schueler 1995, p. 24).

Dealing with the effects of impervious surfaces is costly. An extensive storm water drainage system is built with pipes, concrete culverts and channels. Construction activity is needed to handle the erosion of slopes and streambanks. It is cheaper and more cost effective to limit the amount of impervious surfaces in the watershed rather than to try later to fix the problems impervious surfaces can cause.

The construction of impervious surfaces and the importation of water have resulted in increased runoff and stream flows in the watershed. The Natural Resource Conservation Service (NRCS) collected data at the stream gauge located below Tapia in Malibu Creek for the years 1931-1994. From this data, they constructed a water budget. Their analysis

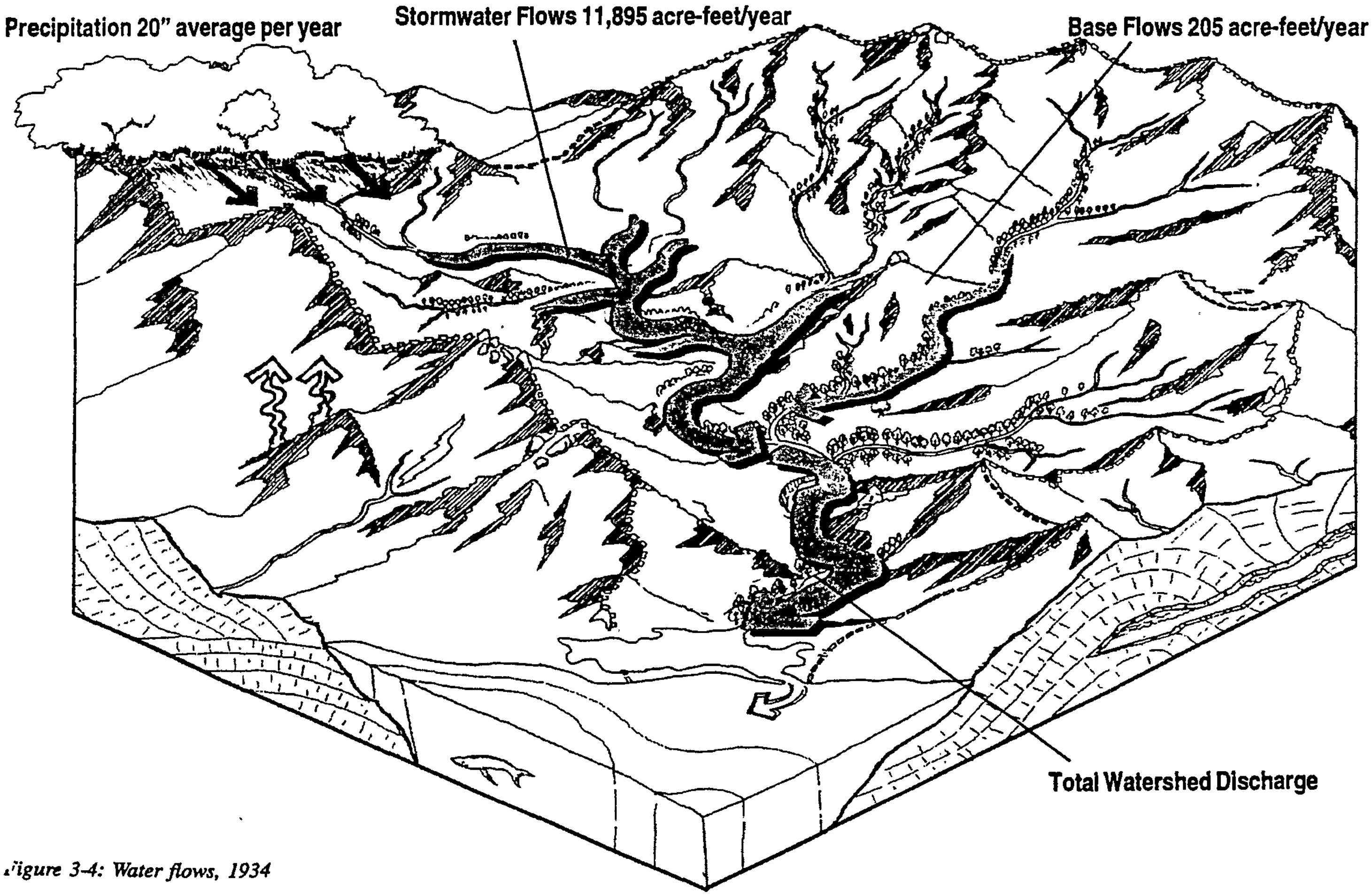


Figure 3-4: Water flows, 1934

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demonstrates how stream flows have been altered due to changing land uses within the watershed, the importation of water, and the replacement of vegetation with impervious surfaces. Their analysis also reveals a change in base flows within Malibu Creek from 205 acre-feet in 1934 (Figure 3-4) to 2,050 acre-feet in 1994 (Figure 3-5). Base flow is the water volume measured in the creek and excludes releases of reclaimed water from Tapia. In addition to increases in base flows, stream flow during storm events also increased dramatically, from an annual average of 11,895 acre-feet in 1934 to over 21,000 acre-feet in 1994.

From 1931 to 1965, prior to significant upstream development, imported water, and discharges by Tapia into Malibu Creek, the average annual stream flows recorded at the stream gauge were about 12,000 acre-feet. The average annual flow of water since 1966, after significant upstream development, has averaged 27,000 acre-feet per year (USDA NRCS MCWNRP 1995, p. 36).

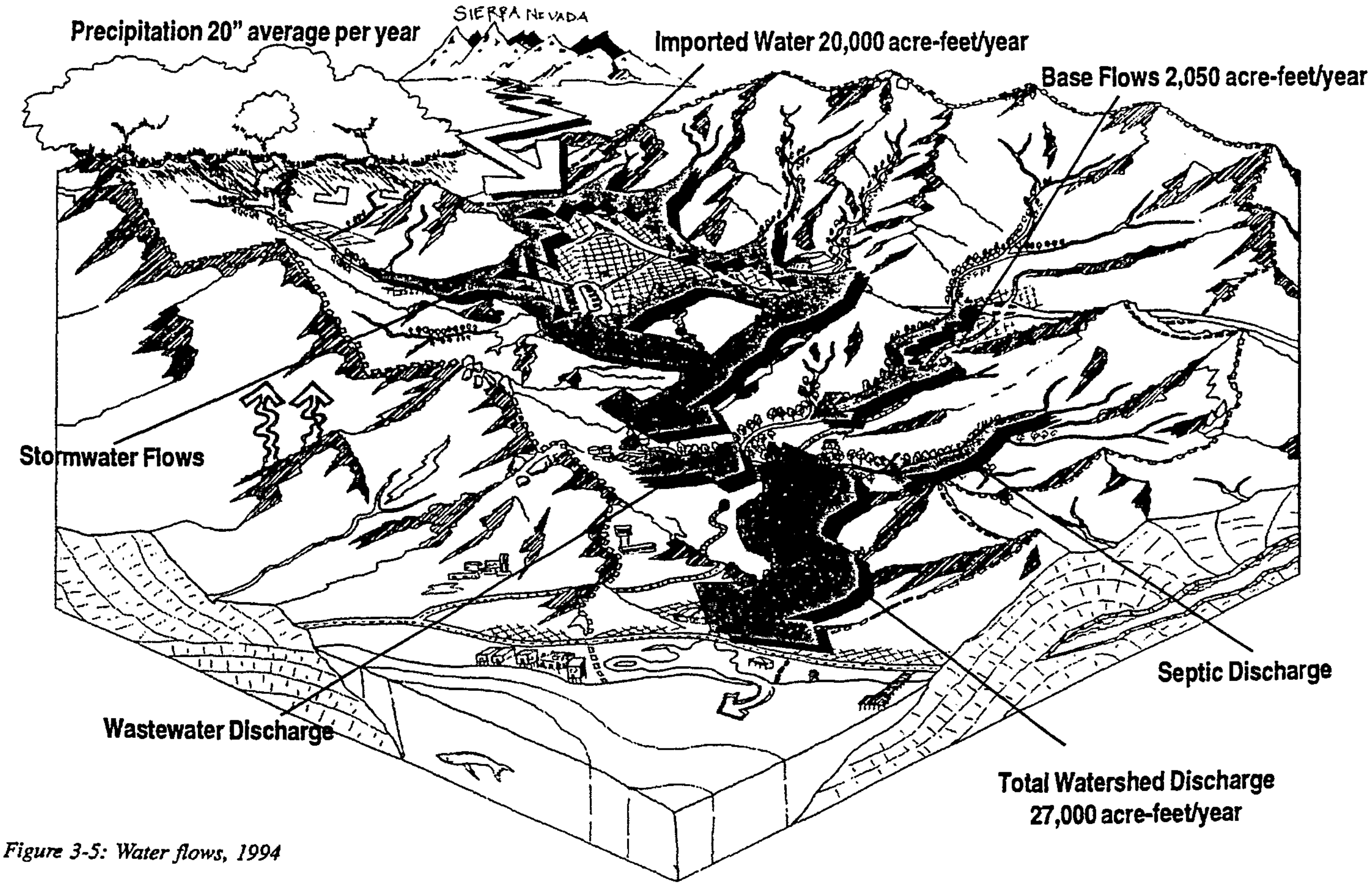

Figure 3-5: Water flows, 1994

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The NRCS Malibu Creek Watershed Natural Resources Plan (MCWNRP 1995), estimates the break down of these increased flows as follows:

Discharge from Tapia	4,000 acre-feet
Runoff from home use and landscape irrigation	2,500 - 3,500 acre-feet
Septic tanks seepage	500 acre-feet
Storm runoff	19,000 - 20,000 acre-feet

A model was created to determine the effects of increasing development and impervious surfaces on peak discharges for each of the seven major tributaries. The model compares the natural conditions prior to human influence with the current conditions in the watershed. The model calculates runoff and peak discharges for 2, 5, 10, 25, 50, and 100-year storm events. The results demonstrate the overall increase in peak flows and the volume of runoff that is particularly evident in the more densely developed subwatersheds of Westlake and Agoura. This model does not consider inputs from Tapia. The overall flows entering the lagoon have also more than doubled. The details and the model can be seen in Appendix A.

To avoid flooding caused by the increased volume and intensity of runoff created by impervious surfaces, many streams and creeks are channelized (Figure 3-6). Potrero Creek from Lake Sherwood to Westlake Lake is almost completely channelized. Significant channelization has also occurred throughout the City of Agoura Hills. Channelization affects a watershed's hydrologic functioning. Designed to move water quickly out of the area, channelized streams are artificially lined with concrete for flood control purposes. The result is a waterway that has few, if any plants, and little wildlife habitat value. The channelization of an area diminishes other benefits of riparian corridors, such as water purification, and slowing water flows. Because there are no cobbles, boulders, plants, or streambank irregularities that could slow down rushing water, downstream riparian areas are often overwhelmed by the increase in water velocity.

Erosion and Sedimentation

Erosion and sedimentation are also important issues of concern within the Malibu Creek Watershed. Erosion is the process of surface water cutting into

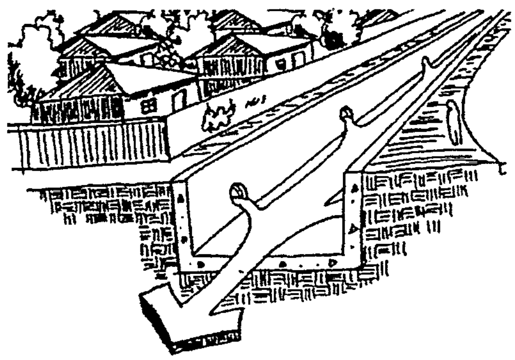

Figure 3-6: Channelization eliminates any benefits provided by riparian corridors.

and carrying soils, organics and rock material into waterways. When they settle, these insoluble particles are called "sediments". The Santa Monica Mountains contains many soil types that are considered highly erodible. An area's erodibility is dependent on the type of soils, slope, vegetative cover, and its exposure to water and rain. Consequently, erosion is a natural process that

happens frequently within the watershed, and erosion adds sediments and nutrients to the streams. Erosion is also part of the natural cycle of wildfires; however, in developed areas, fire suppression measures have resulted in older, unburned plants. This in turn increases fuel loads, and therefore the intensity of a potential fire. The resulting erosion from such intense fire events increases sediment loading into streams.

Increased sedimentation of waterways can have a significant effect on instream habitat quality. Several factors have caused an increase in the sedimentation of streams, altering their natural process. Construction sites have exposed soils that erode, increasing sedimentation (Figure 3-7). Typically, 35 to 45 tons of soil per year per acre is washed from construction sites (Center for Watershed Protection n.d., p. 23). As well, agriculture, animal husbandry, and areas of disturbed or non-vegetated land significantly contribute to sediment loading. These sediments can cover stream bottoms, altering the habitat for aquatic life. The local steelhead trout is particularly sensitive, since they need gravelly stream bottoms for reproduction (Figure 3-8).

Dams used to create reservoirs or recreational lakes also play a role in the sedimentation process. They slow water flow to the point that suspended solids are dropped. The dam then becomes a sediment trap that quickly fills in (Figure 3-9). This has happened at Rindge Dam, located two and one-half miles north of the Malibu Lagoon. It creates barriers, preventing the migration of steelhead trout to their historic spawning grounds in the upper parts of Malibu Creek. The dam also traps sediments that may have been carried to the ocean and used for beach replenishment (Ambrose, Suffet, and Hee 1995, p. 10). Many of the reservoirs and constructed lakes within the Malibu Creek Watershed require regular dredging. Dredging is expensive, particularly if these sediments are placed in a landfill. These reservoirs and dams interrupt the natural migration of sediments.

Figure 3-7: Construction sites can be a significant source of sediments.

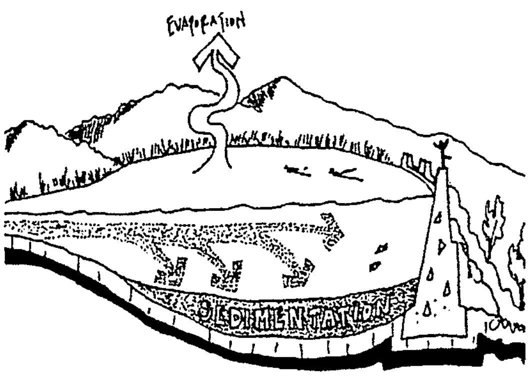

Figure 3-9: Reservoirs slow sediment transport to the point of becoming sediment sinks.

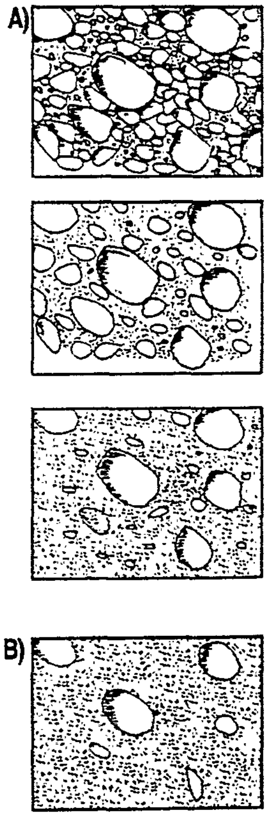

Figure 3-8: How a stream can become embedded in sediments, changing the substrate from gravelly (A) to silty (B), degrading Steelhead Trout breeding areas.

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Nutrient Loading

Nutrients are necessary for the growth of plants and animals in natural water systems, and are primarily composed of nitrates and phosphates (USDA, NRCS Malibu Creek Watershed Natural Resources Plan 1995, p. 47). Nutrient loading takes place when there is an overabundance of nutrients. High nitrate levels may cause increased algae production, cloudy water, decreased oxygen levels, and objectionable odors (USDA, NRCS Malibu Creek Watershed Natural Resources Plan 1995, p. 47). Areas of standing water like the various constructed lakes and the Malibu Lagoon may be subject to increased effects of excessive algal growth and low dissolved oxygen levels causing fish kills and odor problems (Figure 3-10). Persistent eutrophication problems can change the composition of plant and animal species and decrease the biological diversity of a particular water body (USDA, NRCS Malibu Creek Watershed Natural Resources Plan 1995, p. 48). To minimize the growth of algae, many of the constructed lakes

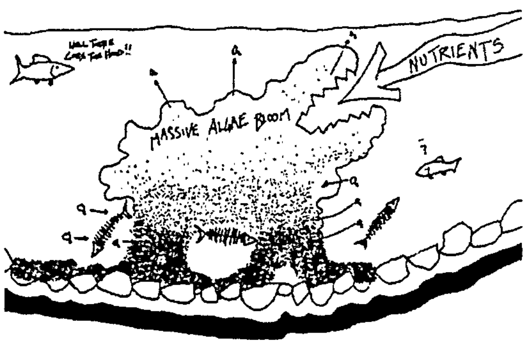


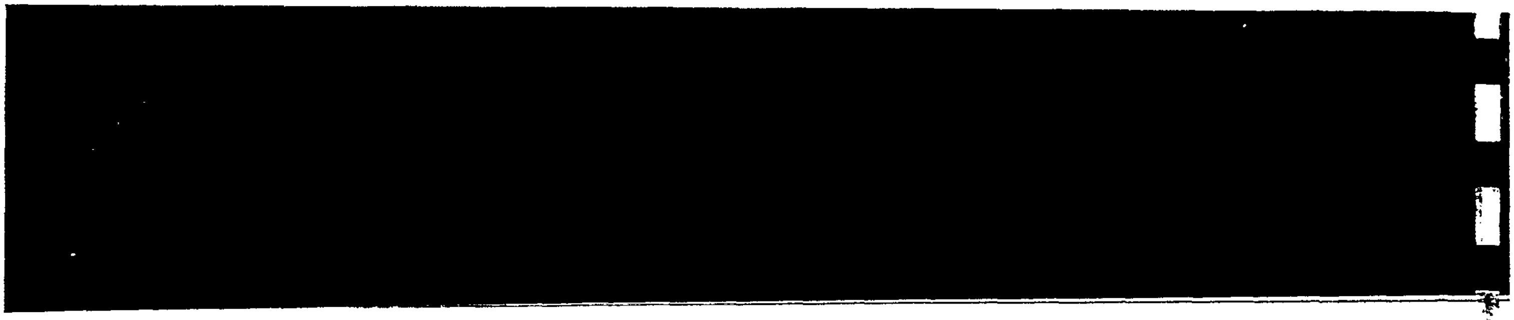
Figure 3-10: Algae blooms sparked by excessive nutrient can result in depleted oxygen level with detrimental effects to aquatic life.

are treated with copper sulfate, a powerful chemical; this may further contribute to degraded water quality and be a threat to the ecological functioning of the watershed. Prior sampling in the watershed has revealed that nutrient loading is a problem throughout the watershed.

High phosphates levels can also disrupt water quality. Sources include runoff from manure storage areas, feedlots, barnyards, leaking or improperly maintained septic systems, wastewater treatment plants, detergents and commercial cleaning preparations, soil erosion, and phosphate rich fertilizers (Behar, Dates, and Byrne 1996, p. 130). The fire retardant used to fight fires is a significant source of phosphorous and ammonia. A 1989 study found that during the first 24 hours following an aerial application of fire retardant, significant amounts of phosphorous, ammonia, and nitrogen were present in nearby streams (Ambrose, Suffet, and Hee 1995, p. 15).

Fire

Fire suppression near developed areas has allowed the plants to age, increasing woody fuel loads, and decreasing wildlife habitat value. Fire within older chaparral and coastal sage scrub stands has resulted in more intense fires and increased erosion. Fires cause increased runoff and stream flow, increasing sediment transport and nutrient loading to the lagoon (Ambrose, Suffet, and Hee 1995, p.7). The natural fire regime affects both water quality and water quantity within the watershed. Chaparral vegetation exudes oils, fats and other organic residues during combustion, which fall to the ground and create water-repellant soils. Water quantity is increased due



to the removal of vegetative cover and the decreased porosity of soils. Increased runoff and less vegetative cover cause soil to be transported into the streams. The increased sediment load raises the turbidity, temperature, and dissolved organic nutrients content in the stream (Levy, Korkosz 1997, p.II-51). Plants that are burned from fire are washed into the streams during rain events causing elevated nutrient levels.

Effects of Settlement on Vegetation & Wildlife

Settlement has altered the native vegetation in the Malibu Creek Watershed. Much of the native vegetation has been eliminated by the addition of housing, roads, and surfaces that do not allow water to be absorbed into the ground, increasing the volume and intensity of storm water run off. Native vegetation is important in the riparian zone because they provide shade, which cools the water temperature, and provide food, habitat and shelter for aquatic animals and fish. Non-native plants brought in by early cattle ranchers and settlers, as well as plants used for landscaping, have been introduced into the watershed, and some of these plants are extremely invasive, displacing large areas of native vegetation. Landscaping practices affect water quality with the use of fertilizers, herbicides, pesticides.

Wildlife is dependent upon vegetation for shelter and food. Though the Santa Monica Mountains provide a large amount of healthy habitat, increased development is taking its toll through loss of habitat and habitat fragmentation.

The Lagoon

Development throughout the watershed has also had a significant effect on the lagoon's ecosystem. Pollutants from urban runoff, sediments, nutrients, and debris collect in the lagoon, creating a sink, or point of deposition. Although lagoons are excellent water purifiers, the additional quantity and lower quality of water reduces the lagoon's capacity to effectively filter the water. Prior to modern development, the lagoon was substantially larger than it's present 13 acres, and had greater species richness and abundance than today's 13 fish species (Ambrose, Suffet, and Hee 1995, p. i). The earliest maps seem to confirm a much larger lagoon that extended eastward around the point and to the west up to the base of the hill where Pepperdine University is now located (Ambrose, Suffet, and Hee 1995, p. 4). In essence, this smaller lagoon is asked to treat more water of lower quality. Excess flows of wastewater discharged into Malibu Creek cause the sandbar to breech during the dry season. This has the potential to suddenly change the lagoon's salinity, disrupting natural processes and affecting wildlife.

Section 4

The Monitoring Program

Many monitoring programs throughout the country utilize a variety of techniques to assess the overall ecological health within a watershed. A comprehensive approach to monitoring, one that takes into account the chemical, biological, and physical aspects of the stream ecosystem, yields the most usable data. This information allows decision-makers to attack the sources of problems from many different angles, not just one. Monitoring techniques include water quality or chemical testing, macroinvertebrate sampling, and stream reach surveying. The methods vary for each monitoring program, and grow out of the program goals and objectives.

The Cal Poly Team has designed a monitoring program that utilizes citizen volunteers to evaluate the overall ecological health of the Malibu Creek Watershed. The monitoring program is designed to address the issues related to imported water, impervious surfaces, erosion and sedimentation, nutrient loading, and pollutants associated with urban runoff. It is hoped that the monitoring program will determine the degree of degraded riparian habitats within each of the subwatersheds and target areas for future enhancement and restoration. Details about the specific monitoring procedures can be found in *The Malibu Creek Watershed, Stream Team Field Guide*, prepared by the Cal Poly Team.

The monitoring program is designed to represent an overall view of the entire watershed. This is a pilot project; therefore, it may not be practical to implement every element in the initial start-up phase. A phased approach allows the program flexibility, and is intended to provide Heal the Bay with options and the flexibility to adjust the program as necessary.

Involvement by citizen volunteers in the monitoring program should allow Heal the Bay and the California State Coastal Conservancy to meet the following long-term objectives:

- To establish baseline information that will ascertain the current overall health of the watershed.
- To determine the potential impacts of impervious surfaces and water quality due to urbanization within the watershed.
- To locate areas of degradation along stream corridors and to identify potential future restoration efforts.
- To assess the effectiveness of planning recommendations or Best Management Practices (BMPs) that are implemented to protect the watershed or mitigate potentially negative impacts.

Design Process

The design of the volunteer monitoring program began with a watershed inventory that involved the collection of studies conducted on the Malibu Creek Watershed. These studies were researched to gain a clear understanding of the natural processes at work in the watershed. A summary of this information can be found in section 2 of this document, Natural Processes. The second step was to analyze the collected information, and consult with concerned groups and local, state, and federal agencies that are active in the watershed. This helped identify key issues and questions that needed answers from the monitoring program. Section 3, Issues and Analysis, summarizes these elements. In addition, monitoring programs and protocols being used around the country were researched. Telephone surveys and questionnaires were distributed to the leaders of these monitoring programs to identify and avoid potential pitfalls. A workshop with a pool of potential volunteers was conducted, wherein volunteers were asked to identify potential monitoring sites and problem areas, to create a name for the program, to evaluate the proposed program for ease of use, and to establish a level of commitment Heal the Bay could expect from volunteers. Monitoring protocols and early drafts of the field guide were tested at two training events. Volunteers were asked to critique the protocols and the field guide. The monitoring program was revised based upon the input and suggestions of volunteers to the current design detailed in this section.

Successful Programs

The following elements were identified as being critical to ensure a successful volunteer monitoring program, as identified in the San Francisco Estuary Institute's *Riparian Station How-To Manual,* and from phone interviews with other monitoring programs around the country.

Motivating Volunteers

- Meet the needs of volunteers. This may be a simple as giving praise for a job well done or providing snacks and water at monitoring events.
- Listen and consider volunteer recommendations and suggestions.
- Acknowledge and reward the efforts of volunteers.
- Explain how the information collected by volunteers is being used to enhance the watershed.
- Involve volunteers in restoration activities and solutions, as well as in identifying problems.

Quality Control

- Provide the necessary equipment to collect good quality information.
- Assure the quality of the data by having frequent quality control checks and ongoing training.
- Ensure the quality of data collected through regularly scheduled training events, and appropriate protocols.

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Program Organization and Expansion

- Organize a well structured program.
- Develop additional funding to support and expand the monitoring program as interest grows.

Using the Information

- Ensure the information collected by volunteers is analyzed and made available to interested agencies and groups that work in the watershed, for planning and resource protection.
- Integrate other locally collected data for analysis and dissemination.
- Use the Stream Team Program to educate the public about watershed issues.

Monitoring Program Overview

The Stream Team Volunteer Monitoring Program has been designed by the Cal Poly team for use in two phases. The purpose of Phase 1 is to provide useful monitoring information while at the same time providing volunteers with an opportunity for hands-on participation. Phase 1 will involve two types of monitoring activities–Stream Walking, and Water Chemistry Testing. This is a fact-finding phase that will help Heal the Bay to ascertain the existing condition of the watershed. In addition, trouble spots will be identified and located for further investigation and restoration. Phase 1 is the pilot phase of the project. Phase 2 expands on Phase 1 by adding the additional activities of Stream Reach Surveying and Macroinvertebrate Sampling.

All the information collected by the volunteers will be entered into a Geographic Information System (GIS) database (a computer mapping and database program) that will be maintained at Heal the Bay. This GIS program will allow the information to be analyzed by Heal the Bay and distributed to agencies throughout the area. The following is a brief description of the activities that will occur during each phase of the project.

Phase 1

Stream Walking

Stream Walking is the systematic visual observation of physical conditions along streams within the Malibu Creek Watershed. The focus includes locating all types of discharges flowing directly into streams, and areas of disturbance such as erosion and invasive plant species, barriers to fish passage, illegal dumpsites, and human alterations to the streambank (Figure 4-2). This is a method for quickly collecting

Figure 4-2: Stream walker with GPS device noting location of discharge point.

information on elements that are impacting the water quality and ecological functions of the stream. This gathered information should alert Heal the Bay to the locations of suspected impacts within the Malibu Creek Watershed so that these impacts can be targeted for immediate removal or restoration. Stream Walking provides valuable information that should help prioritize the more specific testing that will occur during Phase 2.

Water Chemistry Testing

The Water Chemistry Testing team will use chemical testing to examine the water quality of a number of fixed stream sites throughout the watershed (Figure 4-3). Tests include pH, temperature, dissolved oxygen, turbidity, conductivity, nitrates, ammonia, and phosphates. Once the data is compiled and analyzed, a picture of the existing conditions of the watershed should be revealed. This procedure is designed to determine how much each subwatershed is contributing to downstream flows

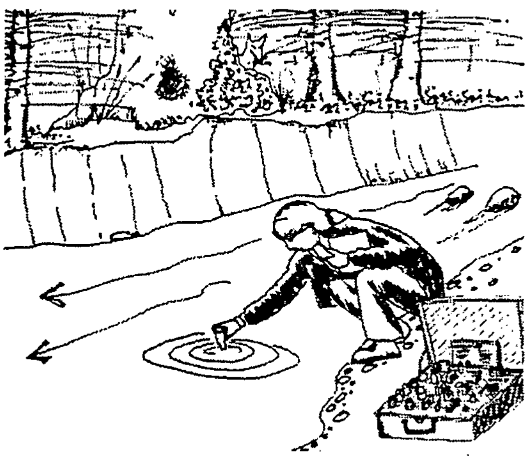

Figure 4-3: Water Chemistry tester taking pH reading.

and water quality. This information will be used to guide the expansion of the Water Chemistry Tes g in Phase 2, and will be shared with the Regic al Water Quality Control Board so that the sources of pollution can be identified and eliminated.

Phase 2

Macroinvertebrate Sampling

Biological monitoring is an important tool for tes g water quality and assessing the health of the watershed. Aquatic macroinvertebrates live mos r all of their lives in the water. They react to polluta , water temperature, and habitat conditions like sedimentation of substrate, and are theref e continuous indicators of water quality. Monitors ll collect macroinvertebrates, identify them, and sort them into taxonomic categories. If a monitor g sample shows a great number of pollution-toler t

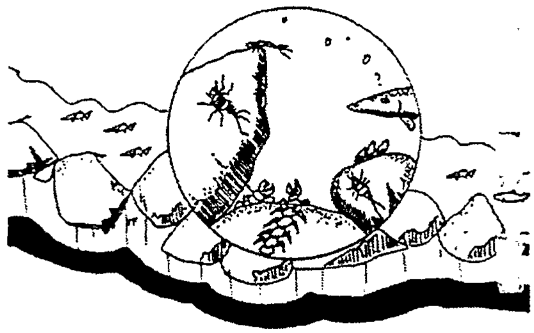

Figure 4-4: View of the macroinvertebrate environm t

macroinvertebrates, and very few, if any, of t pollution-sensitive macroinvertebrates, it can indicate that water quality is poor. A healthy stream sho l demonstrate excellent species diversity for t various types of aquatic macroinvertebrates in the watershed (Figure 4-4).

Stream Reach Survey

Stream Reach Surveying is the detailed measurement and assessment of physical characteristics of randomly selected 100-foot stream segments along the entire length of a stream (Figure 4-5). Further, the Stream Reach Survey involves walking the same tributaries as the Stream Walk procedure, and will be used to monitor the progress made during Phase 1. By examining existing stream characteristics and comparing them against future observations, it may be determined if habitat is being lost or degraded due to upstream development.

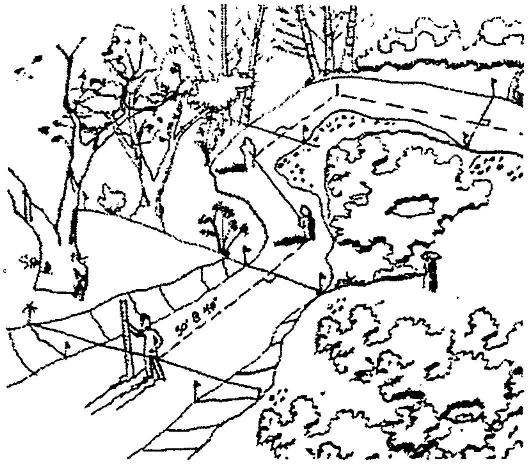

Figure 4-5: Overview of stream reach surveying.

Monitoring relatively undisturbed stream reaches can yield baseline information that can be compared to areas impacted by land use activities, in order to determine if those activities are affecting the conditions of the stream. These same locations can be monitored over time to determine the long term effects of upstream development.

How The Program Works

Volunteers have a choice of taking part in one or more components of the Phase 1 monitoring program. These include Stream Walking or Water Chemistry Testing. Both Stream Walking and Water Chemistry Testing are conducted on a monthly basis, requiring a four-hour commitment on one weekend day per month. Volunteers should be placed on one or more of these teams, based upon their interests, skills, time, and the needs of the volunteer monitoring program.

Each volunteer should attend an initial orientation session, which will provide an overview of the monitoring program and introduce the different components of the program. Following the orientation session, volunteers will be asked to attend two training events. During these events, they will be given the opportunity to learn the basic skills necessary to perform the monitoring tasks. Once they have acquired the necessary skills for monitoring, they can join the Stream Team (Figure 4-6).

Establishing a Core of Volunteers

Volunteers are essential to the Stream Team Program and are an important link between Heal the Bay and the community (Rigney, Fischer, and Sawyer 1996, p. 19). Extensive research on implementing volunteers was conducted through interviewing the program coordinators of other monitoring programs across the country, who were eager to share their experiences and to help others avoid problems they faced. The following suggestions were made:

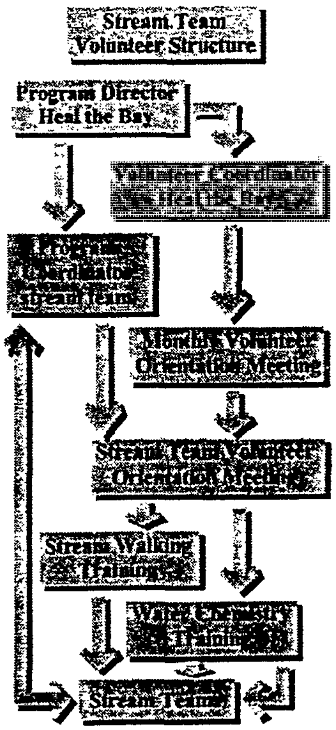

Figure 4-6: Volunteer flow

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- Develop a core of volunteers that are very dedicated to the project. This core will assist the program coordinator in many activities involved with the program.
- Create an open channel of two-way communication. Encourage input from volunteers and good suggestions should be incorporated into the program. Volunteers will get discouraged with any program that is not well organized and does not acknowledge their efforts and emphasize what the program is accomplishing.
- Feedback is critical. Any program should be flexible and have the ability to adapt to change. If the manual or procedures are hard to understand, volunteers can provide excellent feedback that can greatly improve the comprehension of the monitoring procedures. A workshop at Heal the Bay revealed that social interaction and meeting people with like interests was an important factor to becoming involved in the Stream Team Program.

Recruiting Volunteers

Heal the Bay is very experienced in recruiting volunteers and can develop and maintain a significant volunteer pool utilizing their existing channels. Several modifications to existing procedures that incorporate the Stream Team Program will ease the workload and save time within the organization. Currently Heal the Bay attends many events where they provide information and literature about the organization as well as opportunities to get involved on a voluntary basis. This literature should include the Stream Team Program and the volunteer opportunities associated with it. It is important that this literature provide some detail about the physical nature of the project as well as the time commitment necessary to participate.

Heal the Bay should include a section about Stream Team activities on their website. A section of their newsletters should be dedicated to activities and accomplishments of the Stream Team and to volunteer opportunities. Newsletters are an excellent way to recruit new volunteers to the Stream Team program and to share accomplishments of the Stream Team program.

Additional potential sources of volunteers:

- Local residents that live in or near the watershed
- Local high schools, colleges, and universities
- Local environmental groups like the California Native Plant Society, Audubon Society, Surfrider Foundation, Cal Trout, Ducks Unlimited, and the Sierra Club
- Local scuba diving clubs, fishing clubs, and equestrian groups

Training Volunteers

The key to collecting high quality data is good training (Rigney, Fischer, and Sawyer 1996, p. 19).
The volunteers need to feel confident in their abilities and the training they receive. A minimum of two hands-on training events is recommended. Volunteers should be accompanied in the field for at least the first two monitoring events by a Stream Team Captain, the Program Coordinator, or the field biologist.

Tips given by existing programs:

- Training events should have clear goals that are attainable. Do not overwhelm the volunteers with too much information during the first event (Rigney, Fischer, and Sawyer 1996, p. 20).
- Volunteers should receive one-on-one attention for all testing procedures. It is not enough to demonstrate the procedures to a large group. Let each volunteer use the equipment and master the procedures.
- Training should occur in the field.
- Volunteers should set their own limits and tell the Stream Team Captain or other person leading the training event if they feel personally uncomfortable or unsafe.
- Tell volunteers how their efforts are important, who is going to use the information they collect, and what they will gain from the Stream Team Program.

A field guide has been developed for the Stream Team Program. The field guide provides educational material about the natural processes of the Malibu Creek Watershed including the changes caused by extensive development in the region. The field guide was created to be inspirational, educational, and easily comprehended by the volunteer. The Stream Team Field Guide is intended to complement hands-on field training.

Keeping Volunteers Interested and Motivated

The Coyote Creek Riparian Station, located in Santa Clara County, invites speakers to address their volunteers from various environmental disciplines. This affords volunteers the opportunity to meet and learn from environmental professionals. Opportunities for volunteers to participate in field activities other than the Stream Team include the California Department of Fish and Game, California Department of Parks and Recreation, National Park Service, and the Resource Conservation District of the Santa Monica Mountains. These groups all have opportunities that could benefit these organizations as well as the volunteers.

Stream Team T-shirts should be designed and distributed to volunteers. Certificates of Training and awards acknowledging outstanding volunteers should be regularly distributed and signed by the Executive Director of Heal the Bay. An annual awards party for the Stream Team which includes a presentation by Heal the Bay's Executive Director about the progress of the program and how it is making a difference in the Malibu Creek Watershed is recommended. An outstanding Stream Team member should be selected every month and their image posted on the website.

Organizational Structure

All persons wishing to volunteer at Heal the Bay are asked to attend a volunteer orientation, run by Heal the Bay's Volunteer Coordinator. During this volunteer orientation, all the volunteer opportunities available at Heal the Bay are presented. Those who are interested and willing to invest the time required, should be referred to the Stream Team Program Coordinator.

The Program Coordinator is the liaison between Heal the Bay and the volunteers. This person is responsible for organizing the training and monitoring events, keeping volunteers informed about activities, and ensuring that volunteer input is heard and incorporated into the program. The volunteers and their commitment are what determine the difference between a program that fails and one that makes a difference. The Program Coordinator must meet the needs of the volunteers including praise, acknowledgment, rewards, parties, and social interactions, as well as letting those people know how important their efforts are and how much they are appreciated by Heal the Bay.

The Program Coordinator will:

- Maintain close contact with the pool of volunteers
- Schedule and over see training events
- Ensure that the information collected is distributed to stakeholders and decision-makers
- Ensure that volunteers are aware of their contribution to the overall monitoring effort and are aware how the information they collect is making a difference in the Malibu Creek Watershed
- Stay abreast of the latest developments, techniques, and methods for collecting and analyzing data, through contact with other monitoring efforts and continuing education.

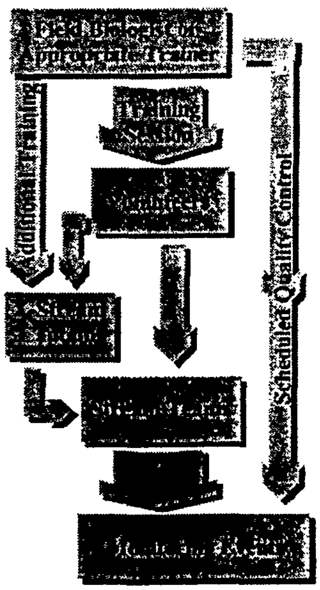

Figure 4-7: Training Flow

The Organization of the Stream Team

A field biologist or other appropriate trainer approved by the science and technical staff at Heal the Bay should train the Program Coordinator and the Stream Team Captains and be present at regularly scheduled quality assurance and quality control events (Figure 4-7). These events are designed to evaluate volunteers on their adherence to monitoring protocols and their familiarity with proper use of the equipment.

The Program Coordinator is ultimately responsible for the safety, training, and day-to-day management of the Stream Team Program. This person should be supported with technical and scientific expertise from within Heal the Bay or from outside consultants. The Program Coordinator should be well versed in all monitoring protocols, procedures, and safety issues, as this person will oversee the training of volunteers. The Program Coordinator must be approachable and accessible for volunteers to express their concerns and provide suggestions regarding the Stream Team.

A core of dedicated volunteers will serve as Stream Team Captains. Stream Team Captains serve as vital link between the Stream Team volunteers and the Program Coordinator. The Stream Team Captains will be organized into a group known as the X-Stream Team and will be identified as X-Stream Team Captains. This group should attend two training events and be accompanied into the field by the field biologist and Program Coordinator for the first three monitoring events. Captains should receive additional training about safety issues. Captains serve as technical advisors in the field and ensure the consistency of the data collected. Having a Captain on each team will ensure that the program is safer, that monitoring protocols are being followed, and the quality of the data is good. Captains will have the responsibility of making sure the equipment

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is treated appropriately, and returned to the Program Coordinator following the monitoring event. An X-Stream Team Captain should be assigned to every team. X-Stream Team Captains must ensure that volunteers are not placed into situations that are unsafe and should brief their team before every event about safety issues. Captains must be reliable, approachable, and able to communicate with their team.

Stream Team Volunteers should be accompanied by an X-Stream Team Captain at every monitoring event. X-Stream Team Captains and Stream Team Volunteers should be periodically checked and evaluated on their familiarity with the equipment, and information collection procedures.

How Data Can Be Used

The data collected should be very useful to local government agencies and organizations, including Heal the Bay, the Regional Water Quality Control Board, California Department of Fish and Game, California Department of Parks and Recreation, the National Park Service, the Resource Conservation District of the Santa Monica Mountains, and other stakeholder agencies working to protect the natural environment. These groups are very interested in using the collected data to track trends in water quality, and in assisting local planning agencies to develop future water quality protection goals and land use management strategies. This data will also be uploaded to a Regional Data Base maintained by the Regional Water Quality Control Board.

Heal the Bay will use the information gathered during the Stream Walking in Phase 1 to create a map of potential restoration sites, discharge points and outfalls, sites that need clean up activities, and potential barriers to fish passage. This mapped information can assist local planning agencies and other concerned organizations in developing future watershed protection goals and restoration strategies.

Monitoring Activities

The following is a more detailed account of the various monitoring activities

Stream Walking

Stream Walking is the starting point for monitoring in the Malibu Creek Watershed. Stream Walking is an active task that requires the volunteer to get down into the riparian corridors and explore with an acute attention to visual details. The goal of Stream Walking is to provide an overall impression of the stream reaches within the watershed as well as identify key elements of concern. Stream Walk teams will be comprised of an X-Stream Team Captain and two Stream Team Volunteers.

What to Monitor

The collection of the following information should provide Heal the Bay with an overall view of the Malibu Creek Watershed. Analysis of the data should help Heal the Bay chart a course of action geared at improving the ecological function and water quality within the watershed. Heal the Bay should distribute this information to the many agencies with responsibility over the area so that they can make informed planning decisions and take necessary corrective actions.

Volunteers are asked to record information about each of these physical parameters:

1. Discharge Points and Outfalls
2. Unstable Bank Conditions
3. Artificial Streambank Modifications
4. Impacting Land Uses
5. Large Patches of Exotic and/or Invasive Vegetation
6. Possible Barriers to Fish Passage
7. Dump Sites

1. Discharge Points and Outfalls
Discharge points and outfalls are pipes and culverts that carry storm water runoff into a stream at a single point (Figure 4-8). This may cause water quality and stream morphology to be impacted, especially at the point of discharge into the creek. Not all discharges are legal, and information regarding the current location of all outfalls to the creeks is limited. This information will help Heal the Bay update available mapped information.

Figure 4-8: Storm drain discharge point

2. Unstable Bank Conditions
Unstable bank conditions are a common problem along local streams, particularly ones that are subject to upstream development. Banks that are eroding or collapsing into the stream do not have stable soil for vegetation to establish (Figure 4-9). Eroding banks contribute sediments that can impact the habitat of steelhead trout and macroinvertebrates, and collapsing banks can block stream flows, causing flooding and damage to nearby property.

Figure 4-9: Collapsing streambanks and vegetation.

3. Artificial Streambank Modifications
Artificial streambank modifications often are used in urbanized or developing watersheds to prevent flooding (Figure 4-10). This method of streambank stabilization and flood control eliminates the natural vegetation. Vegetation provides food and habitat for aquatic and land-based birds and wildlife, slows the flow of surface runoff, and balances the nutrient levels of streams. Alteration of streambanks is often necessary when private property backs up to stream and structures are built close to the stream.

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edge. While artificial bank modification may solve the problem of one property owner, the results are a funneling of problems further downstream to the next property owner, and beyond.

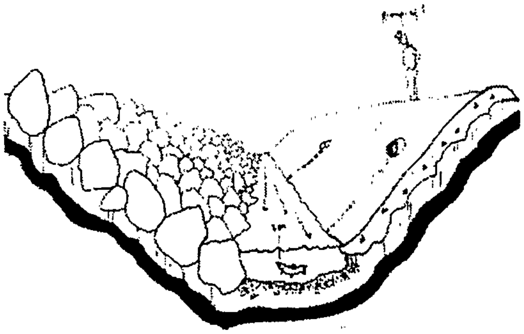

Figure 4-10: Artificially lined streambanks

4. Impacting Land Uses

Impacting land uses that are adjacent to streams can potentially affect the stream environment. The land uses of concern are those that have replaced riparian vegetation. For example, some places in the watershed have horses or other animals that graze right at the edge of the streambank (Figure 4-11). In other locations shopping centers or houses may be located right on the streambank edge. While these land uses may not have a discharge directly to the stream, runoff from these areas could have an effect on stream health.

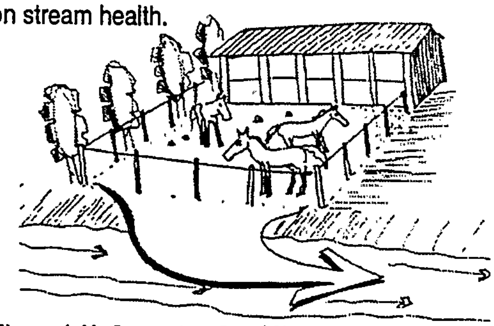

Figure 4-11: Impacting Land Use

5. Large Patches of Exotic and/or Invasive Vegetation

Large patches of exotic and/or invasive vegetation are non-native plants introduced to the Malibu Creek Watershed from other parts of the country or from other regions of the world. Many of these plants are well adapted to local climate and soil conditions; some are aggressive and may out-compete and displace native vegetation (Figure 4-12). Problems arise when these plants do not provide the food and habitat required by the native species of birds and wildlife.

Figure 4-12: Identifying patches of invasive vegetation.

6. Possible Barriers to Fish Passage

Possible barriers to fish passage potentially affect the passage of steelhead trout and other fish to protective spawning ground within the upper watershed (Figure 4-13). Currently, the annual steelhead run is restricted to the lowest 2.5-mile stretch of Malibu Creek, below Rindge Dam. Healthy fish habitat is usually productive habitat for many other aquatic species.

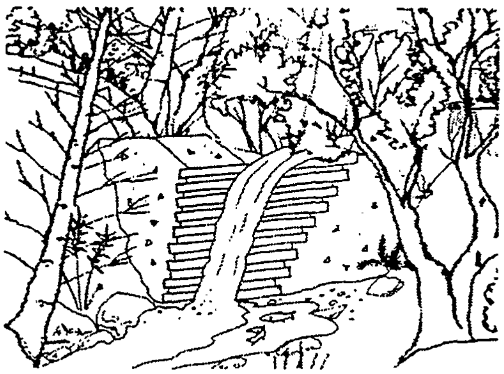

Figure 4-13: Constructed check dams can pose obstacles to fish migration.

7. Illegal Dump Sites

Illegal dumpsites exist partially because dumping is cheaper than legal disposal of waste. Frequently dumped wastes include hazardous chemicals, or large items like appliances (Figure 4-14). The problem is compounded when certain areas become recognized as places to dispose of waste. Areas in and around streams are frequently used as dump sites because they are off the beaten track, lessening the likelihood of the perpetrators being caught in the act.

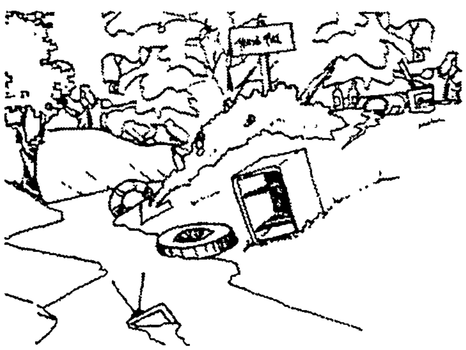

Figure 4-14: Illegal dump sites

When any of the seven listed parameters is identified, a Global Positioning Unit (GPS) will be used to recor its precise location. The location will be added to GIS database that is owned by Heal the Bay. This information will be analyzed by Heal the Bay an suggestions will be made to correct the problem identified during the Stream Walk. Maps that identify the locations of these items along the streams an creeks throughout the watershed should b distributed to interested agencies. By summarizing the information collected during the Stream Walk int a GIS, the data becomes usable by a wide range groups and agencies.

Quality Control and Quality Assurance

The Program Coordinator and a field biologist should provide training to the X-Stream Team Captains an to Stream Team Volunteers. X-Stream Tea Captains should receive two intensive field trainings by the Program Coordinator and a field biologis Captains should be accompanied in the field on th first three monitoring events. Stream Team Volunteers should also attend two training event with either the Program Coordinator or a field biologis All teams should have an X-Stream Team Captain plus two volunteers. All volunteers should be able t demonstrate the ability to follow monitoring protocol and proficiency with using the equipment provided in the field kit. Each team should be recertified onc every six months on their proficiency with dat collection methods and their ability to use the equipment. The field biologist and the Prograr Coordinator should be present during recertificatior

Water Chemistry Testing

If the overall goal of the monitoring program is to improve water quality, then Water Chemistry Testing provides the springboard of data from which further action can be taken. Specifically, the objectives include:

- To establish current baseline conditions within the various subwatersheds of the Malibu Creek Watershed.
- To determine how much each subwatershed contributes to poor downstream water quality.
- To explore the ability of streams to support native plants, and aquatic wildlife such as steelhead trout.

Water quality that is good for aquatic life is often good for humans as well. The overall goal of water chemical testing is to ultimately improve water quality throughout the watershed.

What to Monitor

The specific parameters to be monitored are selected based on issues cf concern and the analysis conducted of the Malibu Creek Watershed. Detecting the presence of pollutants and their potential sources should lead to actions that improve the water quality throughout the Malibu Creek Watershed. Each test is to be conducted twice. If the second result does not closely coincide with the first result, a third test must be performed. Double-checking results in this way will ensure higher quality data.

The following parameters will be measured for the Malibu Creek Watershed Stream Team Pilot Project:

Physical Parameters

1. Site Conditions (weather conditions, debris, and stream properties like color and odor)
2. Stream Flow
3. Air Temperature
4. Water Temperature

Chemical Parameters

5. Dissolved Oxygen
6. pH
7. Turbidity
8. Conductivity
9. Phosphorous
10. Nitrate-Nitrogen
11. Ammonia-Nitrogen

For purposes of the program, Site Conditions are visual observations that do not require quantitative measurements, but do require a general agreement on observation conclusions. Items three through eight are either measured chemically or with meters, and require patience and acute attention to detail. Water Chemistry Teams will collect water samples for items nine through eleven, but will not perform the actual tests. Measuring phosphorous, nitrogen, and ammonia involve complicated procedures. To ensure high quality information, these measurements should be performed by Heal the Bay's Program Coordinator or a field biologist.

1. Site Conditions

The site conditions of the monitoring location will aid Heal the Bay in analysis of the data. These parameters are generally brief, but careful observations should be noted on the "Site Conditions" field sheets. Included among these are weather conditions, presence of debris, and properties of the stream, like presence of algae, water color, appearance, and odor. Observations can be noted at any time during the monitoring event.

2. Stream Flow

Stream flow is the volume of water that moves past a fixed point in a specific interval of time. The amount of water (volume) and how fast it is traveling (velocity) determines the flow of a stream (Figure 4-15).

Stream flow is an important indicator of water quality. It affects the available oxygen level in water that fish and other aquatic wildlife depends on to live. Generally, streams with higher flows have more oxygen available for aquatic wildlife. Stream flow also controls the amount of sediment that is transported in a stream. Streams with higher velocities and larger flows transport greater amounts of sediments than streams with lower flows. In addition, stream flow determines how pollution is transported downstream, and influences the ability of a stream to dilute pollution.

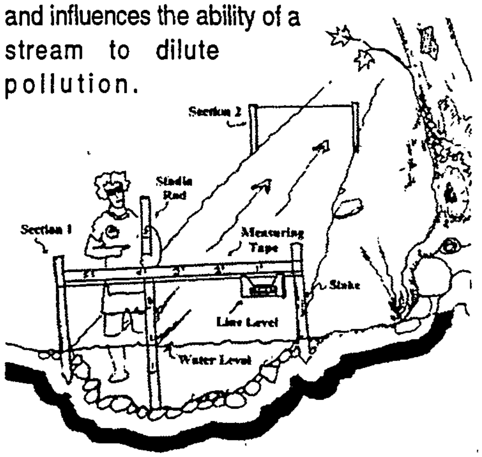

Figure 4-15: Measuring Stream Flow.

Large, swift rivers have a greater ability to dilute and degrade runoff pollutants, unlike smaller stream

3. Air Temperature

Air temperature can influence water temperatur Air temperature measurement should be taken the beginning and end of the monitoring event.

4. Water Temperature

Temperature of the water directly affects biological and chemical processes. Some fish species pref colder waters than other species. Macroinvertebrate will move in the stream in order to find their optimal temperature. Water temperature should be take twice, once at the beginning of the monitoring even, and once at the end.

5. Dissolved Oxygen (DO)

Aquatic organisms rely on the presence of oxygen in streams. Water temperature and altitude, time day, and seasons can all affect the amount dissolved oxygen. Oxygen is both produced and consumed in a stream. Because of constant churning, running water, especially in riffles, dissolves more oxygen

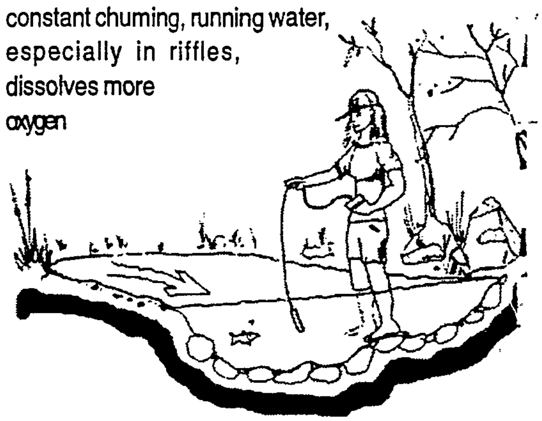
Figure 4-16: Measuring Dissolved Oxygen

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than the still water often found in a lake or stream pool (Figure 4-16) (US EPA 841-B-97-003 1997, p. 139). The presence of aquatic plants also affects dissolved oxygen concentrations. Green plants release oxygen underwater during photosynthesis. Maximum amounts of DO are produced with the energy of the late afternoon sun. By early morning, the same plants may have taken up the oxygen, making levels of DO lowest at this time. Because DO is lowest in the morning hours, it is one of the first tests performed at the sampling station.

6. pH

pH is a measure of how acidic or alkaline the water is at the time of testing. The pH of a stream affects the ability of plants and wildlife to function and live. pH is measured on a scale from 1.0 to 14.0. Neutral pH is 7.0. Acidic pH is less than 7.0, and alkaline is greater than 7.0. A wide variety of aquatic animals prefer a range of 6.5-8.0 pH. A pH meter measures the electric potential of water in millivolts or pH units.

7. Turbidity

Turbidity is a measure of water clarity. Insoluble solids or suspended particles such as clay, silt, sand, algae, plankton and other substances affect the clarity of the water. High levels of turbidity affect the ability of steelhead trout and other aquatic organisms to survive. Water temperature is increased when suspended particles absorb more heat. Also, when turbidity is high, photosynthesis is reduced, due to the decrease in the amount of light traveling through the water (Figure 4-17). Sources of turbidity include soil erosion, waste discharge, urban runoff, eroding streambanks, large numbers of bottom feeders that stir up sediments, and excessive algal growth.

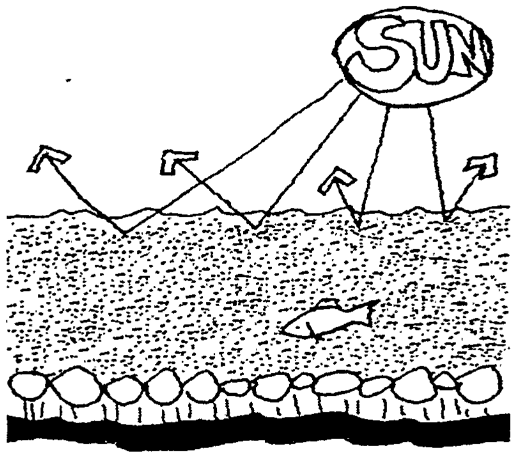

Figure 4-17: Dissolved sediments blocking sunlight

8. Conductivity (Total Dissolved Solids)

Conductivity is a measure of the ability of water to pass an electrical current. The concentration of dissolved solids or the conductivity of streams is directly affected by the substrate or stream bottom material. Conductivity indirectly indicates the presence of inorganically dissolved solids such as chloride, nitrate, sulfate, phosphate, sodium, magnesium, calcium, iron, and aluminum (Murdoch, Cheo, and O'Laughin. 1996, p. 181). These substances and seawater enhance the ability of water to conduct electricity. Failing septic tanks, sewage spills, and agricultural runoff containing phosphates and nitrates are indicated by high conductivity measurements. In general, conductivity is higher in areas with clay soils because these soils tend to dissolve in water. Conversely, organic substances like oil, alcohol, and grease are poor conductors of electricity and will yield low conductivity measurements. Excessive amounts of dissolved solids leads to poor tasting drinking water with laxative effects (Murdoch, Cheo, and O'Laughin. 1996, p. 181).

9, 10, & 11. Phosphorus, Nitrate-Nitrogen & Ammonia-Nitrogen

Phosphorus and nitrogen are both nutrients occurring in streams, and are essential for plants and animals in an aquatic ecosystem. These nutrients originate from both naturally occurring sources and from areas of human development. Naturally occurring sources include soils, eroding rocks, and terrestrial animal and plant waste washing into the streams. Problems occur when large amounts of phosphorous and nitrogen is introduced into the stream ecosystem, results in excessive algal growth depleting the available oxygen in the stream that fish and other aquatic organisms depend upon. Sources of nutrients from human development include wastewater treatment plants, runoff from fertilized agricultural lands, lawns, and golf courses, runoff from grazing animals, commercial cleaning activities, and other similar sources.

Phosphorous is a useful indicator of potential problems associated with excessive plant growth. High amounts of dissolved phosphorous may indicate a pollution source such as chemical fertilizers or septic system leachate. Insoluble phosphorous can be due to excessive erosion, animal waste, or sewage (Murdoch, Cheo, and O'Laughin 1996, p. 180). Two field tests are used to measure the nitrogen content in streams: nitrate-nitrogen (N_2 + NO_3), and ammonia-nitrogen. Although nitrogen (N_2) is the gas that composes 80% of the air we breathe, most plants cannot use nitrogen in this form. N_2 is converted into nitrates, a form that can be used by plants to build proteins. It is this form of nitrogen that the Stream Team will measure. In streams with low levels of dissolved oxygen and elevated levels of nitrates, nitrogen will be found in the form of ammonia. Ammonia is extremely toxic to aquatic life, as compared to nitrates. Sources of nitrogen include wastewater treatment plants, runoff from animal manure storage areas, runoff from fertilized lawns and croplands, failing or improperly maintained septic systems, and industrial discharges containing corrosion inhibitors.

Water Chemistry Monitoring Locations

The long-term goal of the program is to have monitoring locations in each of the seven subwatersheds within the larger Malibu Creek Watershed. Monitoring sites will be at a minimum of two fixed locations in each subwatershed of concern. These two sites will be upstream and downstream of pre-determined land use impacts. The fixed monitoring location above the pre-determined land use will be in a relatively pristine section of the stream. The second fixed monitoring site will be located at the base of the subwatershed, where a stream leaves that particular subwatershed and enters another one.

Comparing the results from these sampling sites should help Heal the Bay determine the effects of land uses and impermeable area on water quality, and to what extent a given subwatershed is contributing to downstream pollution. Based on the results of the work, Heal the Bay and other agencies should be able to determine which subwatersheds require immediate attention and future action.

Because each subwatershed has its own unique natural features and land uses, the impacts to water quality differ between them. For example, the impacts to water quality may be more obvious in the highly developed Westlake and Agoura Hills subwatersheds than in the largely rural Malibou Lake and Cold Creek subwatersheds.

Water Quality Monitoring will occur once a month at each monitoring station. To accurately sample for trends over time, monitoring must take place at the same location, and at the same time of day. This is because concentrations of the substances being tested for vary according to season, time of day, and temperature. A schedule of Water Chemistry Testing events, including the dates and times will be created.

Quality Control and Quality Assurance

Heal the Bay is part of the Southern California Volunteer Monitoring Quality Assurance Project Plan that details testing methods and accuracy requirements of the Water Chemistry Procedures. This section provides recommendations to Heal the Bay that will improve data quality and the time it takes to conduct test procedures.

1. All water chemistry testing volunteers should attend two training events with each volunteer having the opportunity to conduct the tests and use the equipment.
2. X-Stream Team Captains should be accompanied into the field by the field biologist or the Program Coordinator for the first three monitoring events.
3. All tests should be performed twice and if the data does not agree, a third time.
4. Recertification should occur every six months at which time volunteers must demonstrate their proficiency in using the equipment, following the protocols, and accurately collecting analyzing the water samples.
5. Side by side sampling should occur at the same time to ensure the accuracy of the equipment and reagents in the field kit.
6. A strict schedule for replacing reagents in the field kit should be maintained, and the lower expiration limits on those reagents should be used.
5. One person should be in charge of maintaining equipment and ensuring that the equipment is properly cleaned, calibrated, and maintained.
6. The Program Coordinator should be well versed in calibration procedures and life expectancy of all field equipment. A replacement schedule and funding for new equipment should be in place.

Water Chemistry Recommendations:
The following recommendations regard the field kit.

1. Heal the Bay should purchase the testing modules for the field kit packaged individually and not in the current package case format. By modularizing the purchases it will be easier to customize or modify this kit in the future as better testing procedures and methods become available.
2. By modularizing the field chemistry kit, the kit can be assembled in a backpack unit that will be easier for volunteers to

transport.

3. Specialized cases for sensitive equipment like GPS units, electronic water chemistry equipment, and digital cameras can be integrated into a single Stream Team field kit which will be better protected from unforeseen accidents.
4. Volunteers will be more productive and the data collected will be of more value if the field kits incorporate dissolved oxygen meters and turbidity meters instead of the titration method currently being utilized.
5. The nitrate test, nitrogen as ammonia test and phosphate test may not be accurate enough to make the data collected useful in analysis. Water samples should be collected by volunteers, labeled and put into a full ice chest. The sample should be transported to the central meeting place and analyzed using a colorimeter by the Program Coordinator or field biologist. By using a central meeting place, the samples can be analyzed in a more timely manner and only one colorimeter need be purchased.
6. Training and monitoring events should be scheduled far in advance at regular intervals, e.g. the first Saturday of every month.
7. Volunteers should gather at a central meeting place prior to each event and at the end of each event. This can be used to pass out and collect equipment, to ensure that all volunteers are safe, and to perform the nutrient testing.

Phase 2

Phase 2, if implemented, would provide supplemental data regarding the effects of development and urbanization on stream health. This phase would include macroinvertebrate sampling and stream reach surveying. Biological monitoring could be integrated into the Stream Team Program, or be a supplement program conducted by an outside agency. If an outside group samples for macroinvertebrates, they should choose sites detailed in section 5 of this document. This will enhance the monitoring program and ensure the data collected is most useful.

The Stream Reach Survey should be implemented in Phase 2 and should build on the Stream Walk information. This tiered approach allows Heal the Bay time to develop a volunteer pool and develop a well-organized program based on field experience. This approach should allow Heal the Bay to better evaluate if volunteers are able to accurately collect this more complex data.

Macroinvertebrate Sampling

Biological monitoring is a monitoring tool for testing water quality and assessing the health of the watershed. Biological testing depicts water quality over a longer period of time, since the biological components of a stream live in direct contact with water and are affected by the quality of that water. These organisms are the continuous indicators of water quality. An integrated approach using chemical testing, biological testing, and assessing the physical components of a stream, can result in a more comprehensive evaluation of stream and watershed health.

Why Monitoring for Macroinvertebrates is Important

A common way that volunteers can test the biological health of a stream is by monitoring for aquatic macroinvertebrates. Since riparian macroinvertebrates are largely immobile and spend part or all of their life within water, they are continuous indicators of water quality. Some macroinvertebrates are highly pollution-sensitive while others are more pollution-tolerant. They can react to changes in water temperature, dissolved oxygen levels, chemical and organic pollution, and sedimentation. If a monitoring sample shows a great number of pollution-tolerant macroinvertebrates and very few, if any, of the pollution-sensitive macroinvertebrates, it can be an indication that water quality is poor.

What are Macroinvertebrates?

Macroinvertebrates are organisms that have no backbone and can be seen with the unaided eye. These can be aquatic clams, snails, worms, and insects. Many of the macroinvertebrates live the majority of their life within water. For many this is their aquatic stage. They include organisms such as mayflies, dragonflies, and caddisflies (Figure 4-18). Once they enter the adult stage they develop wings and are able to fly, mate, and deposit eggs for another generation to form and develop. The aquatic stage can last a few weeks or up to a few years, depending upon the organism. Other types of macroinvertebrates, such as aquatic worms and snails, live all of their life within water.

The macroinvertebrates to be monitored are benthic macroinvertebrates. These are macroinvertebrates that live on the bottoms of streams and watercourses. Benthic macroinvertebrates can be divided into functional feeding groups. These groups are collectors, shredders, scrapers, and predators. Collectors feed on tiny pieces of organic material, and can be further divided into collector-filterers and collector-gathers. Shredders feed on coarser pieces of organic material such as leaves, algae, and twigs. Shredders break down these larger pieces which other macroinvertebrates can then feed on. Scrapers feed on algae attached to stones and other surfaces found on the stream bottom. Predators directly feed on other aquatic organisms found within the aquatic environment. Each of these functional feeding groups plays a vital role in breaking up organic material and contributing food and nutrients along the food chain.

Selecting Monitoring Sites

Two types of monitoring sites should be chosen in the watershed. These two sites are reference sites and monitoring sites. A reference site is needed to compare other monitoring sites against. It is a site that is minimally impacted by human use and similar in characteristics to the monitoring site. Since the reference site is minimally impacted, it should show what a healthy stream in the watershed looks like, and the mixture and diversity of macroinvertebrates that can be expected. Monitoring sites are picked because of their strategic location and their ability to indicate what is happening in various parts of the watershed.

Monitoring for macroinvertebrates normally takes place in areas of the stream that have riffles. Riffles are areas where water flows rapidly over rocks in a shallower part of the stream. This is a good area to monitor because macroinvertebrates find this

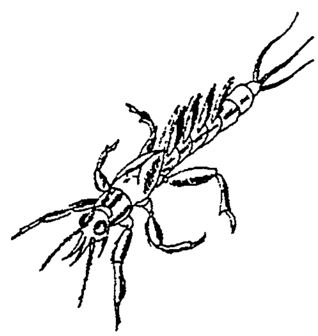

Figure 4-18: Sample macroinvertebrate: a common burrower.

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environment a favorable place to live. The fast moving water captures oxygen from the air, increasing the dissolved oxygen content of the water. The large stones and rocks create niches where macroinvertebrates attach their homes or find shelter from predators in the rapidly moving stream. This environment also creates nooks and crannies where organic material and other food can be trapped. The riffle part of a stream is where a great degree of diversity in the types of macroinvertebrates is found.

Most organisms have been categorized into the following six functional feeding groups based on their method of acquiring food; shredders (SH), predators (P), scrapers (SC), filtering collectors (FC), collector gathers (CG) and piercers (PI). The composition of functional feeding groups will change depending on the type and degree of disturbance to the stream. For example, absence of riparian canopy will allow more sunlight to enter the stream producing more periphyton and more scrapers, which eat periphyton. Macroinvertebrate abundance varies with the type of pollution affecting the stream.

Creating a Monitoring Protocol

Currently the California Department of Fish and Game (CDFG) is revising their protocol to be more user-friendly and geared towards volunteer monitoring programs. CDFG will be publishing a key that will be helpful for monitoring for macroinvertebrates in the Malibu Creek Watershed. Heal the Bay should use CDFG's protocols and the macroinvertebrate key for Phase 2 of the Stream Team Program.

Stream Reach Surveying

Stream reach surveying measures the physical forms and characteristics of a particular section of a stream and provides a documented record that can be compared over time. The idea behind the stream reach survey is to take a representative sample of an entire stream or creek, such as 15% of the total length, and apply the findings to the whole stream. The stream reach survey collects specific information about the channel shape, size, the meander pattern, bankfull width and depth as well as measuring average depth of pools, and characterizing the instream habitat, substrate, and overhead cover. This procedure collects detailed information that can be checked year after year to determine if the stream has been changed due to factors upstream. This procedure will allow the monitoring program to sample the effects of sedimentation on the watershed, whereas the other procedures will only provide limited data regarding sediments.

Stream reach survey design should include collecting data as teams move upstream to the next survey site. It is a logical extension of the Stream Walk procedures used in Phase 1 and provides more detailed quantifiable information about the stream. This method is used by the California Department of Fish and Game and the Forest service, making the information collected extremely useful for analysis and planning.

Why Stream Reach Surveying is Important

Using stream reach survey to chart "change over time," would allow Heal the Bay to discern the effects of development upon the physical character of a stream. This procedure further allows various agencies and users of the information collected to accurately characterize the stream using Rosgen's stream classification technique. The Rosgen system is considered very valuable in restoration work.

The objectives include:

- To accurately map the physical properties of a stream
- To establish current baseline conditions within the various subwatersheds of the Malibu Creek Watershed.
- To compare areas upstream and downstream of urbanization to help determine impacts associated with urbanization.

What to Expect When Stream Reach Surveying

Stream Reach Surveying will occur monthly following the completion of the Phase 1, Stream Walk. Teams consist of an X-Stream Team Captain and three volunteers.

The specific protocols for the stream reach survey should fit the information needs of stakeholders in the watershed at the time Phase 2 is ready to begin. A consultation with Fish and Game will determine the information needs and appropriate methods to collect information. Many volunteer programs are using the Stream Reach Survey to collect information. Care must be taken by the volunteers because many of the field procedures are complex and may be difficult.

This Monitoring Program section details the monitoring program and recommended monitoring protocols for the Stream Team. Special emphasis has been placed on identifying and avoiding potential pitfalls, maintaining high levels of volunteer enthusiasm and participation, and ease of procedures. The Stream Team Program will identify problem areas and provide good quality baseline data about the seven subwatersheds within the Malibu Creek Watershed. The information collected will be in a form that is usable by other groups and agencies charged with protecting the environmental resources of the Malibu Creek Watershed. The program has been designed to educate volunteers about the watershed and provide information that will help identify problems and keep decision-makers better informed. The flexibility of the program, and the two-phased approach, should help Heal the Bay to achieve the monitoring goals and in the long-term improve water quality and enhance the ecological functioning of the watershed.

Section 5

ANALYSIS, SITE SELECTION, and MONITORING PROGRAM

Models are used to better understand where and how key issues function within the watershed. The models created for this project analyzed each subwatershed in terms of land uses, surface water features, and water quality issues. To better understand water quality throughout the watershed, the key components are modeled. These maps predict probable source areas of urban runoff associated with impervious surfaces, nutrient loading, and sedimentation. Areas of recreational resources are mapped to predict areas most likely to receive recreational use. Finally, using these predictive models and criteria, the best monitoring sites are located, and recommendations are made concerning existing and future monitoring sites.

ANALYSIS AND MODELING

Water quality within the Malibu Creek Watershed is a major contributing factor to the overall ecological functioning of the area and the biggest threat to the health of recreational users. Malibu Creek ranked second on a study listing water bodies contributing contaminants to Santa Monica Bay (Santa Monica Bay Restoration Project 1994, pp. 13-14). In 1992, a survey of 5,800 residents within the watershed was conducted by the City of Malibu's General Plan Task Force. Of 406 respondents, 95% felt that the prevention of pollutants to the creeks, lagoon, and ocean should be of the highest priority (Schmidt 1992, p. A3). Achieving water quality that is capable of sustaining a healthy population of aquatic wildlife that does not pose any human health risks is a highly desired goal.

Subwatersheds

To better understand the watershed, and to consider the potential effects of impervious surfaces on each of the major tributaries that drain the watershed, the watershed has been broken down into seven smaller subwatersheds. These seven subwatersheds are Agoura, Cold Creek, Hidden Valley, Las Virgenes, Malibu Creek, Malibou Lake, and Westlake.

Hidden Valley Subwatershed

The Hidden Valley subwatershed is located at the eastern end of the Malibu Creek Watershed in a large fertile valley. Potrero Creek is the major tributary draining this area. Prior to development, this area likely served as a floodplain for Potrero Creek and therefore has collected large deposits of alluvial materials that make up the fertile soils. Hidden Valley subwatershed is 16.9 square miles and is predominantly rural in nature, with an estimated population of 1,200 people. With the exception of vacant land, agriculture is the dominant land use, comprising 1.87 square miles.

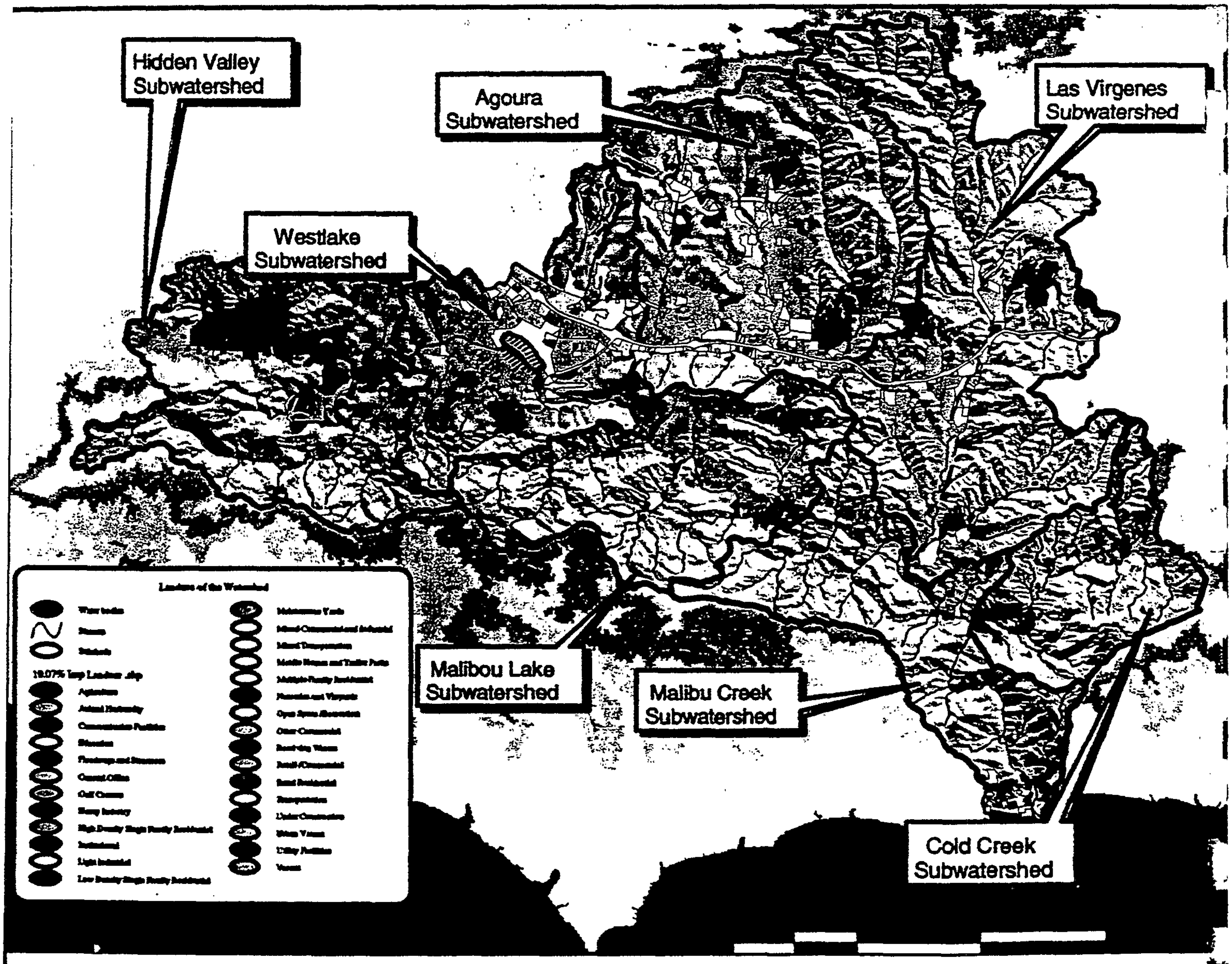
Lake Sherwood is located at the outlet, or base, of this subwatershed and was constructed in 1904 to serve as a source of water for the ranches in the area. The lake can store 2,600 acre-feet of water and has an estimated surface area of 163 acres (USDA, NRCS Malibu Creek Watershed Natural Resources Plan 1995, p. 55). The staff of Lake Sherwood Ranch, which manages the lake, uses copper sulfate to minimize algae growth. Since the mid-1980s, wastewater treatment has occurred through connection to a sewer system, while the potable water supply continues to come from well water (Hidden Valley Municipal Water District 1998). There are numerous ranches in the area with much of the area being used for raising livestock, agriculture, and pastures for horses (USDA, NRCS Malibu Creek Watershed Natural Resources Plan 1995, p. 58). Water samples taken by the NRCS indicate that above acceptable levels of phosphate are present in the receiving waters that drain this subwatershed.

Westlake Subwatershed

Westlake subwatershed is 13.0 square miles in area. Being predominantly urban, the highest land use is high density single family residential, comprising approximately 1.96 square miles. Two constructed lakes and one reservoir are contained within this subwatershed. Westlake Lake is 18 feet deep near the dam, and can store approximately 791 acre-feet of water with a surface area of 95 acres (USDA, NRCS Malibu Creek Watershed Natural Resources Plan 1995, p. 57). Westlake Lake empties into Triunfo Creek and is required to discharge water from May 1 to September 1. Las Virgenes Reservoir (Westlake Reservoir) drains approximately 0.9 square miles with a storage capacity of 10,000 acre-feet or 3.3 billion gallons, and is used by the Las Virgenes Municipal Water District to store imported water (LVMWD 1994, p. 30). Lake Eleanor drains 1.2 square miles and has a surface area of 9 acres that stores approximately 104 acre-feet of water. The channel between Lake Sherwood and Westlake Lake is almost completely altered with either riprap or concrete for flood control purposes (USDA, NRCS Malibu Creek Watershed Natural Resources Plan 1995, p. 57). The population for the city of Westlake Village is estimated at 7,640 residents, which is predicted to grow to 12,200 by the year 2015 (Bauer Environmental Services March 1996, p. 5).

Agoura Subwatershed

Agoura subwatershed contains 180 acres of golf courses and a large single family residential population. Lake Lindero is located within this subwatershed, and drains 5 square miles with the capacity to store 90 acre-feet of water with a surface area of 14 acres (USDA, NRCS Malibu Creek Watershed Natural Resources Plan 1995, p. 59). The total area is 21.6 square miles, with high-density single family residential being the largest land use, totaling 3.4 square miles excepting vacant land. The major tributary is Medea Creek, which is fed by Lindero, Palo Commado, and Cheseboro Canyons. The majority of the 21,000-person population, according to 1993 estimates, resides in the city of Agoura Hills (Bauer Environmental Services March 1996, p. 5). The city of Agoura Hills is expected to increase in population to 27,330 based on SCAG projections for the year 2015. Sampling and modeling conducted in the Agoura subwatershed in 1993 found both high salt levels and high concentrations of coliform. Confined livestock near the Palo Commado area are thought to be a problem regarding water quality.



Sources: Land Use, Watershed Boundary by Los Angeles County Department of Public Works, Streams by National Park Service not for legal use.

Land Use of the Watershed

Universal Transverse Mercator Projection
North American Datum, 1927

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Las Virgenes Subwatershed

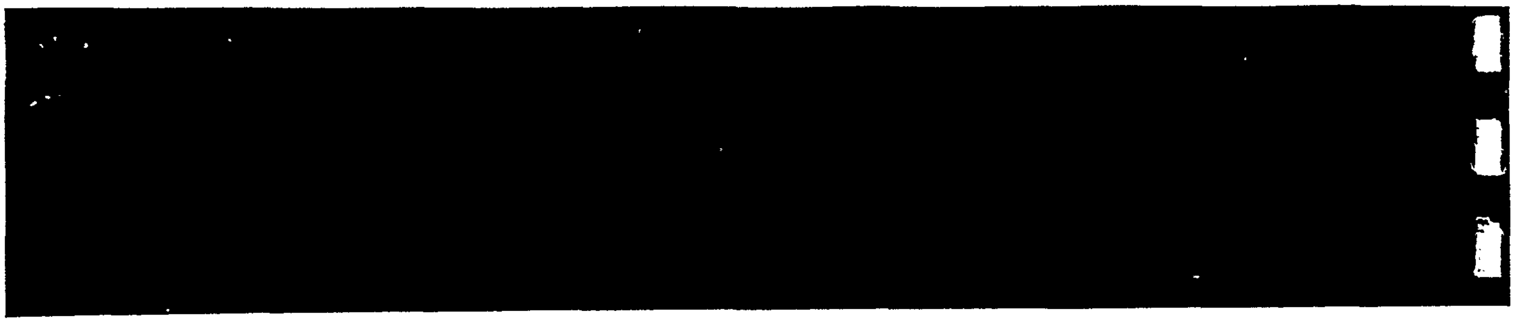
Las Virgenes subwatershed is 24.3 square miles in area with the largest land use being high density single family residential (0.8 sq. mi.). 300 of the 3,766 households in Calabasas are on septic systems, the majority of which are in Stokes Canyon towards the base of the subwatershed. This area has had high nitrogen, phosphorous, and fecal coliform concentrations that may indicate malfunctioning septic systems (USDA, NRCS Malibu Creek Watershed Natural Resources Plan 1995, p. 59). Las Virgenes Creek is the major tributary that drains this area. The remainder of the subwatershed is largely rural in character. This subwatershed also has orchards, pastureland, and field crops but predominantly consists of open space. This subwatershed is not yet heavily developed, and may be undergoing development pressures due to the large amount of undeveloped private land. During May and September, sampling events conducted by NRCS, upper Las Virgenes Creek showed high concentrations of phosphates above the acceptable level and were considered high enough to impact downstream water (USDA, NRCS Malibu Creek Watershed Natural Resources Plan 1995, p. 62).

Malibou Lake Subwatershed

Malibou Lake subwatershed is 13.2 square miles. Rural residential comprises 0.677 square miles and is the dominant land use, with some homes located along creeks and surrounding the lake. This subwatershed receives water from the Agoura and Westlake subwatersheds. Malibou Lake is fed by Triunfo Creek to the west and Medea Creek from the north. The lake drains 64 square miles and has a surface area of 55 acres with a storage capacity of 500 acre-feet. This subwatershed has an estimated 2,978 households with 625 on private septic systems (USDA, NRCS Malibu Creek Watershed Natural Resources Plan 1995, p. 63). Previous water chemistry sampling done by the United States Geological Survey (USGS), from 1985-1987, and those done in 1993 by the NRCS demonstrate high levels of phosphorous in Triunfo Creek and high phosphorous levels and fecal coliform at the base of Medea Creek and in Malibou Lake (USDA, NRCS Malibu Creek Watershed Natural Resources Plan 1995, p. 64). Both Triunfo Creek and Malibou Lake were designated as impaired at least some of the time by the 1994 California State Water Quality Assessment. Malibou Lake opens the outlet valves to the dam annually to expel sediments as well as periodically dredging to remove sediments. The lake is also treated with copper sulfate to minimize algae growth (Trim 1994, p. 36).

Cold Creek Subwatershed

Cold Creek subwatershed, at 8.2 square miles, is predominantly open space with the exception of rural residential land uses on private septic systems comprising 0.8 square miles. In addition, this subwatershed has 34 acres of confined animal units concentrated towards the lower part of the subwatershed (USDA, NRCS Malibu Creek Watershed Natural Resources Plan 1995, p. 65). Sampling conducted by the USGS from 1982 to 1988, and one site survey by the NRCS in 1993, demonstrated consistently high levels of phosphorous averaging in excess of 5.6 mg/l which are high enough to impact downstream water quality (USDA, NRCS Malibu Creek Watershed Natural Resources Plan 1995, p. 65).



Malibu Creek Subwatershed

Malibu Creek subwatershed is 12.8 square miles and comprised mostly of mountainous open space. Low density, single family residential comprises 0.2 square miles and is the predominant land use in this subwatershed. Malibu Creek is subject to receiving waters from the other six subwatersheds. Tapia is located in this subwatershed. Treated water has been discharged from this facility into the creek since 1961 and has altered the dynamics of both surface water quality and quantity. Malibu Creek was listed as having intermediate impairments in the 1994 California State Water Quality Assessment (USDA, NRCS Malibu Creek Watershed Natural Resources Plan 1995, p. 66). Areas tested above Tapia were below the 10-mg/l threshold set by the Regional Water Quality Control Board (RWQCB) for concentrations of nitrates. Measurements taken below Tapia have been recorded in excess of 16 mg/l (USDA, NRCS Malibu Creek Watershed Natural Resources Plan 1995, p. 48).

The Century Reservoir is located in the Malibu Creek subwatershed. This reservoir drains 68.1 square miles and has a surface area of seven acres that can store 70 acre-feet of water. Located within this subwatershed is the 102 foot tall Rindge Dam. This dam is completely full from sedimentation, serving as a testament to the highly erodible soils in the area. Where Malibu Creek empties into the lagoon as it passes through the City of Malibu, a small portion of mainly commercial property is evident. The wastewater at the base of the Malibu Creek subwatershed in the City of Malibu is handled by private septic systems. There is strong public opinion that these septic systems are a major contributing factor to the consistently poor water quality in the lagoon and at Surfrider Beach. Currently, UCLA is studying the lagoon with funding from the California Coastal Conservancy.

The RWQCB has established a list of designated beneficial uses for various water bodies in the Malibu Creek Watershed. The RWQCB has set measurable water quality objectives that ensure that these beneficial uses do not become impaired (USDA, NRCS Malibu Creek Watershed Natural Resources Plan 1995, p. 42). These lists can be obtained in the RWQCB's 1994 Basin Plan.

Impervious Surfaces

Mapping areas of impervious surfaces can be used as an effective tool to predict impacts of development within the watershed. There is a strong relationship between the percentage of impervious surface in a watershed and the quality of stream habitat and water quality. Mapping impervious areas can be useful as a planning tool to help assess and manage impacts development will have in the watershed.

Measuring the percent of impervious coverage is best done at the subwatershed level. Impacts associated with impervious surfaces are likely to occur in the tributary that drains these impervious surfaces. Headwater subwatersheds can be organized into three different categories, depending upon the percent of impervious coverage. These categories are sensitive, degrading, and non-supportive subwatersheds. The sensitive subwatershed has about 1% to 10% impervious cover (Schueler 1995, p. 42). Water quality and stream biodiversity is normally good to excellent, and stream channel stability is stable. The resource objective in the sensitive subwatershed is to preserve and protect biodiversity and channel stability. The next category is the degrading subwatershed, with 11% to

25% impervious cover. Water quality and stream biodiversity is fair to good. Stream channel stability is unstable and the resource objective is to maintain or restore the key elements of stream quality. The last category is the non-supporting subwatershed. This subwatershed has 26% to 100% impervious cover. Water quality is fair to poor, and stream biodiversity is poor. Stream channel stability is highly unstable. The resource objective within the non-supportive subwatershed is to minimize pollutant loads to protect downstream waters.

There are two methods of measuring the amount of impervious surfaces. These are mapped impermeability and effective impermeability. Mapped impermeability includes all impervious surfaces within a subwatershed. Effective impermeability includes only impervious surfaces that are directly connected to the storm water drainage system or to streams. Effective impervious surfaces does not include surfaces such as rooftops where runoff may flow onto landscaped areas and infiltrate into the soil (Figure 5-1). These surfaces have less of an impact upon the watershed. A large percentage of storm water runoff from these disconnected impervious areas flow onto landscaped areas and infiltrate into the soil before reaching the storm water drainage system. This is especially true during smaller storm events. Unlike disconnected impervious surfaces, nearly all runoff from directly connected impervious areas, such as roads and parking lots, flows directly into the storm water drainage system.

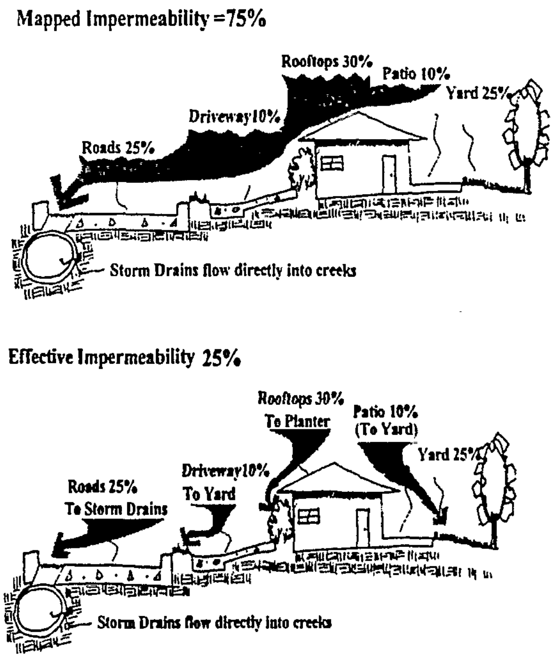
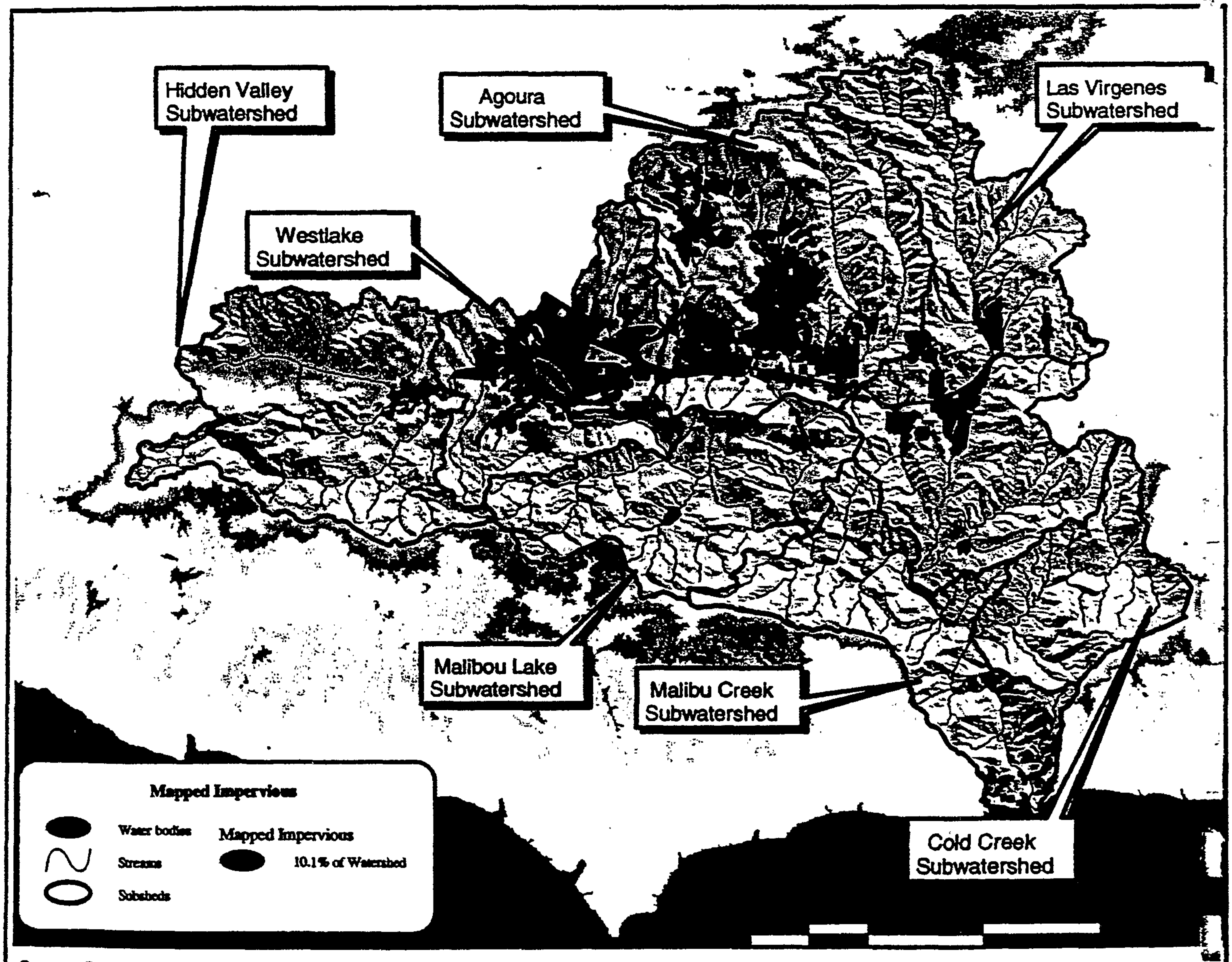


Figure 5-1: Mapped versus Effective Impermeability.

One method of mapping the effective impermeability of an area is by ground truthing or checking data out in the field. Due to the size of the watershed and the limited time of this study, ground truthing for this project was not feasible. The approach used by the Cal Poly team was to calculate the overall area of individual land uses that are known to have impervious surfaces in each subwatershed. These land use areas were then multiplied by an imperviousness factor to come up with the effective impermeability for that land use. The effective imperviousness factor represents the amount of runoff a particular land use generates. Effective impermeability gives a more accurate account of runoff than does mapped impermeability. Imperviousness factors used are from a study done for the cities of Los Angeles County by Heal the Bay (Urban Runoff: A Pollution Abatement Program 1992). Land use categories used in this analysis are based on the maps provided by Los Angeles County Department of Public Works. These maps were updated in ArcView v 3.0a using a digital orthographic aerial photograph taken in April and October 1997. The land use map was placed on top of and compared to the aerial photograph. Adjustments were made so that land use reflected the most current data.

The Impervious Surfaces map shows the effective impervious surface area for each of the seven subwatersheds in the Malibu Creek Watershed. Westlake subwatershed has the largest percentage of impervious surfaces with just over 23%. Agoura subwatershed is second with 18.4% impervious



Sources: Land Use, Watershed Boundary by Los Angeles County Department of Public Works, Streams by National Park Service not for legal use.

Mapped Impervious Surfaces

Universal Transverse Mercator Projection
North American Datum, 1927

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surfaces. These subwatersheds fit into the degrading category, and should have fair to good water quality and stream biodiversity. The objective is to maintain or restore the key elements of stream quality in degrading streams. Within these two subwatersheds, large segments of their tributaries are channelized with concrete or other materials. This suggests that subwatersheds that will potentially reach these percentages of impervious surface area are likely to become channelized and thereby transfer their problems downstream. Westlake subwatershed is dangerously close to reaching a non-supporting level with poor to fair water quality, poor biodiversity, and highly unstable streambanks.

Based upon percent of impervious surfaces, each subwatershed was placed into one of the three categories: sensitive, degrading, and non-supportive (Figure 5-2). The volunteer monitoring program will gather information that will serve as baseline data to further support and identify sensitive, degrading, and non-supportive subwatersheds. Gathering this data will also help to confirm and refine the impervious surface, water quality, and stream habitat relationship.

The Cold Creek, Hidden Valley, and Las Virgenes subwatersheds are all below 9% impervious surfaces. They are considered sensitive subwatersheds, with good to excellent water quality, biodiversity, and stable streambanks. The resource objective in the sensitive subwatershed is to protect and preserve biodiversity and channel stability. The Malibou Lake and Malibu Creek subwatersheds are also within the sensitive subwatershed category. These subwatersheds are not headwater subwatersheds and receive inputs from subwatersheds upstream. Malibou Lake receives water that passes through the Hidden Valley subwatershed into Westlake. The Malibu Creek subwatershed receives water from all of the subwatersheds; therefore the water quality, biodiversity, and stability of their streambanks are subject to upstream levels of impervious surfaces.

In order to preserve the Malibu Creek Watershed and the biodiversity that makes this watershed special, the ever-increasing amounts of impervious surfaces must be addressed. Continued development and build out of the watershed will cause further channelization of creeks and streams, degraded water quality, less abundant populations of fish and wildlife, and will alter the natural character that attracts millions of visitors and thousands of residents to this area.

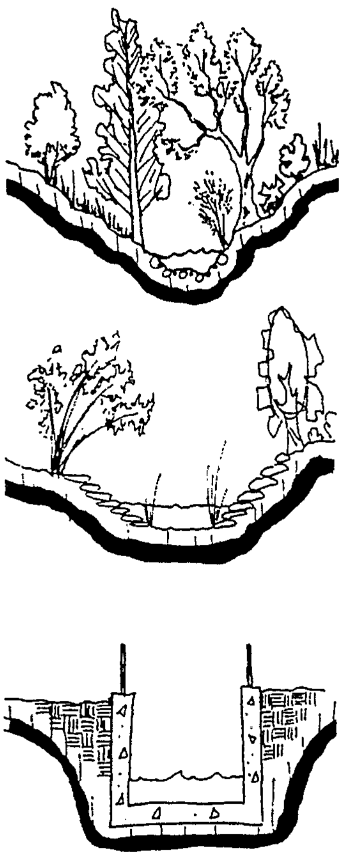


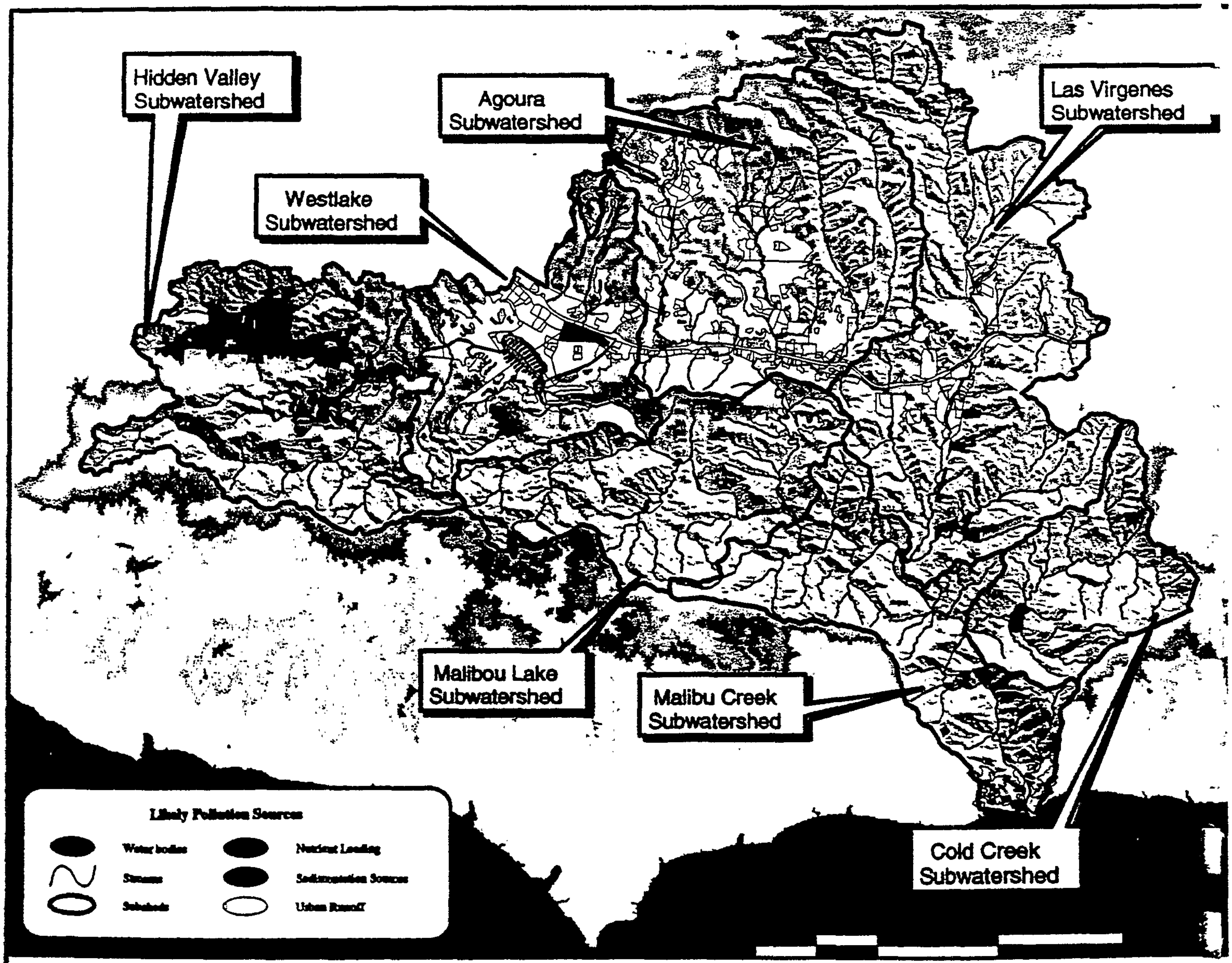
Figure 5-2: The conceptual sketch above shows the condition of riparian corridors in a: A) sensitive, B) degrading, and C) non-supporting, watersheds.

Probable Pollution Sources

This model examines three key issues: urban runoff, nutrient loading, and sedimentation, in terms of their water quality pollution potential. Probable pollution sources was derived from the various land uses. Each land use was weighted for its most likely type of pollutant. The map on the next page highlights potential pollution sources.

Urban Runoff Pollution Sources

The urban runoff pollution source model is based on the following land uses that were considered likely to contribute pollutants to receiving waters: Transportation, Retail/Commercial, Other Commercial, Multiple Family Residential, Mixed Transportation, Mixed Commercial and Industrial, Maintenance Yards, Institutional, Heavy Industry, High Density Single Family Residential, and General Office. All urban land uses have a 30% or greater imperviousness factor, and were considered heavily utilized by automobile traffic.



Sources: Land Use, Watershed Boundary by Los Angeles County Department of Public Works, Streams by National Park Service not for legal use.

Areas Likely to Contribute Pollution

Universal Transverse Mercator Projection
North American Datum, 1927

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Nutrient Sources

The following land uses were considered likely sources of nutrient loading: Nurseries and Vineyards, Golf Courses, Animal Husbandry, and Agriculture. Areas of known septic systems that were located within 300 foot from a water body were also included. Areas with high density septic use like Monte Nido, Cross Creek Plaza, the Malibu Civic Center, and Serra Retreat were considered probable sources due to the volume of wastewater treated and the cumulative effect of long-term treatment.

Erosion and Sedimentation Sources

A model was created to reveal probable sources of erosion and sedimentation. The criteria used to create this model are land uses that are considered likely to supply sediments to surface waters. Land uses such as, Under Construction, Nurseries and Vineyards, Animal Husbandry, and Agriculture were all considered for this model. The latest fire to occur in this watershed took place in 1996 and areas affected by this fire were also considered to be likely sources of erosion and sediments. Finally, soil types rated as severe to very severe, and very severe based on their erodibility, were used as probable sources of erosion and sedimentation. Soil types were based on studies done by USDA-SCS and the University of California Agricultural Experiment Station (Soil Survey, Ventura Area, California. April 1970. USDA-SCS and the Topanga-Las Virgenes Resource Conservation District and the Los Angeles County Department of County Engineer. Soils of the Malibu Area, California with Farm and Non-Farm Interpretations, October 1967).

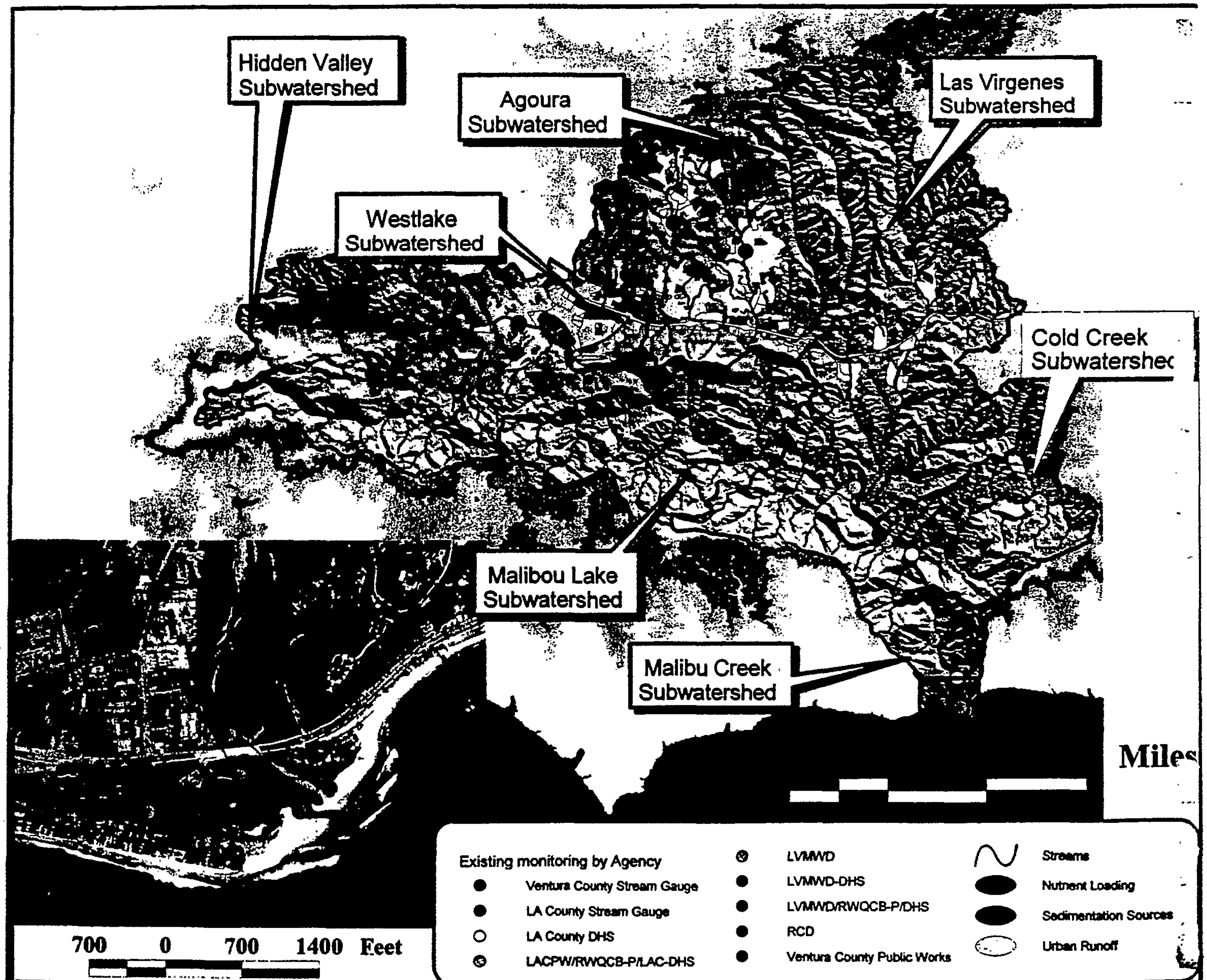
Site Selection Process

It is important that the monitoring program is well organized and steady progress is made in achieving the objectives set by Heal the Bay. This section provides Heal the Bay with two monitoring program options. This flexibility will allow the Stream Team Program to start slowly and progress and expand, as the information base and the experience level of volunteers grows. The two different programs were designed to take advantage of the growing wealth of knowledge about the watershed, the differing skill levels of volunteers, and the growing interest and funding as the program matures.

The site selection process first involves examining existing monitoring efforts within the watershed. Next, streams are classified according to their physical characteristics. Then criteria are established for choosing the different types of monitoring sites. Finally, monitoring sites are selected. A description of the monitoring program follows the monitoring site selection, and the monitoring program options are defined.

Existing Monitoring Sites

The bulk of existing monitoring efforts are at the bottom of the watershed (see map on next page). Very few monitoring stations are located in the upper portion of the watershed, where the probable sources of water quality degradation occur. Currently, four groups are engaged in regular water quality monitoring programs that sample at least once a month. These are the Las Virgenes Municipal Water District, Resource Conservation District of the Santa Monica Mountains, Los Angeles County Department of Health Services, and Los Angeles County Department of Public Works.



Sources: Land Use, Watershed Boundary by Los Angeles County Department of Public Works, Streams by National Park Service, Aerial Photo(April-October 1997) by Aerial Fotobank Inc. Monitoring Sites from Review of Monitoring and Response Protocol for the Malibu Creek Watershed 1994 not for legal use

Existing Monitoring Locations

Universal Transverse Mercator Projection
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There are redundancies and overlaps between the different agencies with their monitoring efforts. This project recommends coordinating the monitoring efforts and relocating some monitoring sites to collect more comprehensive and useful data. These recommendations can be found in Appendix B–Existing Monitoring Efforts.

Stream Classification

As part of the site selection process, the streams within the Malibu Creek Watershed were classified. The first level stream typing method, based on techniques developed by Dave Rosgen of Wildland Hydrology, was used on all second order and above streams. Each stream fits into one of eight distinct types. Stream classification allows monitoring programs to minimize the number of baseline, or reference, monitoring sites. For example, a "B" type stream in one location should look and behave in the same manner elsewhere in the watershed. Stream classification is also useful for future restoration efforts. This technique allows comparison of a pristine stream of a certain type to a stream of the same type that is influenced by development to determine any differences. Stream classification was done by the Cal Poly Team using 3-D modeling to determine the shape of the landscape, and then calculating the slope and sinuosity of the stream itself using the aerial photograph and USGS 7.5 minute topographic maps. Further details about first level stream typing can be found in Rosgen's book, *Applied River Morphology* 1996.

Overview and Criteria

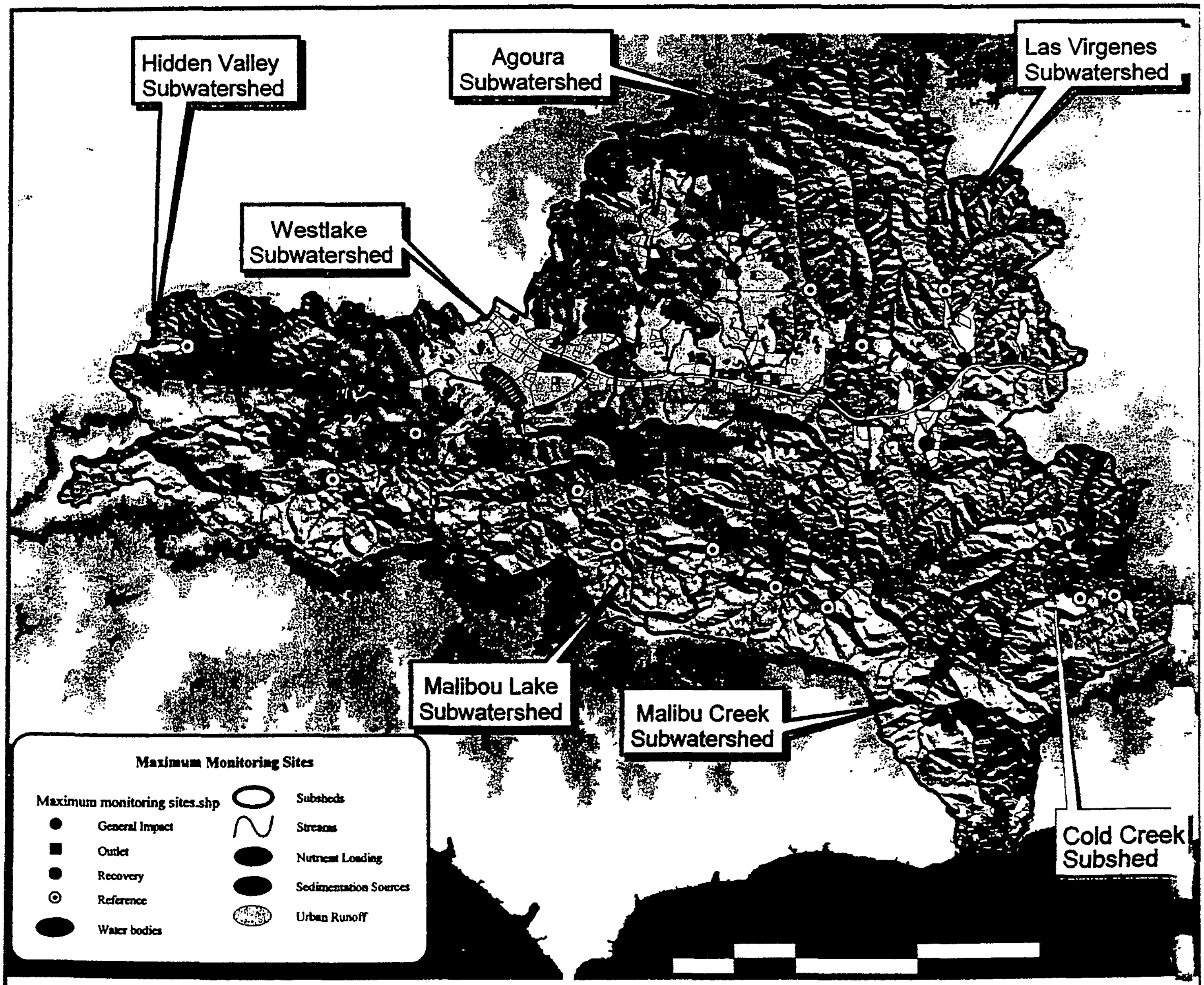
The site selection process for monitoring sites was begun by overlaying the digital aerial photograph, the probable pollution sources model, and land use maps. Using this information, all possible monitoring sites were located, resulting in the Maximum Monitoring Sites Model. These include Reference Sites, General Impact Sites, Recovery and Outlet sites. All streams of less than second order were automatically eliminated from consideration, as it is unlikely that these streams would have adequate water supply to sustain a year round monitoring effort. Using the preliminary first level stream classification discussed earlier, streams of A or AA+ types were eliminated as potential monitoring sites, due to their overall long term stability that, if monitored, would not show changes influenced by development practices. Finally, all monitoring sites chosen had to be located near a road and appear to have access, based on the aerial photo. These sites were also compared against a land ownership map to determine which sites were privately held and those that were public.

Maximum Monitoring Sites Model

Using the above criteria, the maximum number of potential monitoring sites was selected. With all potential sites identified, the monitoring program can expand in the future if changes occur, such as upstream development. When this occurs, this model allows the monitoring program the flexibility of finding new reference locations. The maximum monitoring sites map can be seen on the next page.

Reference Sites are upstream from impacts identified on the Probable Pollution Sources Model and aerial photograph. Reference sites are typically located in relatively undisturbed areas of the watershed (Figure 5-3).

General Impact Sites are located downstream from probable pollution sources. Sites were selected as much as possible to locate and isolate the pollution



Sources: Land Use, Watershed Boundary by Los Angeles County Department of Public Works, Streams by National Park Service not for legal use.

Maximum Monitoring Sites

Universal Transverse Mercator Projection
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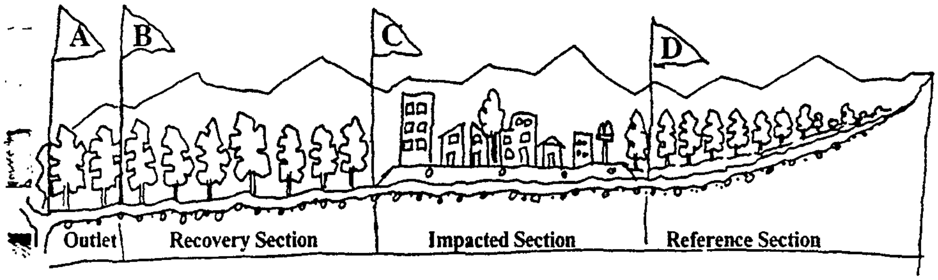


Figure 5-3: This image shows the relative position of the various monitoring sites. They include: A) outlet sites, B) recovery sites, C) impact sites and D) reference sites.

source to a specific tributary. General Impact Sites will help Heal the Bay determine what impacts are being caused by upstream land uses. General Impact Sites were subjected to the same criteria as the reference sites, with the exception that they must be downstream of a suspected impact.

Recovery Sites are located at least 500 yards downstream from General Impact Sites. The goal is to determine how long it takes water quality to recover from probable pollution sources. Recovery Sites were subjected to the same criteria as the previous two types of monitoring sites.

Outlet Sites were chosen for each of the seven subwatersheds. Outlet sites are located where the tributary exits a subwatershed just prior to entering the adjoining downstream subwatershed. Outlet Sites will allow Heal the Bay to determine the contribution of each subwatershed to water quality and quantity.

Monitoring Program Options

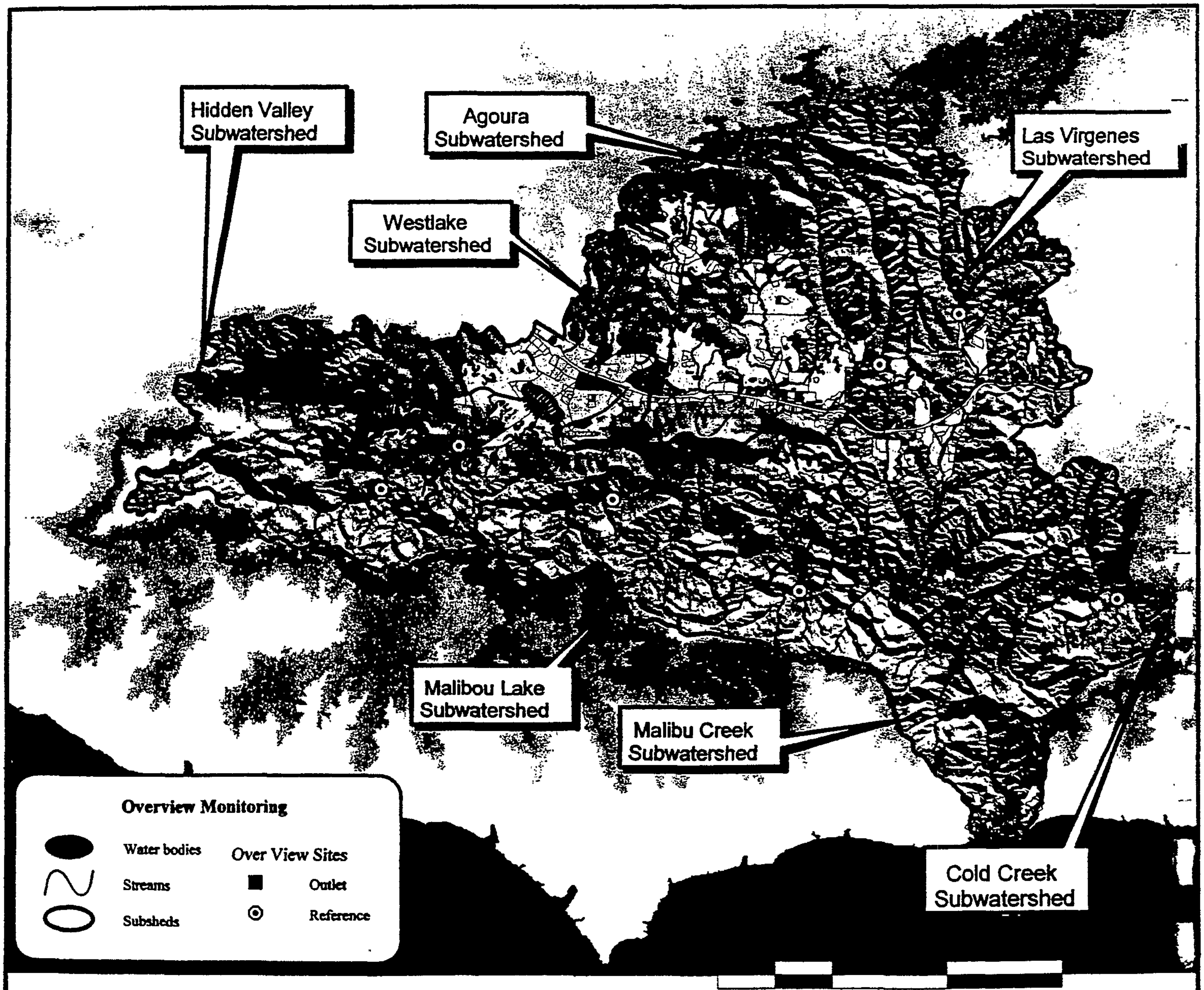
From the Maximum Monitoring Sites Model, two potential programs were created, the Overview Program, and the General Impacts Program. The criteria used for each monitoring program alternative are summarized in the Monitoring Sites Selection Criteria chart (Table 5-1). These criteria are to be used by the program coordinator to assist in determining where to set up monitoring stations. The goal for each program differs, depending on what type of information is desired by Heal the Bay.

Overview Monitoring Program

This is a program designed to test the general water quality of each of the seven subwatersheds within the Malibu Creek Watershed (see map on next page). This program measures the contribution that each subwatershed has on the overall water quality and quantity within the watershed. Each subwatershed contains two sampling stations, one at the base where the waters leave that particular subwatershed, an Outlet Site, and another Reference Site, upstream of all impacts. Sites selected were located on the tributary in each subwatershed that drained the largest land area. By monitoring these two points in each subwatershed, the results can be compared to each other to determine if land uses are affecting the water quality at the outlet. The Overview Program consists of a total of fourteen sites, two per each subwatershed.

Type of Monitoring Site	Monitoring Program Option	Criteria Used for Site Selection	Information Sources
1) Reference 2) General impact 3) Recovery 4) Outlet	Maximum # of Monitoring Sites	1) Above suspected pollution sources and impacts 2) Below probable pollution sources or impacted areas 3) downstream of an unaltered reach, downstream of an impact site 4) Base of a Subwatershed	1-4) probable pollution source model, land use map, aerial photo, streams map, subsheds map
1) Reference 2) Outlet	Overview Monitoring Program	1) Above suspected pollution sources and impacts on largest subshed tributary 2) Base of Subwatershed	1-2) Maximum number of monitoring sites model, subsheds map and stream map
1) Reference 2) General impact 3) Outlet	General Impacts, Minimal Monitoring Program	1) Directly above suspected pollution sources and impacts 2) Downstream of dominant pollution source 3) Base of Subwatershed	1-3) Maximum number of monitoring sites model, subsheds map and stream map

Table 5-1: Monitoring Sites Selection Criteria table



Sources: Land Use, Watershed Boundary by Los Angeles County Department of Public Works, Streams by National Park Service not for legal use.

Overview Monitoring Program

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The Overview approach is recommended for Phase 1 of this pilot program. The Overview Monitoring Program will allow Heal the Bay to determine how each of the seven subwatersheds is contributing to flow and/or degraded water quality within the overall watershed. The weakness of this approach is that it only isolates problems to the subwatershed level. It is a useful approach for Phase 1 and will allow Heal the Bay to determine which subwatersheds are having problems. In Phase 2, Heal the Bay can focus their efforts to target specific areas.

General Impacts Monitoring Program

There are two options within the General Impacts Monitoring Program, Optimal and Minimal. With this program, the maximum numbers of sampling stations are selected based on their ability to isolate the general impacts. These impacts are based on the Probable Pollution model, which highlights areas that are likely contributors of pollution for each of the key issues of sedimentation, nutrient loading, and urban runoff. Additional reference sites were chosen if they were situated immediately upstream of the general impact and were minimally influenced by upstream factors. This was done to help isolate the suspected impact. All sites selected were located near a road on a second order or higher stream, and appeared accessible from aerial photography. As always, A and AA+ stream types were eliminated from consideration. Using these criteria, the program can grow in the future and adapt to unforeseen change.

General Impacts–Optimal

The Optimal option chooses land uses that can be isolated and are potentially impacting major tributaries within each subwatershed. This would allow the monitoring program to generally locate the source of the problem based on the three key issues. Where possible, reference sites were located directly upstream of the suspected impact. When this was not possible, a reference site with the same stream classification was used. Recovery Sites were selected downstream of a location of a likely impact to determine if the stream and water quality has recovered at this lower point and to what extent. This scenario also locates Outlet Sites at the base of each subwatershed to determine the overall contribution to water quality and quantity of each subwatershed. The General Impacts Optimal map can be seen on the next page.

General Impacts–Minimal

The minimal scenario is the fewest number of stations that would determine the effects of pollution on water quality directly above and below an area. This option chooses a Reference Site and a General Impact Site below the suspected dominant pollution source in each subwatershed. An Outlet Site is selected as well. This scenario will isolate pollution sources to a general area and compare the difference between water quality upstream and downstream of the impact. The General Impact Sites, Minimal Monitoring Program map can be seen on page 5-19.

Watershed Monitoring Framework

The Watershed Monitoring Framework section contains three important components of this monitoring program. Prioritizing Subwatersheds provides a framework from which to build a monitoring program. The Recommendations for Future Monitoring contains suggestions on ways to organize the sampling options

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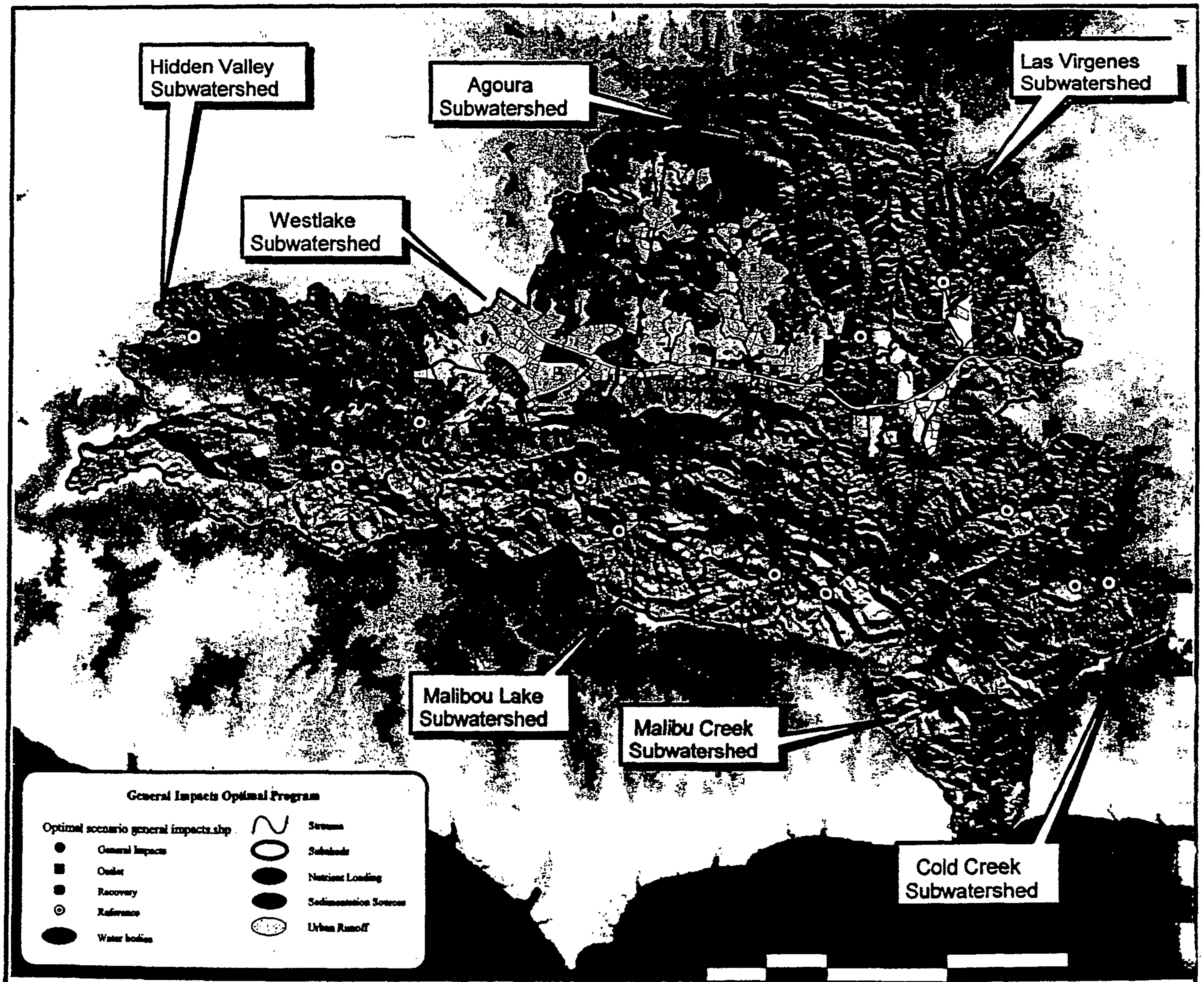

Sources: Land Use, Watershed Boundary by Los Angeles County Department of Public Works, Streams by National Park Service not for legal use.

General Impact Optimal Program

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outlined above. Recommendations for Existing Monitoring Efforts details ways in which current monitoring efforts could potentially be more effective.

Prioritize Subwatersheds

The subwatersheds have been prioritized for each monitoring procedure based on how critical the extent of probable impacts are to the streams. Prioritizing provides flexibility for the implementation of the monitoring procedures. This is due to the unpredictability of volunteer participation and the resources available to create field kits for Stream Walking and Water Quality Teams. Each subwatershed is assigned a number, one through seven, one being most critical, seven being the least critical. Subwatersheds were prioritized with regard to Stream Walking and Water Quality Monitoring. Stream Walking was prioritized using the following criteria: which subwatershed is the most critical to locate barriers to fish passage, which subwatershed should have the most unstable streambanks and outfalls into the streams, and which subwatershed should suffer from the greatest impacts from development (Table 5-2). Water Quality was evaluated in terms of most susceptible to pollutants from urban runoff, sediment loading, and nutrient loading (Table 5-3). The ranking and priority for each category can be seen in the tables below.

Recommendations for Future Monitoring

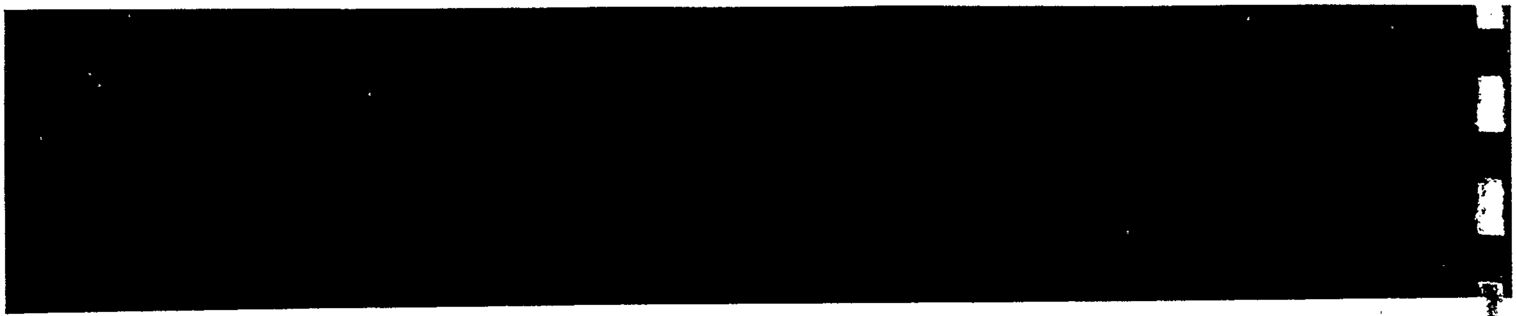
The models created for the General Impacts Monitoring Program should be used to incorporate any future monitoring efforts within the watershed. If a high school or other organization wants to conduct monitoring, water quality sites should be added in accordance with these models. It is recommended that the General Impacts Minimal option be used prior to using the General Impacts Optimal option. By following this plan, the data collection in this watershed will be maximized and redundancy will be minimized. These models should also be used to implement any biological monitoring procedures. By doing so, this data can enhance the overall knowledge about the watershed.

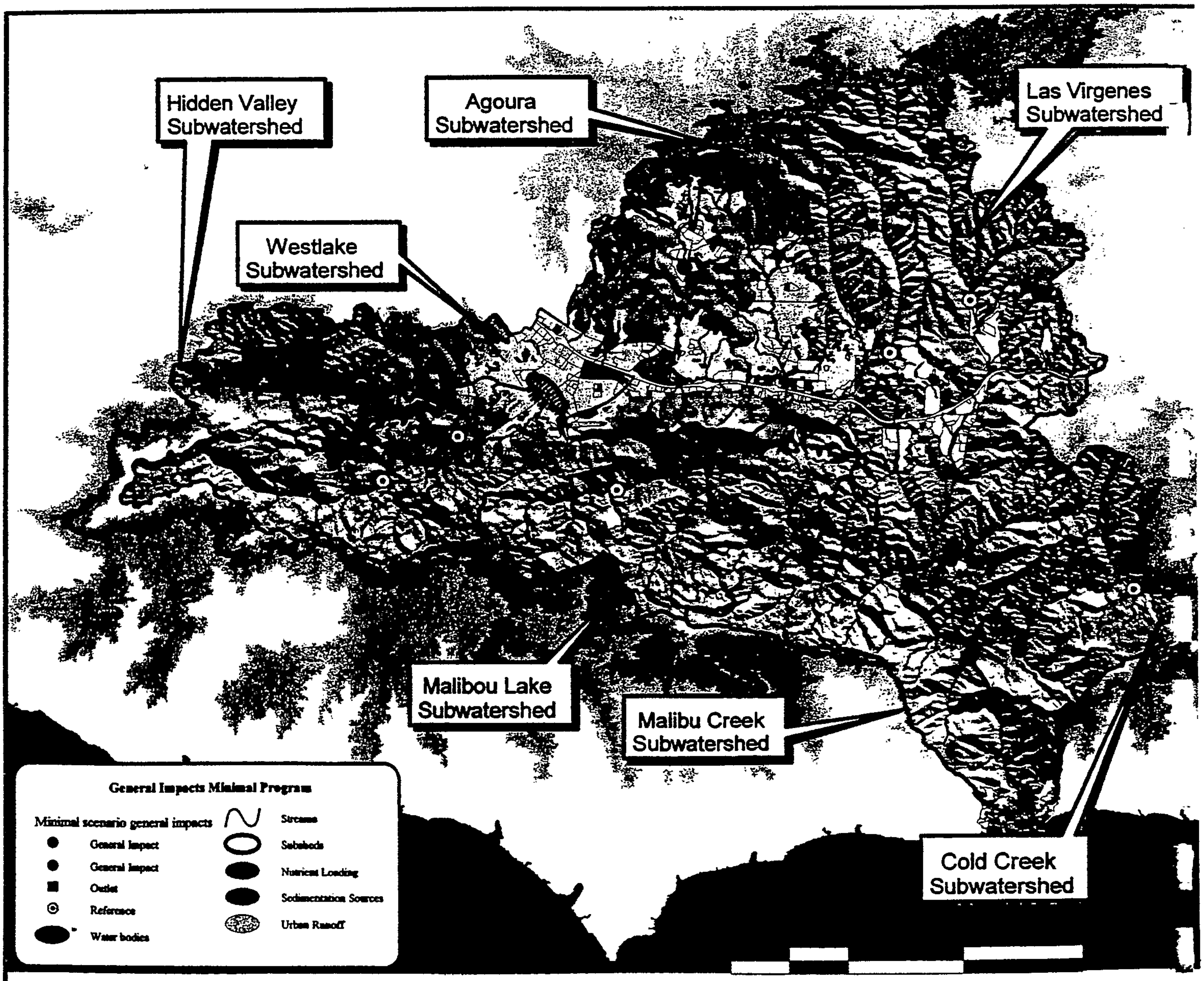
Criteria / Subwatersheds	Fish Migration Potential	Degraded Habitat (based on impermeability)	Greatest Threat from Future Development	Priority of Subwatershed (lowest number equals highest priority)
Malibu Creek	1	6	7	14
Cold Creek	2	7	6	15
Las Virgenes	3	3	1	7
Malibou Lake	4	5	5	14
Agoura	6	2	3	11
Westlake	7	1	4	12
Hidden Valley	8	4	2	14

Table 5-2: Priority chart for Stream Walking

Criteria / Subwatersheds	Likely Pollution from Urban Runoff	Likely Pollution from Nutrients	Likely Pollution from Sediments	Priority of Subwatershed (lower number equals higher priority)
Malibu Creek	4	1	6	11
Cold Creek	7	6	7	20
Las Virgenes	3	4	3	10
Malibou Lake	5	7	5	17
Agoura	2	5	2	9
Westlake	1	3	4	8
Hidden Valley	6	2	1	9

Table 5-3: Priority chart for Water Quality Testing





Sources: Land Use, Watershed Boundary by Los Angeles County Department of Public Works, Streams by National Park Service not for legal use.

General Impacts Minimal Program

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Recommendations for Existing Monitoring Efforts

Current monitoring efforts could potentially be more effective with a few modifications. There is an overlap of monitoring sites by different agencies. Monitoring efforts, including the efforts of the Malibu Creek Watershed Stream Team volunteers, must be coordinated to maximize resources and enhance the quality of data gathered in the watershed.

Monitoring should be done at the same time or at least on the same day at sampling stations that have overlaps. On Malibu Creek at Cross Creek Road, the Department of Health Services (DHS) is testing bacteria, and Las Virgenes Municipal Water District (LVMWD) and LA County Department of Public Works (DPW) are testing conventional, nutrients, bacteria, organic chemicals and making visual observations on a monthly basis (Trim 1994, pp. 12-15). It is recommended that the DHS should consider discontinuing monitoring at the Cross Creek Station. Instead, resources should be re-allocated to include conventional testing, nutrient testing, and bacteria testing at the Salvation Army station on Malibu Creek, so that DHS can quality check LVMWD's data. Currently, DHS is only monitoring bacteria at the Salvation Army Camp station while LVMWD monitors for conventional nutrients, bacteria, organic chemicals, and makes visual observations.

Two ocean sites, 50 yards east and west of the mouth of Malibu Lagoon, are also being monitored by DHS and LVMWD. A schedule should be established to encourage monitoring at the same time that would serve as a quality assurance check. These sites should be monitored ideally in the morning on the first Friday of every month. This schedule will more closely correlate with volunteer monitoring efforts and make the data collected more comparable. Ideally, monitoring would begin at the Salvation Army Site, proceed downstream to Cross Creek, and then end at the two ocean sites. Resource Conservation District (RCD) should work on this same schedule at the lagoon. Further, the RCD should add a monitoring station at Cross Creek Road that is monitored at the same time as LVMWD and DPW. This would be an effective way to verify the accuracy of their data.

The RWQCB Planning Division monitors four surface water sites within the watershed, but does so on an annual basis (Trim 1994, pp. 12-14). This data is of limited use at such an infrequent level of monitoring. The RWQCB Planning Division should discontinue their current monitoring sites and re-allocate those resources to supplying quality control and quality assurance to the volunteer monitoring program. The RWQCB could join the monitoring teams on three Saturdays and three Sundays and take side by side samples to provide quality assurance checks. Further, they could test those samples for bacteria. The Ventura County Department of Public Works monitors three stations on a quarterly basis, testing for conventional nutrients and bacteria. The Cal Poly team recommends that these sites be monitored on a monthly basis–the first Saturday (preferred), or Friday. Finally, Ventura County should add an additional monitoring site to serve as a reference on Cheseboro Road.

Section 6

Beyond Monitoring

The most effective way to improve ecological functioning within the watershed is to take action at the sources of the problems. New construction and renovation provides an opportunity for developers, architects, landscape architects, engineers, planners, and others to integrate designs that combine function, form, and ecological sensitivity. The following section is a catalog of planning and development recommendations, and design alternatives or Best Management Practices (BMPs) for consideration and action.

The monitoring program will advance the understanding of water quality issues, track trends, and identify source areas of pollutants. As long as urban runoff flows untreated and unfiltered directly into streams, water quality will not significantly improve at Malibu Lagoon and Surfrider Beach. By implementing the following action items, the health of stream corridors and ultimately water quality, can improve, fulfilling the vision of the watershed presented at the beginning of this document.

The following recommendations are divided into sections by key issues related to water quality. These are impervious surfaces, nutrient loading and sedimentation, water quantity, riparian habitat conservation, and development. Overall goals describe the conditions for optimal ecological functioning without sacrificing human needs. Objectives contribute towards the improvement of an issue if action items are implemented.

Planning & Development Recommendations could be turned into planning and zoning ordinances for local cities, counties, or regional agencies to implement and enforce. Design Alternatives are land-based actions that an individual or developer could implement on their property or in their community. Reference sections provide specific sources of information relating to a particular objective.

Impervious Surfaces

Reducing the effective level of impervious surfaces can improve water quality. This will increase infiltration, and ultimately reduce not only the volume and intensity of surface flows, but also the pollutants associated with urban runoff within the watershed. Reducing impervious surfaces would diminish future impacts to stream ecosystems. At the site scale, the goal for reducing the effects of impervious surfaces is slightly different than that for the whole watershed. The goal would be to achieve a "no net increase" in the amount of storm water runoff that leaves a given site. This means that the amount of storm water flow off of a site is the same as its pre-development, naturally vegetated state.

Planning and Development Recommendations

Limiting construction of impervious surfaces and promoting the use of permeable surfaces for all current and future projects can help restrict the amount of urban runoff in the watershed. Use of different products and technologies that allow the infiltration of water must be considered for all new developments, whether they are small-scale improvements such as a drainage swale, or a newly planned commercial and residential developments. By enhancing infiltration, the impacts to streams and water quality can be reduced.

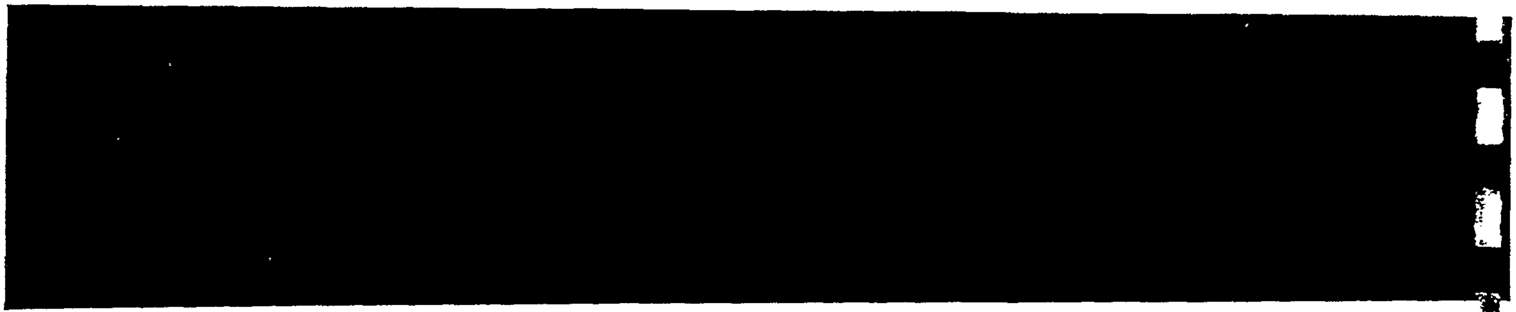
One way to lessen the impact of impervious surfaces is to concentrate development in higher density clustered housing (25% to 100% impervious surfaces) in some of the subwatersheds, in order to limit development in other subwatersheds to 10% impervious surfaces (Schueler 1995, p. 38). Clustered development lessens road length and reduces the amount of other impervious surfaces required to support a development. Reductions of impervious surfaces between 10% to 50% from traditional layouts can be accomplished depending upon the configuration of the clustered development (Schueler 1995, p. 61). Substantial savings in infrastructure costs are a direct benefit to the developer.

Land use zoning and other regulations can be used to limit the amount of impervious surfaces. Positive incentives and flexible codes encourage creative strategies for reducing the amount of impervious surfaces. This zoning should be done at the subwatershed scale and should be based upon the subwatershed classification: sensitive, degrading, and non-supporting. The sensitive subwatershed should have an upper limit of 10% impervious surfaces, degrading a 25% limit, and non-supporting no upper limit on impervious surfaces. Non-supporting subwatersheds have poor water quality and highly unstable streambanks. Future development and growth should be designated to occur in non-supporting subwatersheds in order to protect the sensitive and degrading subwatersheds.

Recommendations regarding specific subwatersheds in the Malibu Creek Watershed include:

- Focus development in the Westlake and Agoura subwatersheds and limit this to no more than 25% mapped impermeable surfaces.
- Change the zoning regulations to ensure that Las Virgenes, Malibou Lake, Malibu Creek, and Hidden Hills subwatersheds never exceed the 10% threshold for impervious surfaces.
- Reduce the level of effective impermeability in the Westlake and Agoura subwatersheds. This can be done through ordinances, building codes, and implementing new technologies to handle development.

Studies, such as Schueler's, have shown that it is more effective to reduce the amount of impervious surfaces related to the transport system (roads, parking lots, etc.), since these tend to have higher concentrations of pollutants than do rooftops or other impervious surfaces. These include reducing driveway length, width of streets and amount of impervious parking area.



Design Alternatives–Impervious Surfaces

The keys to mitigating the amount of storm water runoff are to slow down, capture, store, filter, and release storm water runoff. The most effective strategy, of course, is to limit or reduce the amount of impervious surfaces in the watershed. In addition to limiting or reducing impervious surfaces, it is recommended that design alternatives or Best Management Practices (BMPs) be implemented to reduce the amount and filter pollutants out of urban runoff.

The BMPs strategy will depend upon the subwatershed classification. Sensitive subwatershed BMPs should try and maintain pre-development hydrology and reduce sediment loading. BMPs such as biofilters, swales, and sand filters should be located away from streams to protect the hydrology of streams. BMPs for degrading subwatersheds should be implemented to remove pollutants and to reduce the frequency of bankfull and sub-bankfull floods. Pond or wetland designs can be implemented to achieve these goals. Non-supporting subwatershed BMPs objectives are to reduce pollution loads and prevent pollution.

The amount of impervious surfaces can vary greatly depending upon the development strategies and requirements for an area. The width of streets, the density of buildings, parking lot requirements, and the materials specified for such surfaces all contribute to the amount of impervious surfaces within a development. The amount of actual impervious surfaces can vary from 25% to 60% for medium density, single-family homes (Schueler 1995, p. 21). This all depends upon layout of streets, parking lots, and the overall layout and design of the site.

Recommendations

The following are specific actions that can be used to diminish the amount and effects of impervious surfaces.

Overall Recommendations

- Minimize the pollutants, and volume, and intensity of stream flows by restoring channelized portions of the creek throughout the Westlake and Agoura subwatersheds. Efforts to recapture the natural creek should start at the top and work down.
- Implement Best Management Practices throughout the entire watershed.
- Create a system of freshwater wetlands that biologically cleanses the water and regulate the volume and intensity of stream flows into downstream subwatersheds.

Streets, Driveways & Sidewalks

- Narrow width of streets.
- Use bioswales (vegetated depressions) that collect storm water and create visual separation, instead of creating elevated median strips to separate the traffic on two-way streets.
- Create streets and driveways that combine vegetative materials like grass, and ground covers with porous concrete, cobblestones or other materials that allow for the infiltration of water.
- Reduce the size of driveways for single family homes by sharing driveway

entrances. Create permeable extra parking spaces for visitors.

- Install French drain filter strips at the bottom of driveways or parking lots that collect and filter onsite runoff, then disperse water into planted collection areas.
- Use driveway strips with vegetation in the center to absorb leaks from automobiles and increase infiltration.
- Use permeable surface materials, such as cobbles, bricks or concrete paving blocks laid in a sand bed with mortarless joints, decomposed granite, and gravel.
- Design residential streets that receive little traffic with porous pavement to accommodate one way traffic, and use grass pavement for times when two-way traffic is needed.

Parking Lots

- Maximize how parking lots are used by using permeable surface materials on overflow areas or outer edges that are only used during busy holiday seasons.
- Use bioswales to collect runoff from parking, with plants and soil to filter pollutants associated with cars, before entering into the stream system.
- Support and use public transportation; ride bicycles for shorter trips.
- Create pedestrian-friendly malls that encourage strolling, not driving, between stores.
- Require underground parking beneath large structures, such as commercial buildings or apartment complexes.

Rooftops

Rooftop drainage is often sent directly to driveways and streets to rapidly flow into the storm drain system. Collecting, dispersing and filtering rooftop runoff before it reaches the storm drain system is a simple way of reducing negative effects of runoff.

- Drain roof runoff onto permeable areas such as planter beds. Use gravel to disperse gutter flows and to prevent erosion, or trench drains of gravel.
- Collect rooftop runoff from gutters into underground cisterns for future irrigation use.

Drainage Structures

- Retrofit existing storm water channels with pervious surfaces, where safe, to slow velocity of runoff.
- Create soft-bottom channels in place of concrete or pipes.
- Widen channels where possible.
- Establish retention/detention ponds, filters and infiltration systems.
- Create alternate routes for heavier flows through unused corridors or lots.
- Retrofit areas of high runoff due to impervious surfaces.
- Construct wetlands, where hydrology permits, for the enjoyment of residents.

Nutrient-Loading

Mitigation measures can decrease the impacts of pollutants to water quality. The key to preventing excess nutrients from reaching the water is to mitigate them at their source. The intent of this section is to recommend ways to reduce effects of polluted runoff into streams. New developments represent a good opportunity to implement some of these measures.

The following are specific actions that can be used to diminish the amount and effects of nutrient loading:

Recommendations

- Treat runoff onsite in bio-retention ponds or wetlands, before being released into public storm drain system.
- Collect runoff in parking lots into bio-retention ponds such as tree planters, median strips, or bioswales.
- Line streets and parking lots with bioswales to collect and filter runoff.
- Educate the public on ways they can lessen pollution runoff and impacts to the watershed.
- Maintain a water quality monitoring program to give feedback to the public and to agencies responsible for maintaining water quality.
- Lessen the amount of inputs into managed landscapes, such as pesticides, fertilizers and herbicides.
- Restore riparian vegetation.
- Minimize inputs to the wastewater treatment facility by promoting the use of gray water.
- Minimize the use of detergents containing phosphates that are hard to filter.
- Tapia should utilize wetlands that cool, store, and polish wastewater to be delivered during the summer when demand for reclaimed water exceeds supply.
- Begin a regional horse ownership educational program to encourage composting manure, pasture rotation, and proper planting techniques for grazing areas. Encourage the use of bioswales and filter strips to capture runoff leaving areas where horses are kept.
- Establish ordinances requiring a minimum 200-foot riparian buffer zone between areas where horses are kept and the stream.
- Permit no animal grazing within 200-foot of the riparian zone.
- Properly maintain septic systems; require inspections every two years. Require systems that do not pass inspection to be retrofitted with new septic systems that treat and reuse water for landscape irrigation.
- Pass ordinances that require new construction to meet these same requirements. Utilize computer-type systems to monitor the effectiveness of leach fields.

Recommendations for Steelhead Trout Enhancement (see Appendix E for more details)

- Remove the Rindge Dam to enable steelhead trout to migrate further upstream.
- Designate and protect critical habitat for steelhead trout.
- Require Tapia to cool, store, and polish wastewater using wetlands prior to any creek discharge.

- Implement construction BMPs on all projects requiring grading.
- Establish a no-build riparian buffer zone of at least 200-foot from the stream throughout the entire watershed.
- Reduce the effective impermeability of upstream cities through new zoning ordinances, building codes, and implementing structural BMPs.

Sedimentation

With the soils of the watershed being highly erodible, the goal regarding erosion and sediment loading is to minimize its occurrence. The following are specific actions that can be used to diminish the amount and effects of sedimentation:

Recommendations

- Reduce erosion and sedimentation at all construction sites with erosion and sedimentation control measures.
- Require Storm Water Pollution Prevention Plans (SWPPP) at all construction sites. These SWPPPs should be checked along with all sedimentation control measures during the construction process.
- Enforce compliance for all construction sites that do not display a SWPPP or have not implemented the erosion control measures.
- Limit clearing of native vegetation on construction sites.
- Require new construction projects of all sizes to implement sediment and erosion control devices at the construction site (such as silt fences, straw bales, etc.).
- Install terraces, temporary dams, sediment traps, or wetlands, that capture, store, and slowly release sediments over time.
- Protect soil from erosion during construction activities. Soil is highly vulnerable to erosion when vegetation has been removed during construction.

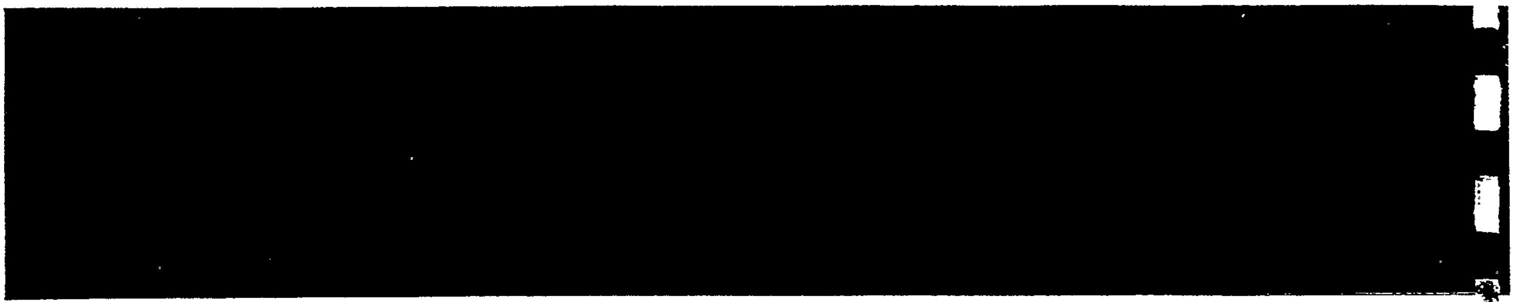
Water Quantity

The ultimate goal regarding water quantity is reducing the amount of imported water to be used, while accommodating population growth and development. With the continued consumption of imported water, the quantity of treated water being stored and released into Malibu Creek will continue to increase.

The following are specific actions that can be used to diminish the amount and effects of water quantity:

Recommendations

- Reduce imported water consumption through more efficient irrigation practices and low flow devices.
- Educate residents on the effects of imported water and provide incentives for reduced consumption.
- Increase the re-use of reclaimed water by allowing the distribution of reclaimed water to more customers, including residential users.
- Encourage the use of gray water systems through better landscape ordinances and rebates to supplement the initial costs.



- Encourage the use of drought tolerant and native vegetation.
- Create a series of wetlands throughout the watershed that would increase groundwater recharge, and decrease the intensity and volume of flows associated with impervious surfaces. Enhance water quality through biological filtration, and increase the available habitat for birds and other wildlife.

Riparian Habitat Conservation

Healthy stream habitats can help to reduce and mitigate problems associated with impervious surfaces, sediment loading, and nutrient loading.

The following are specific actions that can be used to enhance and protect riparian habitats.

Recommendations

- Protect existing riparian habitats.
- Preserve existing riparian corridor habitat.
- Preserve remaining native vegetation patches adjacent to riparian corridors.
- Protect sensitive areas from being developed. These include areas near streams, steep slopes, land on highly erodible soil, and areas with well established native vegetation.
- Protect existing vegetation that is covering the soil and holding the soil together.
- Protect soil from erosion by planting disturbed sites with native vegetation.
- Establish buffer zones between developed areas and streams. Reducing the amount of impervious surfaces near streams will help the vegetated buffer zone absorb and filter storm water runoff. The best strategy is to create a vegetated buffer zone by protecting existing native vegetation.
- Protect existing wildlife habitat corridors.
- Designate additional open spaces that link existing private and public open space.
- Re-establish the natural fire cycle to minimize the intensity, and associated sediment loading, from large intense wildfires.

This section contains recommendations and design ideas that if implemented, could aid in the restoration and enhancement of the ecological functions of the watershed. It is up to concerned citizens and stewards of the watershed to take action and help restore this diverse and spectacular watershed. These ideas are only a smattering of the various opportunities that can help solve the water quality problems of the watershed. Stewardship and design are a strong combination that, together, can result in positive change.

Section 7
References

Ambrose, Richard F., Irwin H. Suffet, and Shane S. Que Hee. *Enhanced Environmental Monitoring Program at Malibu Lagoon and Malibu Creek.* Prepared for Las Virgenes Municipal Water District. Environmental Science & Engineering Program, University of California. Los Angeles, CA. March 23, 1995.

American Rivers. *Lessons Learned, A Case Book for Successful Urban River Projects.* June 1997.

California Storm Water Best Management Practice Handbooks: Construction Activity. March 1993.

California Storm Water Best Management Practice Handbooks: Industrial/Commercial. March 1993.

California Storm Water Best Management Practice Handbooks: Municipal. March 1993.

Center for Watershed Protection. *Teacher's Guide for Creating a Water Monitoring Program.* Silver Spring, MD. no date.

Coastal Watershed Council. *Quality Assurance and Quality Control (QA/QC) Document for the Soquel Creek Watershed Monitoring Project, Draft.* Prepared for the California State Coastal Conservancy. Santa Cruz, CA. March 1997.

Coastal Watershed Council. *Soquel Creek Watershed Assessment and Problem Identification.* Santa Cruz, CA. January 31, 1997.

Behar, Sharon. G. Dates, and J. Byrne. *Testing the Waters: Chemical and Physical Vital Signs of a River.* Kendal/Hunt Publishing Company, Dubuque, IA. 1996.

Bovee, Ken D. USDI. Fish and Wildlife Service. *A Guide to Stream Habitat Analysis Using the Instream Flow Incremental Methodology.* Instream Flow Information Paper: No. 12. June 1982. Fort Collins, CO.

Coyote Creek Riparian Station. *Santa Clara County Citizens' Monitoring/Stream Inventory Project: Protocols and Procedures.* 1995.

Department of Agriculture. *Malibu Creek Watershed Natural Resources Plan.* July 1995.

Doyle, T. W., T. Doyle, C. H. Laubach, F.C. May, J. J. Merrick, L. Pfeifer, R. L. Rindge, and J.B. Rindge. *The Malibu Story.* Malibu Lagoon Museum, Malibu , CA. 1985.

Edmondson, Jim. *"Restoring Southern California Coastal Streams and Wetlands Through the Allocations of Reclaimed Water: The Malibu Creek Experience (Los Angeles Co.) Experience."* California Trout, Inc. San Francisco, CA. March 6, 1991.

Edmondson, Jim. *"Supplement Comments on Tentative Waste Discharge Requirements and NPDES Permit – Las Virgenes Municipal Water District, Tapia Water Reclamation Facility (CA0056014)."* Letter to Winnie D. Jesena, Chief, Los Angeles Coastal Unit, Los Angeles Regional Water Quality Control Board. California Trout, Inc. San Francisco, CA. May 28, 1997.

Entrix, Inc. *Characteristics of Pool, Channel Form, and Surficial Fine Sediment Over Time, Malibu Creek, Los Angeles County.* Walnut Creek, CA. June 13, 1994.

Entrix, Inc. *Malibu Creek Steelhead Habitat Assessment and Recommendation for Fish Passage.* Walnut Creek, CA. May 1989.

Entrix, Inc. *Malibu Creek-Santa Monica Mountains, Steelhead Investigations.* Prepared by Keegan, T.P. Walnut Creek, CA. April 1990.

Firehock, Karen, and Jacqueline Doherty. *A Citizen's Streambank Restoration Handbook.* Save Our Stream Program. Izaak Walton League of America, Inc. Gaithersburg, MD. 1995.

Firehock, Karen. *Save Our Streams: Volunteer Trainer's Handbook.* The Izaak Walton League of America. Gaithersburg, MD. April 1994.

Harrelson, Cheryl, C. L. Rawlins, and John P. Potyondy. *Stream Channel Reference Sites. An Illustrated Guide to Field Technique.* General Technical Report RM-245. United States Department of Agriculture Forest Service. Fort Collins, CO. April 1994.

Heal the Bay, *Urban Runoff: A Pollutior Abatement Program.* Developed for the Cities of Los Angeles County. 1992.

Hewlett, John D. *Principles of Fores Hydrology.* University of Georgia Press. Athens, GA. 1982.

Humboldt State University. *Overview of Wetland Opportunities of Malibu Creek Watershed.* Environmental Resources Engineering Department. August 1989.

Jorgen, Randolph. *Mountains to Ocean: A Guide to the Santa Monica Mountains National Recreation Area.* Southwest Parks and Monuments Association. Tucson, AZ 1995.

Las Virgenes Municipal Water District. *Las Virgenes Municipal Water District Populatioi Growth, Residential Development ana Employment Activity Report.* LVMWD Report Number 2041. Prepared by Baue Environmental Services, Santa Ana, CA. March 1996.

Las Virgenes Municipal Water District. *A History of the Las Virgenes Municipal Water District.* Calabasas, CA. 1994.

Leopold, Luna B. *Water, Rivers, and Creeks.* University Science Books. Sausalito, CA. 1997.

Levy, Louis, and John Korkosz. *Water Resources Management Plan: Santa Monica Mountains National Recreation Area.* Prepared for the National Park Service. Environmental Careers Organization. April 1997.

Malibu Creek State Park. *Flora: A Check List.* January 1983.

Mill Valley Watershed Project. *The Mill Valley Watershed: Volunteer Stream Survey Manual.* Mill Valley, CA. January 1997.

Ministry of Natural Resources. *Natural Channel Systems, An Approach to Management and Design. Ontario, Canada.* June 1994.

Muns, Bob. *Flora of Malibu Lagoon State Park.* 1988

Murdoch, Tom, Martha Cheo, and Kate O'Laughlin. *Streamkeeper's Field Guide: Watershed Inventory and Stream Monitoring Methods.* Adopt-A-Stream Foundation. Everett. WA. 1996.

Napa County Resource Conservation District. *Napa River Watershed Monitoring, Stream Gauge Protocol.* Draft. February 1998.

Olympia, City of. *Impervious Surface Reduction Study, Final Report.* Public Works Department, Water Resources Program. May 1995.

Olympia, City of. *Stream Team Volunteer Handbook, Third Edition.* Public Works Department, Water Resources Program; City of Lacey, Water Resources Unit; Thurston County, Storm & Surface Water Program. June 1995.

Pacific Southwest Region Stream Condition Inventory. *Stream Condition Inventory.* Version 3.4. June 27, 1996.

Regional Water Quality Control Board, Southern California. *Volunteer Water Monitoring Manual.* 1997.

Resource Conservation District, Santa Monica Mountains. *Biological Overview of the Malibu Creek Watershed Proposed Channel Clearing Site.* October 20, 1997.

Resource Conservation District, Santa Monica Mountains. *Stable and Horse Management in the Malibu Creek Watershed, A Manual on Best Management Practices for the Reduction of Non-Point Source Pollution.* August 12, 1997.

Rindge Dam Removal Study. *An Effort to Reduce the Decline of the Malibu Creek Steelhead Population in Southern California.* April 1995.

Roques, Dominic, and Andy Peri. *The Mill Valley Watershed: Volunteer Stream Survey Manual.* Mill Valley, CA. January 1997.

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Roques, Dominic, Peri, Andy. *The Mill Valley Watershed: Volunteer Stream Survey Manual.* Mill Valley, CA. January 1997.

Rosgen, Dave, and Hilton Lee Silvey. *Applied River Morphology.* Wildland Hydrology. Pagosa Springs, CO. 1996.

Rosgen, Dave, and Hilton Lee Silvey. *Field Guide for Stream Classification.* Wildland Hydrology. Pagosa Springs, CO. 1998.

San Francisco Estuary Institute. *Riparian Station How-To Manual, Final Report.* Prepared by Chris Fischer, Michael Rigney, and Elizabeth Sawyer. September 10, 1996.

Santa Monica Bay Restoration Project. *State of the Bay 1993: Characterization Study of the Santa Monica Bay Restoration Plan.* Monterey Park, CA. January 1994.

Santa Monica Bay Restoration Project. *The Review of Monitoring and Response Protocol for the Malibu Creek Watershed.* Prepared by Heather Trim. November 1994.

Schmidt, Katherine A. *Water, traffic, open space top Malibu priorities.* "The Outlook" 12 December 1992, A3.

Schueler, Tom. *Site Planning for Urban Stream Protection.* Prepared for the Metropolitan Washington Council of Governments. The Center for Watershed Protection. Silver Spring, MD. December 1995.

Soquel Creek Watershed. *Clean Streams Volunteer Monitoring Project.*

State of California Resources Agency. Department of Fish and Game. *California Salmonid Stream Habitat Restoration Manual.* Third Edition. January 1998.

State Water Resources Control Board. *California's Directory of Volunteer Monitoring Organizations.* Sacramento, CA. June 1997.

State Water Resources Control Board. *Southern California Volunteer Monitoring Quality Assurance Project Plan.* Sacramento, CA. June 17, 1998.

Steelhead Restoration Project. *Report of Geotechnical and Environmental Study, Malibu Area, Los Angeles, County, CA.* May 23, 1993.

United State Department of Agriculture. Natural Resources Conservation Service. *Malibu Creek Watershed Natural Resources Plan.* Davis, CA. July 1995.

United States Department of Agriculture. Forest Service. *Sampling Designs for Estimating the Total Number of Fish in Small Streams.* May 1986.

United States Department of Agriculture. Forest Service. *Stream Channel Reference Sites: An Illustrated Guide to Field Technique.* General Technical Report RM-245. Prepared by Cheryl C. Harrelson, C. L. Rawlins, and John P. Potyondy. Rocky Mountain Forest and Range Experiment Station. Fort Collins, CO. April 1994.

United States Department of Agriculture. Forest Service. *Stream Condition Inventory Protocols.* Version 3.4. Draft. Pacific Southwest Region. San Francisco, CA. June 27, 1996.

United States Department of Agriculture. Natural Resources Conservation Service. *Malibu Creek Watershed, Technical Documentation. Nitrogen and Phosphorous Analysis, Final Plan.* Davis, CA. February 1995.

United States Department of Agriculture. Natural Resources Conservation Service. *Malibu Creek Watershed Natural Resources Plan, Los Angeles and Ventura Counties, California.* Draft. March 1995.

United States Department of Agriculture. Soil Conservation Service. *Plan of Work.* June 1992.

United States Department of Agriculture. Soil Conservation Service. *Comprehensive Malibu Creek Watershed Mediation Effort.* May 1994.

United States Department of Interior. National Biological Service. *The Instream Flow Incremental Methodology: A Primer for IFIM.* March 1995.

United States Environmental Protection Agency. *Monitoring Guidance for Determining the Effectiveness of Non-Point Source Controls.* September 1997.

United States Environmental Protection Agency. Office of Wetlands, Oceans and Watersheds. *Volunteer Stream Monitoring: A Methods Manual.* EPA 841-B-97-003. Washington, DC November 1997.

United States Environmental Protection Agency. *Technical Guidance for Streams and Small Rivers.* May 1996.

United States Environmental Protection Agency. Water Division, Region 10. *Streamwalk Manual.* EPA 910-B-94-002. Seattle, WA. July 1994 (Rev.).

United States Environmental Protection Agency. *Water Quality Laboratory at Heidelberg College, Estimation of Pollutant Loads, A Guidance Document for NPS Programs.*

Warner, Richard E., and Kathleen M. Hendrix, Eds. *California Riparian Systems: Ecology, Conservation, and Productive Management.* University of California Press. Berkeley and Los Angeles, CA. 1984.

Woodward-Clyde Consultants. *Project Implementation Plan for Evaluation of Potential Water Quality Impacts on Malibu Creek and Lagoon From On-Site Septic Systems.* Santa Ana, CA. August 4, 1997.

Yates, Steve. *Adopting A Stream: A Northwest Handbook.* The Adopt-A-Stream Foundation. Everett, WA. 1991.

Appendix A

Recommendations and Project Limitations

RECOMMENDATIONS

Any efforts to correct existing digital storm drain data that currently is in a form that is unusable, should consider the Malibu Creek Watershed a high priority. Many groups and agencies currently monitor in the area and can immediately utilize this information to isolate the sources of pollution. An opportunity exists to use the volunteer monitoring program as a way to collect locations of storm drain outfalls by using global positioning systems. This alternative would enable the county to accurately locate storm drain outfalls for a fraction of the cost and time it would take for county employees to accomplish this task. While this would require funding for equipment and training, this is a viable alternative that would mutually benefit both groups.

An important element to any monitoring program is the ability to isolate the sources of pollution problems. Isolating sources of pollution would be more effective if storm drain locations were mapped. The Los Angeles County Department of Public Works, and Ventura County Department of Public Works, should create a single comprehensive digital storm drain map for the Malibu Creek Watershed. This storm drain map must identify storm drain outfalls and the areas drained by each outfall, and identify who is responsible for maintaining each storm drain. In addition, to ensure that digital data is readily available, and to increase the effectiveness of management of this complex system, this information must be compatible with the GIS employed by these counties. Without this type of information, locating the sources of water pollution problems will be impossible.

Existing information exists regarding monitoring throughout the watershed. This data should be synthesized and kept in one location that is accessible by the public and agencies in the watershed. This data can be helpful in making decisions concerning the watershed.

At the current time, Heal the Bay has the facilities to ensure the timely dissemination of the information collected by the Stream Team. As a non-profit agency, they can distribute this information at little to no cost. As the data base grows, Heal the Bay will be forced to upgrade their computer hardware to accommodate the increased volume of stored data. Beyond the time frame of the pilot project, it is recommended that funding to upgrade the computer hardware and software be acquired. Further, Heal the Bay should purchase a new orthographic digital aerial photograph every three years. Funding should be secured to accommodate additional Stream Walk Teams during the course of Phase 1. If Heal the Bay decides to expand the program into Phase 2, the person running the program should receive specific training for Macroinvertebrate Sampling and Stream Reach Surveying.

Flow data at the two stream gages in the watershed does not provide a picture of the contribution from each subwatershed. It is felt that many of the streams that were once intermittent are now perennial from artificial inputs into the streams. Installation of stream gages and rain gages at the base of each subwatershed, that accurately measure low flows would be beneficial to the area.

Project Limitations

Data from this study is based on the most current available information. The soils map received in digital form is considered obsolete and unreliable for this area. The Natural Resource Conservation Service is currently conducting a detailed soil survey for the area, and they have already discovered eight new soil types (Koeneker 1998, p. 5). When this new study is ready, the model should be updated. Land Use data has been revised by the project team from a digitally rectified orthographic aerial photo to reveal the newest information. The aerial photo is a blend of photos taken in April and October of 1997. Sites chosen for the monitoring, and stream classifications are based on observations from the aerial photo, USGS Topographic Maps, and street maps. These sites have not been field checked. The data provided in the digital data set should not be used for building, precise modeling, or any activity that needs data at higher accuracy than 30 meters.

Appendix B

Runoff Analysis for the Malibu Creek Watershed

by Bradley B. Owens

Introduction

The software used for modeling the watershed is called Watershed Modeling System (WMS) created by Environmental Computer Graphics Laboratory (ECGL) of Brigham Young University. With this model, runoff was estimated utilizing data supplied by Los Angeles County Department of Public Works and digital elevation data from DEMs. The watershed was modeled for two conditions– pre-development and current development. Results show a dramatic increase in runoff from pre-developed conditions to the current developed condition.

WMS provides a graphical interface for standard computer models such as HEC-1 and TR-20; HEC was developed by the United States Army Corps of Engineers, and TR-20 was developed by the Soil Conservation Service (SCS, now the Natural Resource Conservation Service or NRCS). When using this software program, the model can be updated and refined as new information becomes available, thus adding to the effectiveness of analyzing and predicting changes in the watershed.

Peak Runoff Explanation

A hydrograph is a graphical representation of a volume surface flow at a common point, such as a stream gage, in a given time period (cubic feet per second). For this model, a 24-hour storm was used as the time period. After the initial infiltration of rain into the topsoil, overland flow, or runoff, will occur and a peak will also occur at some point when the flows are greatest due to factors such as subwatershed geometry (area, slope), soil types, cover (land use, vegetation), and storm pattern.

The WMS software requires that certain data sets are available, depending on the model type and accuracy desired. Data was collected from a variety of different sources listed in table 1.

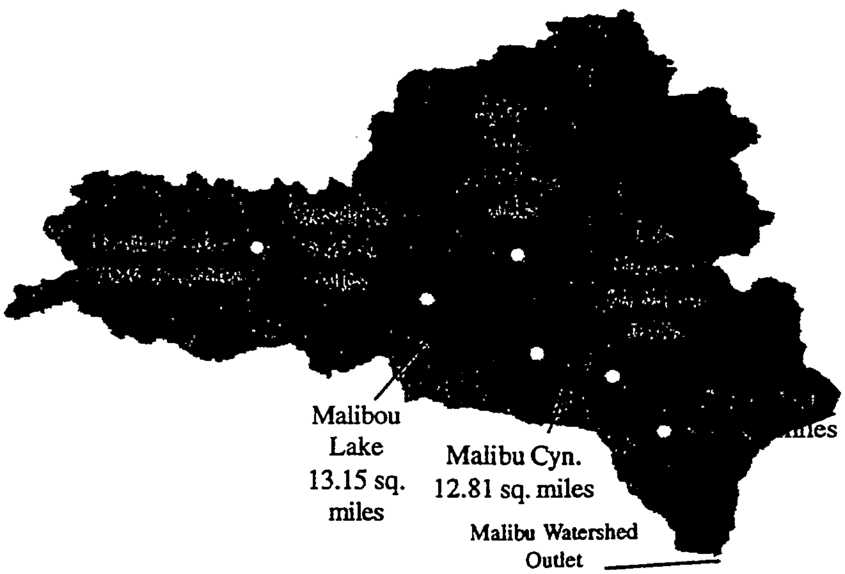


Figure B-1: Malibu Creek Watershed, Boundaries, and Area

Model Inputs and Methods

HEC-1 was chosen as the hydrograph method within WMS due to its ability to utilize the land use and soils data, thus providing more precision than other models such as TR-20. Within HEC-1, the NRCS curve number method was chosen to compute losses (runoff) for the same reason. The curve number method was developed by the NRCS as a way to index various surface runoff conditions based on land use conditions and soil characteristics.

The model was run for intervals of 2, 5, 20, 25, 50, and 100 year storms, based on rain data available from the National Oceanic Atmospheric Agency (NOAA) and applied to two conditions. Current developed conditions and predevelopment conditions were based on a vegetation survey done from 1930 to 1934 by A. E. Wieslander of the United States Forest Service. For predevelopment land use conditions, the Wieslander survey was used to visually estimate the percentages of different vegetation type. These were averaged together to generate predevelopment curve numbers.

Dams

There are at least six dams/reservoirs in the watershed; of these, four were used in the model due to their size and/or location within the watershed. The dams used (with the DWR number) for this model are Lake Sherwood (765-000) in Hidden Valley, Westlake Lake (786-000) in Westlake, Lindero Lake (785-000) in Agoura Hills, and Malibou Lake (771-000) in the Malibou Lake subwatershed. Information about the dams is available on the World Wide Web (see references).

Assumptions, Limitations

This model is dependent on the available primary data; it is assumed that this is the best available at this time. It is known that the soil survey on which the

Primary Data	Source	Notes
Rainfall	NOAA	24hr. 2-5-10-25-50-100 year storms.
Soils	National Park Service	Modified by Suzanne Dallman, UCLA to reflect new information.
Land Use	Los Angeles Co. Department of Public Works	Modified by Cal Poly Pomona 606 Team using digital aerial photography and 3-d analysis.
Watershed, Subshed Boundaries	Los Angeles Co. Department of Public Works.	Modified by Cal Poly Pomona 606 Team using digital aerial photography and 3-D analysis.
Vegetation (current)	National Park Service	
Vegetation (pre-development)	USFS	Survey by A.E. Wieslander.
Elevation DEMs	Cal St. Northridge	Digital Elevation Model (DEM).

Table B-1

GIS shapefile was based is an interim survey by the NRCS and is currently being updated for official release due in year 2001 (personal communication, Al Wasner, NRCS). In addition, the land use categories supplied did not have direct correlation to the SCS curve number table and this was manually interpolated.

As stated previously, this model has many inputs so modification and refinement over a long period of time will return the best results. Additional information useful would be channel geometry, reservoir geometry and conditions, and more exact soils data. Hydrologic modeling is both art and science, so the results are assumed to be estimates, and will differ from actual conditions.

Results

The runoff analysis resulted in two primary results, predevelopment and current developed conditions with modeled estimates of peak runoff (cubic feet per second) for each subwatershed and a total at the ocean outlet for each storm interval. The data is presented on the following pages in tabular form with a hydrograph for the outlet. Figure 1 represents predevelopment conditions and Figure 2 represents current conditions.

Conclusion

The modeling has shown that the watershed is yielding a large increase in runoff since predevelopment conditions have changed. Increases greater than 100% are seen in every subwatershed, most approaching 200% for a two year storm, and the Westlake subwatershed showing an over 700% increase. Figure 3 shows the relationship between the increase in mapped impervious surfaces and the increase in the amount of runoff is highly correlated.

Table 2 shows that the increase in impervious surface area in each subwatershed has increased the runoff into Malibu Creek (with the assumption being that the predeveloped condition had zero impervious surface). The clearest example is in the Westlake subwatershed where a 22.89% increase in impervious surface has led to a 722.01% increase in runoff. The linear graph also shows that the increase is a logarithmic relationship; small incremental increases of impervious surface leads to greater and greater amounts of runoff (Figure 4).

Although typical (and costly) structural devices such as dams and weirs can be used to control runoff, it is clear that this watershed will yield extreme amounts of runoff as impervious surfaces increase, and due to the erosive nature of the soils, will render these devices largely ineffective in relatively short periods of time as seen with Rindge Dam which has completely filled with sediment.

Malibu Creek Watershed Outflow, Pre-Development Conditions [cfs]

Storm Interval	**Malibu Creek Outlet**	Malibu Cyn	Cold Creek	Las Virgenes	Malibou Lake	Agoura Hills	Westlake	Hidden Valley
2yr/24hr	**1,601**	229	97	260	248	278	159	340
5yr/24hr	**5,247**	635	483	522	1,702	856	901	1,175
10yr/24hr	**8,663**	964	681	841	2,762	1,856	1,001	1,768
25yr/24hr	**13,130**	1,829	1,177	1,285	4,064	2,109	1,308	2,965
50yr/24hr	**15,427**	2,393	1,289	1,533	4,581	2,652	1,761	3,284
100yr/24hr	**23,056**	3,398	1,908	2,545	6,463	4,175	2,498	4,631

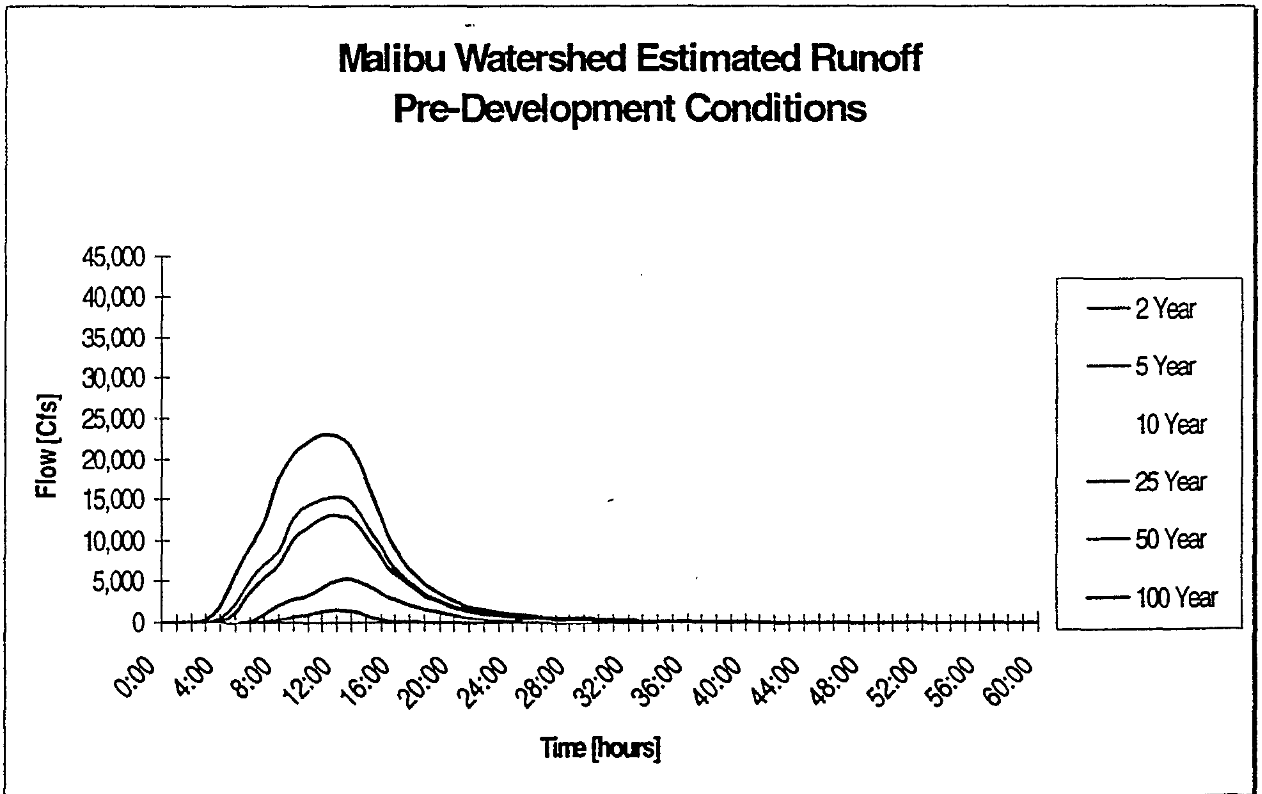


Figure 1

Malibu Creek Watershed Outflow, 1998 Conditions [cfs]

Storm Interval	Malibu Creek Outlet	Malibu Cyn	Cold Creek	Las Virgenes	Malibou Lake	Agoura Hills	Westlake	Hidden Valley
2yr/24hr	**3,766**	573	270	702	693	921	1,307	939
5yr/24hr	**13,255**	1,365	1,074	1,265	3,646	2,311	3,162	2,668
10yr/24hr	**19,821**	1,950	1,432	1,888	5,454	4,305	3,907	3,738
25yr/24hr	**26,616**	3,342	2,249	2,682	7,469	4,784	3,982	5,708
50yr/24hr	**30,161**	3,735	2,433	3,109	8,762	5,751	4.814	6,189
100yr/24hr	**42,090**	5,596	3,356	4,699	10,948	8,221	6,559	8,146

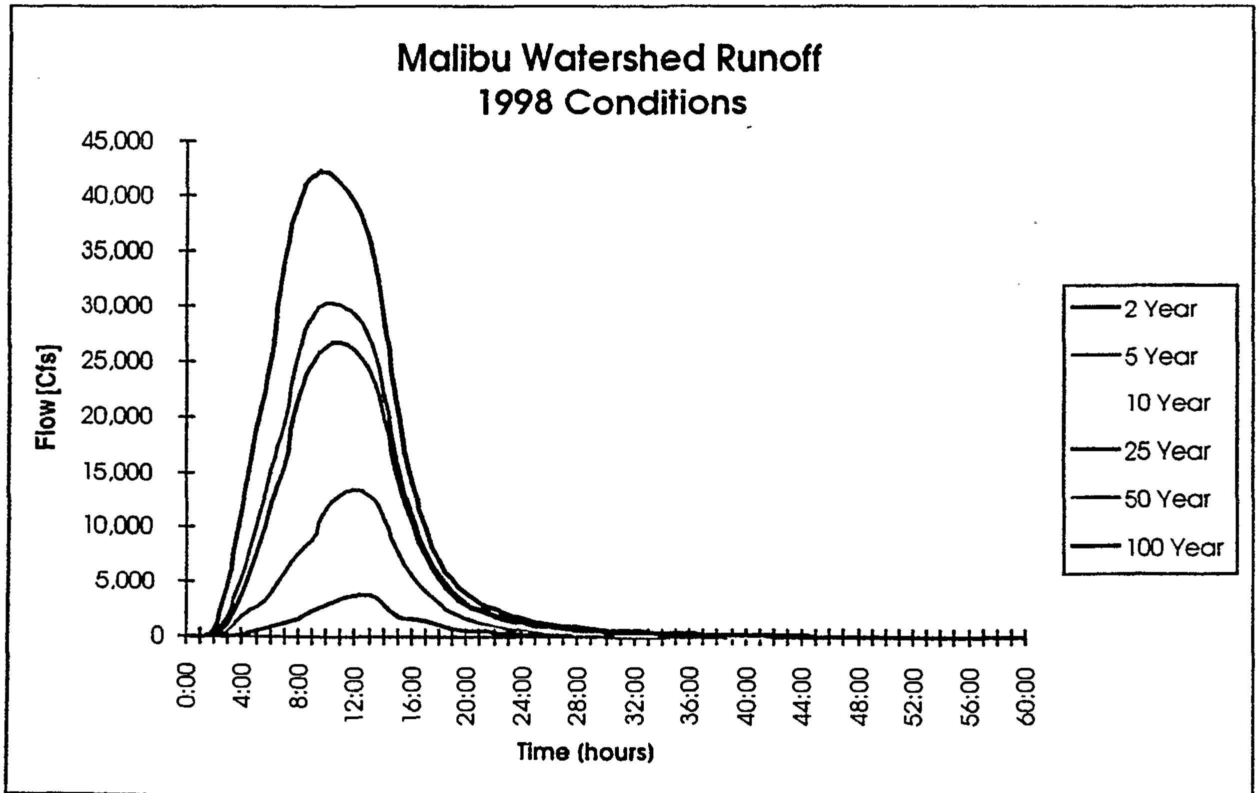


Figure 2

Malibu Watershed Area, Development/ Runoff Relationship

	Malibu Cyn	Cold Creek	Las Virgenes	Malibou Lake	Agoura Hills	Westlake	Hidden Valley
Total Area [mi^2]	12.81	8.16	24.34	13.15	21.62	12.99	16.86
Mapped Impervious (current) [mi2]	0.48	0.16	1.73	0.44	3.98	2.97	0.94
Percent Impervious (PreDev)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Percent Increased (Current)	3.71	2.01	7.11	3.38	18.39	22.89	5.56
PreDev. Runoff (2yr) [cfs]	229	97	260	248	278	159	340
Current Dev. Runoff (2yr) [cfs]	573	270	702	693	921	1,307	939
Percent Increased Runoff	150.2	178.4	170.0	179.4	231.3	722.0	176.2

	Malibu Cyn	Cold Creek	Las Virgenes	Malibou Lake	Agoura Hills	Westlake	Hidden Valley
Percent Increased (Current)	3.71	2.01	7.11	3.38	18.39	22.89	5.56
Percent Increased Runoff	150.22	178.35	170.00	179.44	231.29	722.01	176.18

Table 2

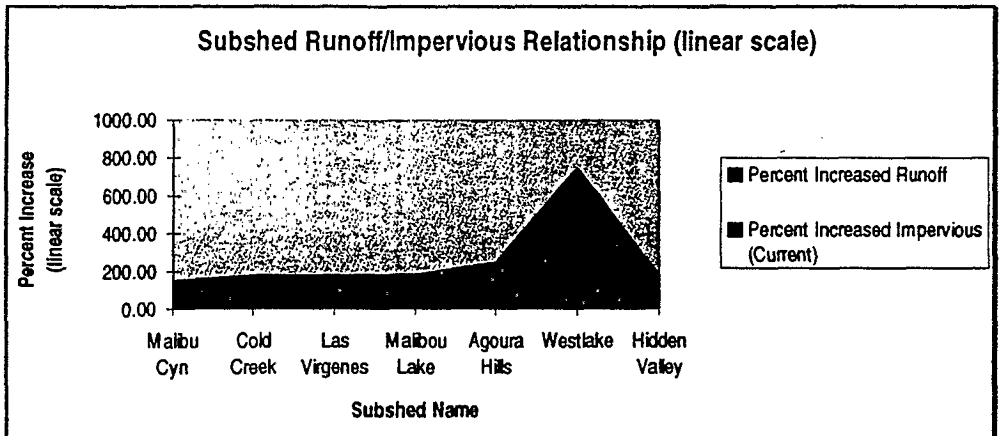


Figure 4

[redacted]

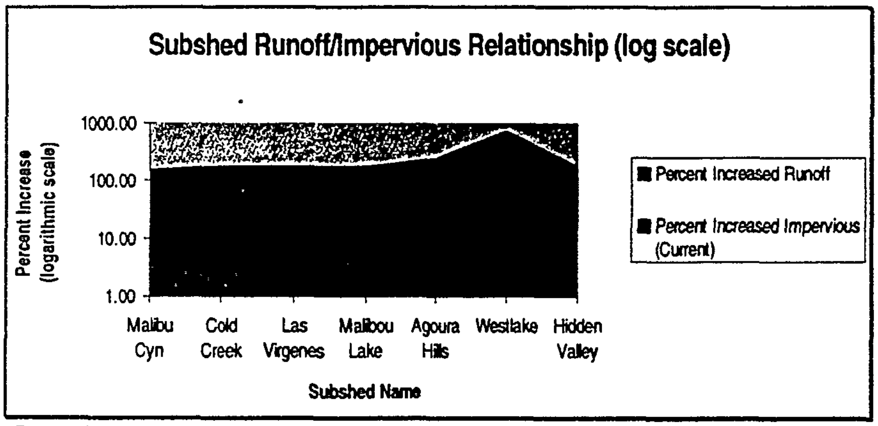


Figure 3

REFERENCES

Bedient, Philip B. *Hydrology and Floodplain Analysis.* Addison-Wesley Publishing Company. 1992.

Dams Within Jurisdiction of the State of California, Bulletin 17. California State Department of Water Resources. June 1993. *http://galaxy.cs.berkeley.edu/kopec/b17.*

Engineering Computer Graphics Laboratory. Brigham Young University, Provo, Utah. (801) 378-2812. *http://www.ecgl.byu.edu/software/wms.*

HEC-1 Users Manual version 4.0, United States Army Corps of Engineers, Hydrologic Engineering Center. 1990.

Maidement, David R., ed. *Handbook of Hydrology.* McGraw-Hill, Inc. 1992.

Precipitation Frequency Maps for the Western United States (Return Periods NOAA Atlas 2). *http://www.wrcc.dri.edu/pcpnfreq.html.*

WMS Reference Manual, version 5.0, Environmental Computer Graphics Laboratory. Brigham Young University, Provo, Utah. 1997.

WMS Tutorial, version 5.1, Environmental Computer Graphics Laboratory. Brigham Young University, Provo, Utah. 1998.

Appendix C

Within Every Healthy Watershed Dwell Citizen Stewards

by Eileen Takata Schueman

Introduction

Human beings have altered natural systems by dredging wetlands, channeling streams, damming rivers, and by increasing impervious surfaces by paving over porous soils. Over time, the accumulated effects have altered the natural hydrologic cycle, degraded habitat for native plant and animal species, and strained precious water resources. Government agencies alone can not bring changes to the current situation. Banded together, however, private citizens are capable of improving conditions of these altered streams, rivers, lakes, wetlands, and estuaries in and around their neighborhoods, towns, cities, and counties. Citizen stewards, who participate in monitoring the current health of these ecosystems, contribute to the future health of their natural resources.

Overview of Existing Monitoring Programs

It is not clear how many volunteer monitoring programs exist or how many participants are active in this country. The U.S. Environmental Protection Agency reports that over 24,000 volunteers involved with state-supported programs monitor more than 985 streams and rivers, nearly 2800 ponds, lakes, and wetlands, and four major estuaries. Throughout Pennsylvania, 60 groups and over 6,000 volunteers sample surface and groundwater. California's Directory of Volunteer Monitoring Organizations (1997) list over 50 groups around the state. What is clear is that the numbers are rising. Internationally, Australia and the United Kingdom support many stream-monitoring programs, and a joint program exists between Mexico and the U.S.

In the past, coastal lagoons and wetlands had been the focus of citizen monitoring efforts. Isolated streams and rivers have also been monitored extensively. More recently, watershed management has become the impetus behind new grassroots organizations and projects. This holistic approach addresses multiple issues affecting the complex system of streams, wetlands, and creeks. Watershed-wide monitoring addresses problems at their source, and can be effective in integrating multiple solutions to the complex problems.

WHO Is Monitoring?

Volunteers are either local concerned citizens of all ages, elementary through college students. They share a sense of wanting to contribute to "the environment." Monitoring groups call themselves Stream Team, X-Stream Team, Stream Keepers, Stream Watch, Watershed Watch, Texas Watch, Friends of the Estuary, and Riparian Station. Naming ensures a "team spirit" and contributes to the motivation factor, which will be discussed later.

Statewide programs such as Kentucky Water Watch and Hoosier Riverwatch in Indiana are run through their respective Department of Natural Resources. Auburn University's Alabama Water Watch is an example of a collaborative effort between Federal, State, and local agencies. Non-profit organizations coordinate local, regional, or statewide monitoring efforts. In Virginia, the Izaak Walton League's Save Our Stream Program (SOS) supplies its data to the Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation. The Bay Area Regional Watershed Network promotes watershed stewardship by acting as a facilitator and regional funding base for different groups in the San Francisco Bay Area. students at Sequoia Elementary School in Pleasant Hill, California monitor Murderer's Creek.

WHAT Is Being Monitored?

Every project is unique in terms of what is being monitored, and depends largely on the goals and objectives of that particular program. The name Stream Team implies stream quality monitoring, but could easily include wetlands, lakes, vegetation and habitat restoration or watershed surveying. Friends of the Santa Margarita River in southern California are concerned about the health of the entire watershed. In northern California, the Lindsay Museum Watershed Watchers monitor Walnut and Pine Creeks.

Each program samples one or a combination of several stream and watershed parameters. A large number of programs train for chemical sampling of water quality. Physical stream characteristics and biological sampling of benthic macroinvertebrates are also common. Other parameters include bacterial, habitat assessment, illegal dumping, discharges, vegetation, stream/beach cleanup, erosion, or sedimentation. More and more groups are realizing the importance of setting goals for a holistic monitoring program. This ensures that the overall health of a watershed is being measured, not just one particular stream or river.

WHY Monitor?

Volunteers monitor in their community to contribute to society, to do something "good for the environment", and to gain something back. School children gain hands-on educational experience in the natural sciences. Adults gain satisfaction knowing their monitoring results will be used to make improvements to the health of surrounding ecosystems. Many organizations offer training workshops and informational lectures for their volunteers. In this way, volunteers learn new skills and techniques that are essential for high quality data collection.

Programs originate because of one or a combination of three general categories. The U.S. Environmental Protection Agency, Non-Point Discharge Elimination Survey (NPDES) compliance is a primary impetus for starting a program. Many programs have begun due to citizens organizing for a specific reason, such as to take action against a known point-source polluter, or to save an endangered species, or to combat invasive exotic vegetation which has taken over a stream bank. Lastly, effects of degradation and human-induced alterations of riparian ecosystems or watersheds prompt citizens and professionals to organize and develop a comprehensive monitoring program.

Key Issues in Monitoring Programs

In order to gain first hand insight into key issues in monitoring and program planning, I developed a questionnaire which guided telephone interviews. A sample copy is included and follows the bibliography. There are eighteen questions, relating to four general categories: The Program Goals & Objectives, Program Organization and Change, Data Collection and Dissemination, and Volunteers. Talking to actual monitors and program coordinators has unveiled some interesting insights, especially on the importance of volunteers, and reinforced existing knowledge.

Seven organizations have been contacted. Interviews were conducted with Hoosier Riverwatch in Indianapolis, IN, River Watch Network in Montpelier, VT, Kentucky Water Watch in Frankfort, KY, Sonoma Ecology Center in Sonoma, CA, Coyote Creek Riparian Station in Alviso, CA, Bay Area Action out of Palo Alto, CA, and the Mill Valley Watershed Organization out of Fairfax, CA. The contacted persons are program coordinators, office managers, or technical advisors to the project. These contact persons represent either state-sponsored programs, or regional and local non-profit agency-sponsored programs. The one exception is River Watch Network, a non-profit organization that assists in the development of new monitoring programs around the country.

Program Goals and Objectives

Goals for existing monitoring programs surveyed to date serve two primary purposes. The first goal serves the needs of humans, namely the volunteers and the public at large. Monitoring provides educational opportunities for teachers and students of all ages, and provides opportunities for citizen stewardship. Hoosier Riverwatch aims to increase public awareness. The second goal addresses ecological concerns. The need to improve water quality ranks high among these groups. Physical degradation of stream banks, habitat and or species loss, native vegetation concerns, and overall watershed health are other examples of goals stemming from ecological concerns.

What a group monitors depends largely on these goals and objectives. Bay Area Action is concerned with bird and wildlife habitat quality, and the control of invasive plants, as well as the restoration of native vegetation. The Mill Valley Watershed Organization surveys habitat, vegetation, sedimentation, and stream substrate. Watershed survey data is also an important component of data collection. Hoosier Riverwatch sends students out to collect chemical and biological data for school projects.

Program Organization and Change

The individuals that were interviewed have one of four roles within their organization. They are either a Volunteer/Program Coordinator, technical advisor, student intern, or volunteer. Being a program coordinator is a full-time paid position at Kentucky Water Watch and Hoosier Riverwatch, which are also state-funded programs. As for the non-profit organizations, it is not clear if program coordinators are paid or volunteer positions. The Sonoma Ecology Center utilizes a volunteer technical advising committee. Bay Area Action employs a few staff members, engages six student interns for specific projects, coordinates with five to six key managers, and oversees about twenty to thirty citizen volunteers on a typical work day.

Collaboration among agencies on goals and program elements are important to the Sonoma Ecology Center, Coyote Creek Riparian Station/Watershed Initiative Pilot Program, and Bay Area Action. These three groups work with agency partners and local community organizations to plan current projects and future directions. Bay Area Action is involved with the Coordinated Resource Management Process (C.R.M.P.) project, a group of stakeholders interested in an integrated approach to solving watershed-wide problems. Issues range from biodiversity, flood control, and pollution, to the homeless living in creek corridors.

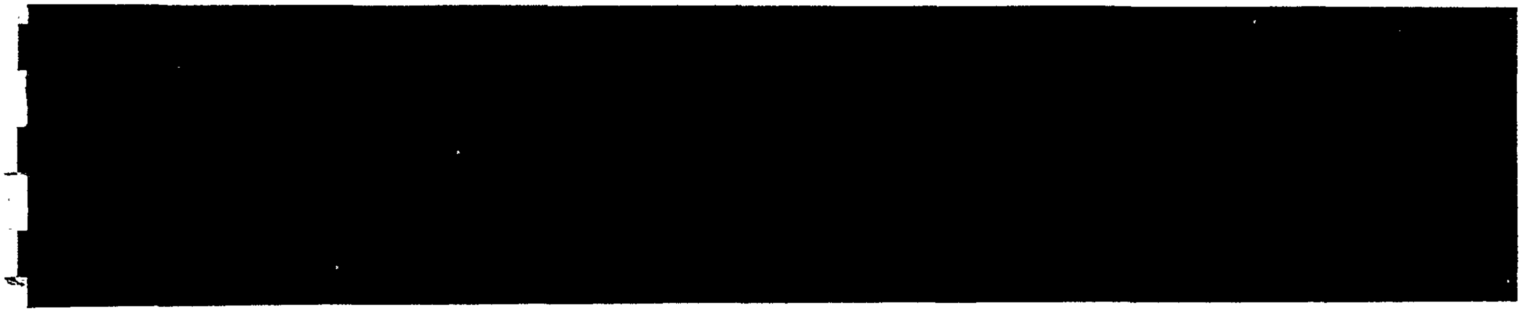
Program objectives change over time for some organizations. Hoosier Riverwatch began as a trash clean-up and awareness program, and has since expanded to include biological and chemical testing. Another group, the Coyote Creek Riparian Station is undergoing a transition because their goals and resource needs have changed. Originally they monitored riparian habitats of several creeks. However, focus has recently shifted towards watershed monitoring, recognizing the need to understand the entire ecosystem, rather than single creek riparian systems. From this reassessment of program goals, the interagency Watershed Initiative Pilot Program was born. This program is collaborative, potentially allowing more access to funding and technical resources through its partner organizations.

Data Collection and Dissemination

A volunteer will record his or her data onsite. The forms that they use vary with each program. Once sampling is complete, forms are turned in to the monitoring organization for data entry and analysis. In the case of Kentucky Water Watch, their World Wide Web site contains an electronic submittal form similar to the paper one, which approximately 20% of volunteers use. The only problem seems to be duplicate submissions; users frequently hit the "submit" button more than once, sending duplicate sets of data to be analyzed. More and more groups are giving volunteers the opportunity to submit data electronically.

Volunteers like to know that their hard work will result in some positive action. Understanding how data will be used is an important part of program planning. Many programs make their data readily available on the internet. The Hoosier Riverwatch program does not know whether or not their Internet database is used. Their goal is to make the information readily available for interested persons, rather than to target specific users. Quality Assurance/Quality Control (QA/QC) methods are employed by various organizations to ensure high quality data. Data collected by school children tend not to be accurate, so it is not released to the general public. Trained adults collect data that is more trusted, therefore, more likely to be used in studies and management decisions. In addition to data quality, Environmental Protection Agency and state agencies will consider funding programs that have a QA/QC plan in place.

The World Wide Web provides opportunities for sharing information across long distances. Information networks are designed for local, regional, or global use. Hoosier Riverwatch plugs their data into the RiverBank database maintained by Global Rivers Environmental Education Network or GREEN. RiverBank is a database that allows volunteers and schools to record and store data. The Coyote Creek Riparian Station/Watershed Initiative Pilot Program will



be adding data to the Bay Area EcoAtlas database. EcoAtlas is a Geographic Information Systems (GIS) database available online used to support local and regional environmental planning and management.

During the Fifth National Volunteer Monitoring Conference in August 1996, a special discussion planning session focused on the topic of "Turning data into action" (Proceedings, 1996). The discussion outlined "burning issues" such as making the data available and finding better ways to put the data to use, and improving volunteers' ability to follow up on monitoring results themselves for increased citizen action. Key recommendations involved empowering the citizen monitors by involving them in the decision-making process of how the data will be used by various stakeholders.

Volunteers–The Human Component

The most important information gathered during the interviews relates to the human component of monitoring programs - finding, keeping, and motivating volunteers. Each person interviewed had advice to give on some aspect of the issue of human involvement in the program. Clearly, monitoring programs would not be successful without meeting the needs of volunteers. Background education on why they are monitoring, what they are monitoring for, when they are expected to participate, and where the monitoring will take place is important to convey to volunteers. In turn, they are more motivated, better prepared, and capable of contributing to the best of their abilities. The relationship between volunteers and monitoring agencies or organizations is symbiotic; each is concurrently teaching or learning from the other.

Finding volunteers required some work for one non-profit organization. Once the monitoring creeks were selected, homeowners on or near the creeks were contacted. Information packets were mailed containing monitoring information, meeting or training session information, phone numbers to call in case of illegal dumping, etc. The purpose of these packets is to promote a sense of ownership and to arm creek-side homeowners with basic tools to become active stewards. In addition to adjacent landowners, recreationists are another potential pool of volunteers.

Motivating volunteers through education and training ensures a well-informed, committed volunteer base. A successful program will attempt to explain the "interconnectedness" between the volunteer and their everyday life, as one program coordinator suggested. Keeping volunteers can also mean simply taking care of them by bringing food and drinks to work days and training sessions. In the case of Kentucky's Water Watch program, keeping volunteers means addressing issues of "safety and access first." According the program coordinator Ken Cooke, the following list contained his words of serious advice (Cooke, 1998): (1) Safe parking place; (2) Clear path to river or creek; (3) Comfortable place to stand/sit during testing; (4) Will anyone shoot me while I'm monitoring? If yes, select different site; (5) THEN review hydrologic schematic of watershed to see if location is significant.

River Watch Network, an agency experienced in setting up volunteer programs stressed the need for a committed sponsoring group to take the responsibility for a successful program. Within that group, a "star" person is needed to take the lead. Alabama Water Watch calls this person the Volunteer Monitor Coordinator. River Watch Network recommends that volunteers be given the opportunity to assist in shaping the goals and objectives of the program. Also, they should be encouraged to give their insight into land uses, preferably on a land use map. This way, the citizen who is aware of the "important swimming hole" is contributing to the overall success of the monitoring project.

Towards Watershed Health

According to the Streamkeeper's Field Guide, "A stream is only as healthy as its surrounding watershed." This delightful book, subtitled *Watershed Inventory and Stream Monitoring Methods*, covers overall understanding of watersheds and their investigation in the first two chapters. Many other programs are beginning to see the importance of planning and taking action at the scale of the watershed, versus at a single creek, river, lake, wetland or estuary. Every single person lives in a watershed. Citizens who monitor their local creek ensure the future health of their surrounding watershed.

Existing Water Quality Monitoring Programs QUESTIONNAIRE

Date:
Project Name/Location:
Contact Name/Title:
Phone Number:

The Program Goals & Objectives

1. WHO is monitoring WHAT?
2. WHY are they monitoring?
3. WHAT were the original goals and motivating factors of the program?
4. HOW have the goals been met, exceeded, or fallen short?

Data Collection and Dissemination

5. WHAT agency or organization serves as the clearinghouse for the data? Is this the originating organization?
6. HOW are they monitoring and submitting their data?
7. (If online) HOW successful is online data submission?
8. WHAT percentage of volunteers submit online?
9. WHAT are the pitfalls/perks to collecting data online? Paper?
10. WHO is using the information and HOW?

Program Organization & Change

11. WHICH, if any, existing programs did they look to for a model on HOW to set up a monitoring program? WHY?

12.. WHAT aspects of existing programs are successful now?

[redacted]

13. WHAT changes in the current program are taking, need to, or will take place?

14. WHERE do existing/future sources of funding come from?

Volunteers

15. HOW were the Volunteers organized?

16. WHAT motivates the Volunteers to stick to a schedule, sample accurately, etc.?

17. WHAT are the challenges/rewards in working with Volunteers as opposed to hired employees?

18. WHAT are some words of advice to a fledgling monitoring program?

References

Printed Sources

Firehock, Karen. 1994 (April). Volunteer Trainer's Handbook. Save Our Streams, Izaak Walton League of America. Gaithersburg, MD.

Fischer, Chris, Rigney, Michael, and Sawyer, Elizabeth. 1996 (September 10). Riparian Station How-To Manual, Final Report. San Francisco Estuary Institute. San Francisco, CA.

Murdoch, Tom, and Cheo, Martha with O'Laughlin, Kate. 1996. Streamkeeper's Field Guide. Adopt-A-Stream Foundation. Everett, WA.

Olympia, City of. 1995 (June). Stream Team Volunteer Handbook, Third Edition. Water Resources Program; City of Lacey, Water Resources Unit; Thurston County, Storm & Surface Water Program. Olympia, WA.

Proceedings. 1994 (April 10-14). Fourth National Citizens' Volunteer Monitoring Conference. Portland State University. Portland, OR.

Proceedings. 1996 (August 3-7). Fifth National Volunteer Monitoring Conference. University of Wisconsin, Madison. Madison, WI.

Starrett, Gwen, and Delia Lopez. State Water Resources Control Board. 1997 (June). California's Directory of Volunteer Monitoring Organizations.

Internet Sources

Global Rivers Environmental Education Network (GREEN). 1997 (December 12). *RiverBank.* Ann Arbor, MI. http://www.igc.org/green/greeninfo.html

International Center For Aquaculture and Aquatic Environments, Department of Fisheries and Allied Aquacultures, Auburn University. 1995 (December 20). *Alabama Water Watch.* Auburn, AL. http://www.ag.auburn.edu/dept/faa/al_ww/html

Pennsylvania Department of Environmental Protection. 1998 (February 26). *New Citizen Panel to Discuss Water-Quality Monitoring.* http://www.pathfinder.com/money/latest/press/PW/1998Feb26/1159.html

San Francisco Estuary Institute. 1997 (December 18). *The San Francisco Bay Area EcoAtlas.* Richmond, CA. http://www.sfei.org/ecoatlas/default.html

United States Environmental Protection Agency. 1997 (April 4). *What is Volunteer Monitoring?* Monitoring Water Quality. Office of Water. Washington, D.C. http://www.epa.gov/OWOW/monitoring/volunteer/epavm.html

Personal Communication

Agan, Mark. 1998 (March 12). Coyote Creek Riparian Station/Watershed Initiative Pilot Program. Alviso, CA.

Cooke, Ken. 1998 (January 28). Kentucky Water Watch. KY.

Dale, Richard. 1998 (March 13). Sonoma Ecology Center. Sonoma, CA.

Gibson, Margaret. 1998 (March 10). River Watch Network. Montpelier, VT.

Muse, Jeff. 1998 (March 10). Hoosier Riverwatch. Indianapolis, IN.

Peri, Andy. 1998 (March 13). Mill Valley Watershed Organization/Bay Area Watershed Network. Fairfax, CA.

Smernoff, David. 1998 (March 11). Bay Area Action. Palo Alto, CA.

Appendix D

Ecological Engineering Planning Process for Designing Constructed Wetland Storm Water Systems

by Chris Padick

In undeveloped areas, storm water runoff is managed through the natural hydrological cycle, effectively accommodating even severe storm events. As in the Malibu Creek Watershed, land-use changes associated with urbanization alter the natural hydrology by changing peak flow characteristics, total runoff, and water quality. With a traditional storm water management regime being one of getting the water off site as quickly as possible, the resulting condition is a degraded watershed, poor water quality, erosion and flooding.

Within the Malibu Creek Watershed, the rapid expansion of urban development is having a tremendous impact on the Malibu Creek ecosystem. As levels of impermeability rise, the resulting increase in urban storm water has a direct impact on the water quality of the watershed, primarily in the form of non-point pollution, sedimentation and increased peak water flows. As the watershed continues to be developed, these problems will only continue to increase. The result of these problems is a degraded creek ecosystem. Once the impermeability of a watershed reaches 10-15 % of the total watershed area, we begin to see degradation on the creek ecosystems, primarily in the form of degraded water quality and the erosion of stream beds and banks due to dramatically higher intensity peak flows (Schueler). Though only about 12% of the total Malibu Creek Watershed is developed, development tends to be highly concentrated along many of the upper reaches of the Malibu Creek ecosystem, including some subwatersheds reaching 45% total developed area. The result is a stream system impact that has an effect throughout the watershed.

To deal with these development issues, ecological engineered solutions are proving to be both very effective and environmentally sensitive. Ecological engineering is the design of human environment within the natural environment for the benefit of both (Mitcsh 1989, p.4). Defined, it is engineering that involves the design of natural environments using quantitative approaches and basing approaches on basic science (Mitcsh 1989, p.4).

As the understanding of ecosystem functions and structure drives ecological engineering, ecology is the basic science driving design. Well defined by Odum in 1962 as "environmental manipulation by man using small amounts of supplementary energy to control systems in which the main energy drives are still coming from natural sources", ecological engineering is the design of ecosystems that, once created, rely on the self designing properties of natural ecosystems with a minimum of maintenance. Key to the process is that ecologically engineered designs need to be solar-based, requiring little intervention, thus based on natural ecosystems that are self-sustaining systems running on solar energy (Mitcsh 1989, p.7).

Ecological engineering, with its roots in ecology, is quickly proving to be a significant alternate solution to some of the pressing problems associated with the impacts of human development on the environment. The goal of this appendix will be to introduce the field of ecological engineering as a guiding force for design opportunities concerning constructed wetland applications within the Malibu Creek Watershed for the treatment of non-point pollution sources associated with urban runoff.

When making design decisions for alternative storm water treatment applications, it is important to first understand the key principles driving an ecologically engineered design. The following are in essence, guidelines for a design process.

1. Ecosystem structure and function are determined by the forcing functions, such as temperature, nutrient imports, and water flows, of the system. Alteration of the forcing function causes the most dramatic changes on an ecosystem. Structure of an ecosystem is ultimately controlled by forcing functions. As the driving forces behind an ecosystems function, an in-depth understanding is critical for a successful design (Mitcsh 1989, p.22).

2. Ecosystems are self-designing systems. The more one works with the self-designing ability of nature, the lower the cost of energy to maintain that system. An ecosystem's regulation and feedback mechanisms give it the ability to adapt and self-design to the environment and minimize changes in the function of the ecosystem. It is here that ecosystems and ecological processes are used, not replaced as a primary guiding force in ecological engineering (Mitcsh 1989, p.24)

3. Elements are recycled in ecosystems. Matching humanity and ecosystems in recycling pathways will ultimately reduce the effects of pollution. Elements cycle in all ecosystems, an example of this would be the nutrient cycle. Of primary importance in an ecologically engineered application is understanding the individual cycles of the ecosystem and their rates (Mitcsh 1989, p.25).

4. The processes in ecosystems have characteristic time scales that may vary over several orders of magnitude. For optimal performance, manipulation of ecosystems must be adapted to the ecosystem's natural dynamics (Mitcsh 1989, p.29).

5. Ecosystem components have characteristic space scales. Manipulation of ecosystems should take into account the appropriate size necessary to achieve the desired results (Mitcsh 1989, p.30).

6. Chemical and biological diversity contributes to the buffering capacity of ecosystems. When designing ecosystems, one should introduce a wide variety of parts for the ecosystem's self designing ability to choose from. The more possibilities an ecosystem has, the higher its buffering capacity. This is especially true for the buffering capacities related to the function of the system. A system with a high diversity may change

[redacted]

species composition radically and therefore be considered unstable yet still have a high buffering capacity related to its function. The higher the diversity, the more capable an ecosystem is in handling fluctuations of its force flows (Mitcsh 1989, p.33).

7. Ecosystems are most vulnerable at their geographical edges. Ecological management should take advantage of ecosystems and their biota in their optimal geographical ranges. As ecosystems have defined ranges in which they are tuned to the climatological and geological features of the landscape, these should be primary considerations in the design process. As ecological engineering involves manipulation of ecosystems, the stability of the system will be enhanced if the species are in the middle of their environmental tolerances (Mitcsh 1989, p.33).

8. Ecotones are formed at the transition zones between ecosystems. The interface between human settlement and nature should be designed as gradual transitions, not as sharp boundaries. Nature has developed transition zones, between ecosystems, to make soft transitions. Ecotones may also be considered buffer zones between ecosystems that are able to absorb undesirable changes imposed on an ecosystem from neighboring ecosystems. (Mitcsh 1989, p.34)

9. Ecosystems are coupled with other ecosystems. This coupling should be maintained wherever possible and ecosystems should not be isolated from their surroundings. Ecosystems are open systems, and as such, exchange mass and energy with their environment. Thus it is important in ecological engineering to take this into consideration. If a component is removed from one system, the problem is not solved if the component then harms another system (Mitcsh 1989, p.35).

10. Ecosystems with pulsing patterns are often highly productive. The importance of pulsing subsidies should be recognized and taken advantage of wherever possible. Ecosystems with pulsing pattems often have greater biological activities and chemical cycling than systems with relatively constant patterns. But careful understanding is required to ensure proper frequency and duration to allow a system to operate at optimal levels (Mitcsh 1989, p.36).

11. Everything is linked to everything else in the ecosystem. It is impossible to manage one component of an ecosystem without affecting other parts. As all components of an ecosystem are linked in one way or another, it is particularly important to understand these connections in ecological engineered designed solutions (Mitcsh 1989, p.36).

12. Ecosystems have feedback mechanisms, resilience and buffer capacities in accordance with their proceeding evolution. And understanding of these characteristics will ensure greater success (Mitcsh 1989, p.36).

With these principles guiding the design process, there is a greater chance of understanding the ecosystems involved. With this better understanding, adopting an appropriate design will blend the needs of humanity with the needs of the ecosystem for the benefit of both.

With this in mind, we can now address one of the major issues concerning water quality with in the Malibu Creek Watershed. Non-point pollution sources (NPS), especially those associated with urban runoff, are considered among the nations leading source of surface water and ground water quality impairment (www.epa.gov). Urban storm water runoff, as well as being a major NPS, also contributes to water quality problems through increased peak flows that degrade streams and erode stream banks. The first step in designing the solution is understanding the problem.

In the Non-point pollution associated with urban storm water runoff, the following are the pollutants of concem.

- Biological Oxygen Demand (BOD): Organic molecules and other substances that require large amounts of oxygen to be broken down constitute BODs. Because of this high O2 demand, when released into the environment, those organics can have a detrimental effect on fish and wildlife by robbing them of the available dissolved oxygen.
- Nutrients: When high level of nutrients accumulate in waterways, it creates algae blooms that depletes oxygen needed by fish and other wildlife.
- Suspended Solids (SS) Suspended solids are insoluble materials, sediment particles that cloud water when suspended preventing light and oxygen from reaching aquatic life. Increased sediment settling can also degrade wildlife habitat, especially that of the steelhead trout that needs gravelly bottoms for breeding success.

Along with NPS pollutants, the other major problem associated with urban storm water runoff is the increase in peak water flows during storm events. The result is an overloading of the stream system to the point of downstream flooding and accelerated stream bank erosion.

Here is where ecological engineered solutions can play a vital role in the mitigation of these problems. Showing itself as being a very effective solution is the use of a variety of constructed wetlands. Basically, constructed wetlands are created ecosystems, modeled after natural systems and designed to mimic the natural processes of these ecosystems. Evidence is showing that these artificially created ecosystems, depending on type, are very efficient at filtering out most solid BOD as it passes through sand, soil, crushed rock or brick elements of the wetland substrate, while dissolved BOD is eaten by microbes. Microbes colonize on the surface of plant roots where oxygen is made available as plants photosynthesize and transport oxygen from their leaves to their roots. Constructed wetlands filter these nutrients by using them for vegetative growth. Sediments are also trapped within the wetland systems, primarily from settlement due to slow water flows through the system.

There are several basic types of constructed wetlands to be considered. Some resemble traditional wetlands in character while others are more marshlike. The basic types of constructed wetlands that are being used for storm water treatment consist of Free Water Surface Wetlands (FWSW) and Subsurface Flow Wetlands (SFW).

Free Water Surface Wetlands consist of basins or channels with suitable mediums to support the growth of emergent vegetation, with open areas and with water flowing at relatively shallow depths. The key feature is the presence of free water surfaces. These can include a variety of substrate and are designed as ground water recharging or non-recharging systems. Very similar to natural wetlands, these types often provide wildlife habitat as well.

Subsurface Flow Wetland (SFW), also known as rock reed systems or root zone systems and sometimes interchangeable with the term bio-filter, involve shallow basins or channels planted with suitable vegetation growing in a variety of media designed so that the runoff water flows horizontally through the media with no above surface flow or open surface flow. In SFW systems, runoff is applied to flow horizontally through basins or channels filled with rock or sand. In SFW systems, specific surface area and the porosity of the medium are important variables (Etnier 1996, p.29).

Within both of these systems, vegetation plays a critical role. Wetland vegetation is a function of climate, hydrology and nutrient availability. In a constructed wetland, climate, hydrology and pollutant response influence the selection of plant species. Wetland plants have specific tolerances to the levels and types of pollutants, which could be altered by varying storm water quality. This in turn could alter the plant community. Since new dominants reflect more efficient use of nutrients or more tolerance to pollutants, these plant changes should benefit overall pollutant removal (Hammer 1989, p.258). When referring to the considerations of an ecologically engineered design approach, an understanding of the plant palette is critical. In determining which plants are appropriate for the type of constructed wetland design, it is crucial to look at known efficiency of a plant type in pollutant removal and more importantly, appropriateness of a plant type for survival in local conditions.

As well as vegetative considerations, relationships between the hydrology and wetland characteristics must be included in the design to ensure long term effectiveness. The source of water, volume, renewal rate and frequency of inundation influences the chemical and physical properties of the wetland substrate, which in turn influences species diversity and abundance, primary productivity, organic deposition and flux and nutrient cycling. Hydrology also influences sedimentation, aeration, biology transformation and soil absorption processes. Critical factors that must be evaluated include velocity and flow rate, water depths and fluctuations, detention time, circulation and distribution patterns, seasonal and climatic influence, groundwater conditions and soil permeability. This also includes establishing wetland hydro-period to determine form, nature and function of the wetland. Hydro-period is the depth and duration of inundation measured over the annual wet or dry cycle. Acceptable high and low water elevations will determine the storm water treatment volume capacity of the wetland. Water depth and inundation period can change the plant community, with beneficial or detrimental effects on the wetland or storm water pollutant removal (Hammer 1989, p.225).

It is a solid understanding of both the structure and function of the wetland processes as well as an understanding of the local environmental conditions

Appendix E

Malibu Creek Steelhead

by Mark J. Abramson

It's early morning. The sky is gloomy and threatening as I stand in the shallow waters of a stream in the Santa Cruz mountains. The air on my face is brisk and invigorating. Suddenly, as if attacked by a shark, my rod tip is nearly touching the water. The fight is on and my heart and mind begin to race. I see the shimmering silver-blue green of the majestic steelhead trout and imagine the perilous journey this fish has gone through. Emerging as a tiny fry in this very stream it must survive threats from both native and exotic aquatic species to reach a size and maturity where it can eventually migrate to the ocean. The fish must survive fishing and other threats from marine species to return to its native stream to spawn and continue the life cycle. At times this migration route can be blocked by drought for years at a time, not allowing smolt to leave or adults to return and spawn. The ability of a fish to survive in both fresh and salt water is extraordinary. As I release this fish and admire the pristine natural beauty of the surrounding stream, a feeling of deep respect for this worthy fish floods over me.

A century of water diversions, pollution, dam building, urbanization, and degradation of creeks, streams and rivers have hit California steelhead populations hard. Steelhead trout (Oncorhynchus mykiss), the anadromous form of rainbow trout, were once abundant up and down coastal streams draining mountains throughout the state including the Santa Monica Mountains. "California steelhead populations have dropped by more than 90 percent statewide and estimates of the adult steelhead population is only 250,000, less than half of estimates from 30 years ago."[1] "Historically over one hundred and twenty-two streams south of San Francisco Bay are known to have once contained steelhead populations; 33 percent no longer have any, and all the remaining streams are in decline, some of them in population nosedives."[2] These startling statistics have instigated the National Marine Fisheries Service (NMFS) to list the southern coast populations, those found from the Santa Maria River to Malibu Creek, as endangered.

Life History:

Steelhead is the anadromous form of rainbow trout. They are born in fresh water, then immigrate to the ocean where a majority of their growth occurs. When a storm event provides sufficient flow to breach the sandbars that close the mouths of coastal streams, mature steelhead return to their native streams to spawn. Unlike the salmon, steelhead do not necessarily die after spawning and may make numerous round trips or may spawn and then remain in the stream.

The female selects a site having good intergravel flow, to ensure that oxygen is available for eggs and small hatchlings, and then digs a redd (nest) to deposit eggs. After being fertilized by the male, the eggs are then covered with gravel and the female swims upstream to repeat the process. Hatching time is dependent

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mostly on water temperature. Studies conducted by Leitritz and Lewis in 1980 record eggs hatching in about 30 days in water temperatures of 51 degrees F. The young hatchlings live in the protective gravel for approximately 4-6 weeks after hatching, depending on the depth of the redd, gravel size, siltation, and temperature, before the emerge as fry.[3] Newly emerged fry move to shallow, protected areas associated with stream margin.[4] Fry soon will find feeding locations in areas of the stream. Juveniles will inhabit riffles but larger ones often inhabit deeper runs or pools.[5] South coast steelhead like those of Malibu Creek, are ocean maturing (winter steelhead). South coast steelhead typically begin their spawning migration in fall through winter and spawn January through March, within a few weeks to a few months of entering fresh water.

Non-anadromous or resident forms of rainbow trout (O.m. irideus) are now believed to be a critical component of the adaptability of steelhead and integral to any type of management plan. It was once believed that they were two distinct subspecies but genetically there are little to no differences between resident and anadromous forms. It is not uncommon for anadromous forms for males to mature as parr then assume a resident life style.[6] Mature male parr rainbow trout have been observed spawning with female steelhead in Waddell Creek.[7] Steelhead are dependent on a variety of conditions in order to successfully migrate to the ocean. Malibu Creek is subject to extreme variations in rainfall and droughts that may last years. These variations may force steelhead to remain in streams for several years at a time. Sufficient stream flow is required to breach sandbars and allow access to stream headwaters or the ocean. During a storm event with sufficient flow, only a brief window allows steelhead to transfer between the ocean and freshwater environments. This flexibility in life history, which allows steelhead to survive and spawn until a time when a migration route is opened, is critical, particularly in the harsh southern geographic limit.

Steelhead must be adaptable in order to exploit resources in rivers, streams, and the ocean as few species do. Southern populations are the most adaptable of all steelhead. Studies of the Malibu fish show them to be the most genetically diverse of any known trout population. For this reason the southern steelhead is considered critical for the survival of the entire species due to their unique ability to adapt to marginal conditions such as high temperatures, and unpredictable water flows.

Instream Habitat

Following are the types of instream habitat preferred by the steelhead trout:

Depth: Steelhead prefer to spawn in depths between 6-24 inches. Fry will utilize water between 2-14 inches deep, while parr utilize water depths between 10-20 inches. In a 1972 study, Thompson reports that seven inches of water is the minimum depth required for successful migration of adult steelhead.

Velocity: Velocities in excess of 10 –13 feet per second hinder the swimming ability of adult steelhead and may slow migration (Reiser and Bjorn 1979).[8] The larger the fish the higher the velocity of water that can be utilized for spawning. Steelhead will spawn with water velocities ranging from 1- 3 cubic feet per second (Barnhardt 1986).[9]

Substrate: Adult steelhead have been reported to spawn in substrates between .2- 4 inches in diameter. The Unified Soil Classification System classifies sand as particles with diameters from .003- .19 inches, gravel as .19- 3 inches, and cobble as 3- 11.8 inches. Gravel must be highly permeable to keep incubating eggs well oxygenated and contain less than 5 percent sand and silt. Fry and juvenile steelhead prefer slightly larger gravel and cobble than spawning adults.

Temperature: While temperature preferences are well documented for northern streams less is known about southern streams. Egg mortality begins to occur at 56 degrees F and steelhead have difficulty getting adequate oxygen from water with temperatures above 70 degrees F.

The type of habitat required by juvenile steelhead varies with lifestage. Younger smaller fish prefer slower shallower water than larger fish.

MALIBU CREEK STEELHEAD

Malibu Creek has been listed as the southern most geographic area to support a self-propagating run of steelhead trout. "This run has adapted to drastic changes in flow, water quality and population expansion occurring within the Los Angeles basin."[10] There is a concerted effort by local citizens, and local, state and federal responsible agencies to prevent this run from becoming extinct. The Malibu Creek Watershed does have certain benefits that may help protect steelhead trout and other wildlife in the future. Large partitions of land are owned by California Department of Parks and Recreation as well as the National Park Service, which will ensure that these areas are not developed.

The native fish community include steelhead trout, Arroyo Chub (*Gila orcutti*), and Pacific Lamprey (Lampetra tridentatta) another native anadromous species. Introduced species include bluegill (Lepomis macrochirus), green sunfish (Lepomis cyanellus), largemouth bass (Micropterus salmoides), brown bullhead (Ictalurus nebulosus), and channel catfish (Ictalurus punctatus).[11]

The water regime within Malibu Creek has been drastically altered as a result of dependence on imported water. The coastal Mediterranean climate results in approximately 16 inches or 41cm of rainfall annually, with nearly all precipitation occurring from November through April. Stream flows typically range from summer lows of 6-10 cubic feet per second (cfs) to storm flow peaks above 600 cfs. Extreme flows include historic no-flow conditions, prior to discharge of treated effluent by Tapia in the late 1960s, and peak flows of 33,800 cubic feet per second were recorded in January 1969.[12]

Accessible Steelhead Habitat

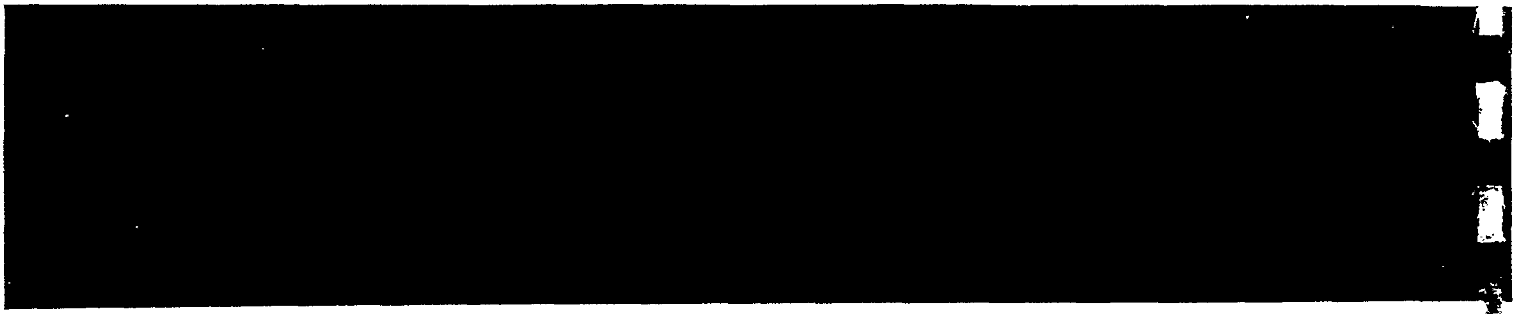
Currently, useable steelhead habitat occurs on an approximately 2.6 mile stretch below Rindge Dam. This stretch of Malibu Creek is characterized as a steep gradient gorge nearest the dam that gradually flattens out into a valley section and eventually flows to the Malibu Lagoon. Steep canyons walls provide topographic shading in the gorge nearest the dam, which serves to regulate water temperature. The gorge has a pool riffle ratio of 1:1 with pools as deep as 5 feet and with more frequent and longer riffles than in the valley section. Dominant substrates in the gorge section range from small cobbles to large boulders, which serve to cool water and provide shelter from predators.[13] As the gradient flattens out, sediments in the slower moving water have the opportunity to settle and particle size decreases to smaller gravel and sand. A >6:1 pool riffle ratio occurs in the low gradient valley section, which has many long pools from 1-3 feet in depth.[14]

Good quality adult and juvenile steelhead habitat is found in the steep canyon for about the first two kilometers heading to the ocean from the dam. Excellent gravels, appropriate channel morphology and abundant cover in the form of boulders, deep water, and surface turbulence, provide good habitat for spawning fish in this section. Good rearing habitat occurs in pockets most abundantly in the gorge where deep pools and larger substrates provide cover, food-producing riffles are more abundant, and canyon walls provide shade and maintain cooler water temperatures of 12.2 degrees Celsius, 100 meters below Rindge Dam.[15]

Largemouth bass thrive on warmer water temperatures and are believed to be a predator of juvenile steelhead trout. Largemouth bass abundance increases with distance downstream, the opposite of steelhead distribution and accounts for 80 percent of the total fish community in the valley section. This section is characterized by low gradients with long pools and runs separated by short riffle sections and increased settlement of sediments. This section had only 3.5 fish per 100m of pool/run habitat due to poor marginal rearing habitat associated with that section. Rearing steelhead seem to prefer pool habitat to run habitat showing 50 percent more utilization of pools than runs.[16]

Several issues are contributing to the severely decreased steelhead run on Malibu Creek. These issues are exotic invasive predator fish species, loss of suitable spawning and rearing habitat, and water quality. The California Department of Fish and Game identifies freshwater habitat loss and degradation resulting from inadequate stream flow, blocked access to historic spawning and rearing areas, and human activities that discharge sediment and debris into water courses as the main factors contributing to the decline of steelhead trout populations.

The Malibu Creek steelhead population is currently relegated to approximately 2.5 miles (4.2 kilometers) representing approximately 35 percent of total available stream habitat below the Rindge Dam. The Rindge Dam is considered the primary obstacle or barrier to steelhead in Malibu Creek. Rindge Dam was originally constructed to provide agriculture irrigation and domestic water supply for the Rindge Ranch. Rindge Dam was built between 1924 and 1926 with private funds from the Rindge family, and was authorized for use on January 31,1933. The original storage capacity was 574-acre feet of water. As a result of the highly erodable soils and fire frequency throughout the watershed, the reservoir was completely filled with sediments and decommissioned by the State of California in 1967. The reservoir is estimated to contain approximately 1.6 million cubic yards of sediment. In 1984, 960 acres of Malibu Canyon, including Rindge Dam were sold to the State of California to become part of Malibu Creek State Park. California Department of Parks and Recreation, manages Malibu Creek State Park and the Rindge Dam, and one mission of that organization is to increase the native biological diversity of the lands they own and manage.



Potential Steelhead Habitat

Entrix investigated the potential of steelhead habitat above Rindge Dam in an effort to determine if removal of the dam would increase available habitat, and likely increase the steelhead population. From Rindge Dam to the Los Angeles County stream gauge, good quality steelhead habitat for both spawning and rearing were found. The entire stream reach is well confined by the steep sided canyon, which provides topographic shading to the stream except for in the lower .4 mile stretch of the stream, which meanders through the sand and gravel deposited behind the dam.[17] In the flatter lower third of the stream reach nearest the dam, substrate is composed of sands and small gravels with a pool/riffle ratio of 4:1. This section has abundant overhanging tree cover and shading. This area has outstanding spawning sites.[18] The remaining section of this stream reach is steeper and has larger substrates of gravels, cobbles and boulders that provide excellent opportunities for escape and instream cover. This section of the stream reach provides good quality rearing habitat. Directly adjacent to the tunnel on Malibu Canyon Rd., is a natural fall of approximately 18-feet that creates a barrier to upstream passage. To provide fish passage around this barrier using a concrete flume, was estimated at a cost of $120,000 in 1989.[19]

The stream reach that starts at the stream gauge and ends at Las Virgenes Creek is characterized by a wide flat valley section moving upstream from the confluence at Cold Creek followed by a more narrow valley section that widens out as Las Virgenes Creek and Malibu Creek converge. Topographic shading is less in this stream section, which has a pool to riffle ratio averaging 5:1. Substrates are filled with fine sediments estimated at 40 percent embeddedness throughout this stream section. Evidence of pools being filled and high degrees of embeddedness suggest that sediments are being transported down Las Virgenes Creek and into Malibu Creek which are impacting potential steelhead habitat. "In the section of stream below Tapia foam appeared on the water beneath each riffle and there was a total lack of attached algae on the stream bottom, algae was present at all the other sites surveyed. The water had an acrid odor and kick samples produced almost no macroinvertebrates."[20] Along this stream reach are two small sections between Cold Creek and Tapia, and adjacent to Tapia Park that exhibit suitable steelhead habitat. These sections have a steeper gradient and therefore have larger substrates with 25 percent embeddedness, and a pool to riffle ratio of 1:1. This area has deeper pools, greater water velocities, and greater amount of cover overhead and instream.[21] The researchers who conducted this survey evaluate the overall habitat quality along this stream reach as ranging from poor to fair.

The stream reach that runs from Las Virgenes Creek to Century Dam flows in a wide valley between gentle hillslopes heading upstream from the confluence of Malibu Creek and Las Virgenes Creek. Triunfo Canyon, in the upper third of the reach, is confined by a deep narrow gorge heading towards Century Reservoir.[22] The bottom section of the reach has a pool to riffle ratio of 8:1, no topographic shading or substantial riparian cover, and small substrates. It is suspected that water temperatures in the lower .5 mile of this reach may exceed the levels tolerable for steelhead. [23] The best steelhead habitat occurs in the upper third of this reach in Triunfo Canyon. This section has large deep pools and excellent topographic shading. Field investigations reveal the substrates in the canyon section range from boulders to bedrock with low percentages of embeddedness.

The stream reach from the mouth of Cold Creek to Stunt Ranch Road is confined by a narrow valley which widens out in short stretches near the mouth and below Stunt Ranch. The canyon is well shaded from a combination of topographic shading and riparian cover. Average pool depths were about 6 inches with the deepest pool measuring 3.6 feet. Pool to riffle ratios ranged from 4:1 in flatter sections to 1:1 in steep sections.[24] Substrates were smaller towards the mouth of the creek with bedrock and boulders in the steepest portions of the reach. The lower third of the creek had 35 percent embeddedness in contrast to the steeper upper reaches that had less than 10 percent.[25] Flows were a limiting factor for upstream migration. Cold Creek has a substantial amount of useable habitat for steelhead during their first most vulnerable year, beyond that age class, only a few deep pools in steeper parts of the reach provide adequate habitat.[26] Three barriers are located on Cold Creek that would prevent upstream migration.

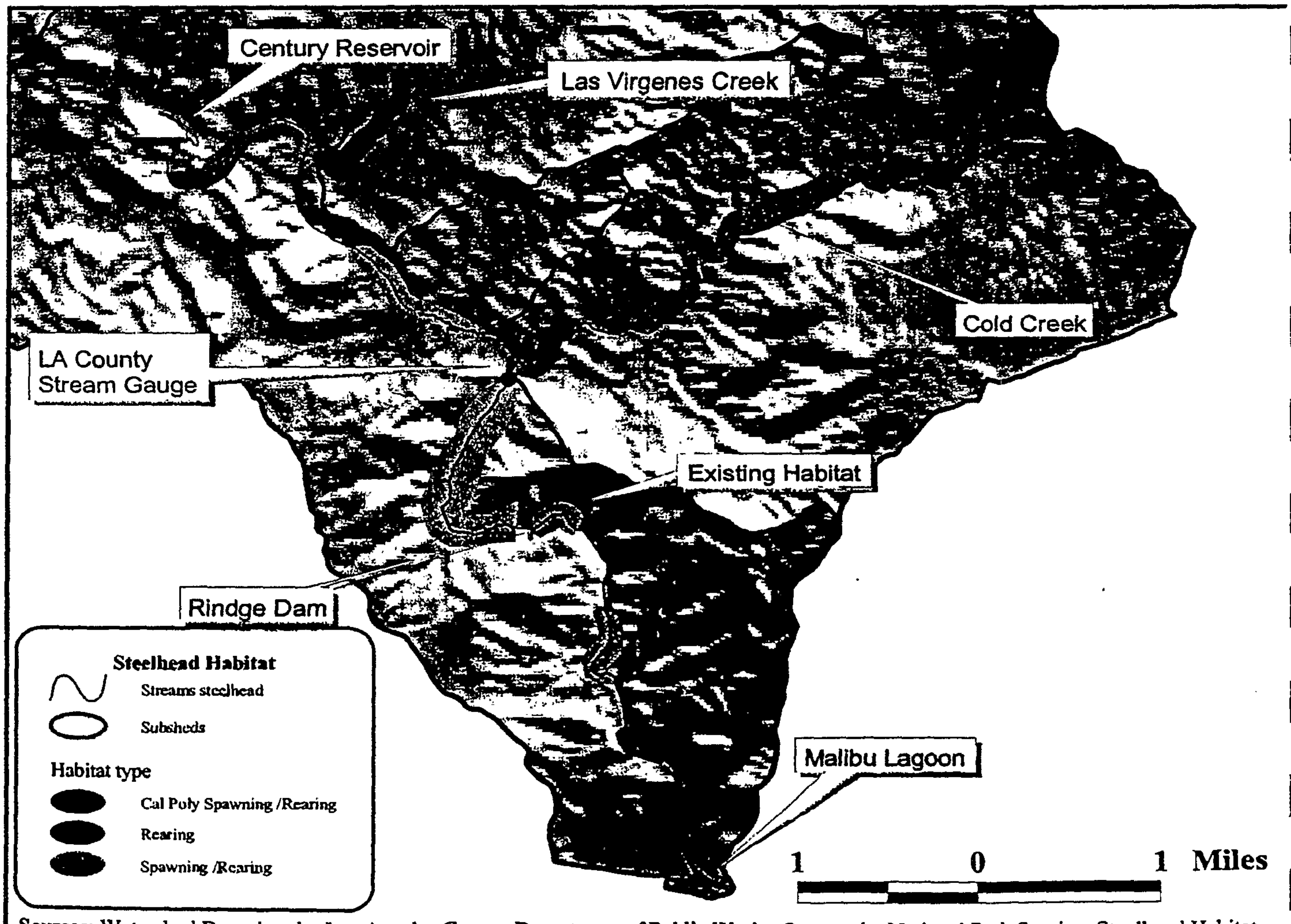
Extensive site investigations were conducted for this project by the research team from Cal Poly, Pomona. The 1998 El Nino year yielded above average rainfall. Site visits in the later months of 1997 confirm the Entrix findings along Cold Creek, and on Malibu Creek from the stream gauge to Las Virgenes Creek. Subsequent visits in March-May of 1998, following several large storm events, revealed lower percentages of embeddedness along both of these stream reaches and pools that were much deeper. Embeddedness on the lower portions of Cold Creek were estimated at 15-25 percent and 20-30 percent from the stream gauge to Malibu Creek. This suggests that sediment deposits had been scoured out during high creek flows. The investigators estimate the average depth of flow beteween 10-18 inches along Cold Creek and average pool depths between 12-18 inches.

The Cal Poly team also investigated the last mile of Las Virgenes Creek where it converges with Malibu Creek. The numerous site investigations reveal that prior to the substantial creek flows in the winter of 1998, the average water depth on this section of Las Virgenes Creek was between 8-12 inches and embeddedness was estimated at 35-40 percent. Following the El Nino winter, average water depth increased to greater than 12 inches and embeddedness decreased to between 20 and 25 percent. Further, the team identified habitat that would be useable for both spawning and rearing.

Currently 65 percent of usable rearing habitat and 86 percent of the spawning habitat in Malibu Creek are inccessible.[27] Four fish barriers have been identified that significantly reduce access to prime steelhead habitat within the Malibu Creek Watershed:

1) Rindge Dam.
2) Tunnel Falls, a natural falls near the tunnel on Malibu Canyon Road.
3) A concrete apron at the county-operated stream gauge below the mouth at Cold Creek.
4) A concrete road crossing in Century Ranch State Park.

According to the 1989 Entrix Steelhead Habitat assessment, by allowing fish passage at these four barriers, the watershed will realize a 590 percent increase in spawning habitat and a 180 percent increase in rearing habitat for steelhead trout or about 4.8 miles of new habitat. "A healthy population of 145



Sources: Watershed Boundary by Los Angeles County Department of Public Works, Streams by National Park Service, Steelhead Habitat from Entrix (1989) not for legal use.

Potential Steelhead Habitat

Universal Transverse Mercator Projection
North American Datum, 1927

Malibu Creek Watershed: A Framework for Monitoring, Enhancement and Action

606 Studio **California State Polytechnic University, Pomona** **August 1998**

juveniles of three year classes of steelhead utilize Malibu Creek downstream from Rindge Dam, which is particularly significant because the study was conducted in August during the third year of drought conditions."[28] This study suggests that the steelhead population declines as you move further downstream closer to the ocean as a result of declining habitat quality in the lower reaches of Malibu Creek and increased numbers of largemouth bass, a predator to juvenile steelhead. The Steelhead investigations, conducted by Entrix Incorporated, suggest that the steelhead population in Malibu Creek can expect at least a three-fold increase if full habitat is utilized both above and below Rindge Dam.

The best available spawning habitat on Malibu Creek occurs 2 kilometers below Rindge Dam stretching above the dam to the confluence at Cold Creek. These locations were selected because they have adequate water depths and velocities, accessible cover, excellent grain size distribution of substrate materials, low degrees of embeddedness.[29]

The best available rearing habitat was focused in narrower canyon stretches having deeper, swifter flowing water and provided better cover than was found in valley sections. These areas also exhibited more abundant and diverse populations of aquatic macroinvertebrates, and shorter pool lengths ensuring adequate transport of food downstream.[30]

Further, several studies have been conducted regarding fish passage over the Rindge Dam. The Army Corps of Engineers recently completed a reconnaissance study to determine the plausibility of providing access to steelhead above Rindge Dam. If they receive approval and $ 750,000 of funding from Congress the following alternatives will be researched:

1. Complete removal of the dam with the sediments being disposed of in a landfill. The cost of this alternative is estimated at 40 million dollars. If sediments can be used to replenish beach sands or create shallow water habitat nearby, the cost estimate drops to 25 million dollars.
2. Installing a conduit or pipe through the dam which will provide passage. The estimated cost is 10 million dollars.
3. Constructing a hydraulic lift to allow access is estimated to cost 1 million dollars.[31]

Alternatives that have been previously considered include:

1. Notching the dam in intervals and allowing the sediments to flow downstream in a semi-regulated manner.
2. Reestablishing the reservoir for use as fire suppression water storage.
3. Drilling into the top 10 feet of sediments and installing pipes to utilize the dam as a giant sand filter for treatment of surface water during dry weather. This last alternative is proposed until a time when the dam could be removed.

The current consensus among knowledgeable stakeholders is the dam needs to be removed and that lifts to provide passage over the dam will be too unreliable, and, due to poor road access, impossible to maintain. Opposition by Ron Rindge, a descendent of the Rindge family, to keep the dam and get it registered, as a historic structure is ongoing.

Restoration of California's anadromous fish populations is mandated by The Salmon, Steelhead Trout, and Anadromous Fisheries Program Act of 1988 (SB 2261). This act establishes State policy to increase significantly the natural production of salmon and steelhead and directs the California Department of Fish and Game to develop a program that strives to double the naturally spawning anadromous fish populations by the year 2000. Governor Wilson, in his April 1992 Water Policy Statement, specifically states the urgent need to provide safe reliable water supplies to restore fish and wildlife resources among other things.

Recommendations to Increase and Enhance Steelhead Habitat

This section makes recommendations, that if implemented, will increase and enhance steelhead habitat throughout the Malibu Creek Watershed. Section 6 details recommendations that address the issues identified during the course of this project. Implementing these alternatives will improve water quality and decrease the concentration of pollutants that reach receiving waters. These issues need to be addressed over the entire watershed.

The different alternatives on how to address Rindge Dam have been researched with the following conclusion. The dam is a significant feature of Malibu but serves no useful function at present time. It is not practical and would likely be costly to revitalize the structure to be used for fire protection or irrigation. To maintain the dam would require frequent dredging of sediments due to the highly erodable soils and frequent fires in the area. Removal of the dam is the preferred option. Leaving the spillways and creating an overlook site on Malibu Canyon Road that provides information about the dam is recommended. Ideally, a use for the sediments contained by the dam would be found. This project should also include habitat restoration in the flat area immediately preceding the dam and the riparian zone directly above and below the dam. Further, the restoration and any feasibility study should include passage over tunnel falls.

Quickly designate Malibu Creek, Las Virgenes Creek, Cold Creek, Triunfo Creek and their tributaries as critical habitat areas. This should include at minimum a 200-foot buffer zone on each side of the creek.

Cold Creek has been identified as suitable rearing habitat for juvenile steelhead in their first year when they are most vulnerable. Following winters with significant rainfall, migration corridors are more than deep enough to accomodate steelhead trout. The diversity of macroinvertebrates was greater on Cold Creek as compared to Malibu Creek. The barriers to fish passage are relatively small and could be overcome with small inexpensive projects. Cold Creek offers a perennial source of cool clean water that must be protected to enhance the ability of species survival.

Triunfo Creek has the best diversity and abundance of macroinvertebrates of all areas studied. While Century Dam currently poses an obstacle to the best habitat along this reach, it is owned and operated by California Department of Parks and Recreation. Fish passage can be easily and inexpensively accomplished through removal of the dam or using a fish ladder.

Small pockets of useable spawning and rearing habitat were identified on lower Las Virgenes Creek. This section of the creek has excellent riparian overhead canopy, significant amounts of large woody debris and instream habitat. The majority of this reach is owned by California Department of Parks and Recreation and will never be developed.

The findings recorded by the Cal Poly team suggest that periodically sediments are flushed from the substrate, and pools are scoured creating better and more useable habitat. Although Triunfo Creek, Las Virgenes Creek, and Cold Creek have limited useable habitat, they empty into the best available spawning and rearing habitat along Malibu Creek. Sediments being transported by Las Virgenes Creek are already causing pools to fill and substrate embeddedness of 40 percent where it converges with Malibu Creek. Critical habitat designation will ensure that future construction projects are sensitive to steelhead trout and the habitat they depend upon.

Implement Best Management Practices to reduce the impacts of upstream development, nutrient loading, and sediment loading to the watershed (See Beyond Monitoring, Section 6).

Zoning Ordinances must be changed to prevent the Agoura and Westlake subwatersheds from exceeding 25 percent impervious surfaces. Hidden Valley, Malibou Lake, Cold Creek, Las Virgenes, and Malibu Creek subwatersheds should be maintained at less than 10 percent impervious surfaces. If sensitive building practices are adopted throughout the watershed and these levels of impervious surfaces are maintained water quality and channel stability will be good.

Require all future building to address the needs of fish passage like properly designed culverts. This should be required in the Malibou Lake, Las Virgenes, Agoura, Malibu Creek, and Cold Creek subwatersheds. This will ensure that costly projects to provide fish passage are not necessary when passage above Rindge Dam is realized.

Do not channelize any more of the streams or creeks in the watershed. This increases the velocity of stream flows and can cause downstream erosion of streambanks.

Tapia should be required to further polish and cool reclaimed water before releasing it into Malibu Creek. Reclaimed water has higher than normal levels of nutrients, which can be removed, through biological treatment using a wetland. If properly designed this wetland would also cool water before it is released. This should benefit Tapia by allowing them to store water during the rainy season when the demand for reclaimed irrigation water is low, to be sold when demand increases. Dry season releases to the creek should only be permitted during sustained periods of drought to sustain a creek flow of 1 cfs. LVMWD is currently funding a research project to determine which substrate materials most effectively infiltrate and filter water.

Potential Funding Sources

The following are potential funding sources that could be used to pursue steelhead habitat monitoring and assessment programs. These funds may also be available to organizations that have identified problems that are affecting steelhead or critical steelhead habitat that wish to undertake restoration projects.

Wildlife Conservation Board Funding is authorized to make grants to public organizations and private nonprofit groups for fish and wildlife habitat restoration. This Board has the legal responsibility for disbursement of the following funds:

- California Riparian Habitat Conservation Program, are funds to protect and restore riparian habitat throughout the State through acquisition of interests and rights in land and waters.
- California Wildlife Protection Act of 1990. The Board is responsible for administering annual appropriations to the Habitat Conservation Fund of up to 11.5 million dollars. Funds may be used for acquisition, restoration, or enhancement of aquatic habitat for spawning and rearing of anadromous trout resources.
- Cal Trans Environmental Enhancement and Mitigation Program.
  Funds are available to local, state and federal agencies and nonprofit entities to mitigate impacts of modified or new public transportation facilities. Grants for individual projects are generally limited to $500,000 each but may be larger if certain criteria are met. Eligible projects include the acquisition, restoration or enhancement of resource lands (natural areas, wetlands, forests, woodlands, meadows, streams or other areas containing fish or wildlife habitat) to mitigate the loss or detriment to, resource lands within or near the right-of-way acquired for proposed transportation improvements.

References

[1] California Department of Fish and Game. *Steelhead Restoration and Management Plan for California*, February, 1996.

[2] Slack Gordy, "Planet of the Steelhead" California Wild Winter 1998: 6-7

[3] Shapalov and Taft ,1954 as reported by California Department of Fish and Game. *Steelhead Restoration and Management Plan for California*, February, 1996.

[4] Royal 1972; and Barnhart 1986 as reported by California Department of Fish and Game. *Steelhead Restoration and Management Plan for California*, February, 1996.

[5] Barnhart 1986 as reported by California Department of Fish and Game. *Steelhead Restoration and Management Plan for California*, February, 1996.

[6] Titus et al. In press, as reported by California Department of Fish and Game. *Steelhead Restoration and Management Plan for California*, February, 1996.

[7] Shapalov and Taft ,1954 as reported by California Department of Fish and Game. *Steelhead Restoration and Management Plan for California*, February, 1996.

[8] as reported by California Department of Fish and Game. *Steelhead Restoration and Management Plan for California*, February, 1996.

[9] as reported by California Department of Fish and Game. *Steelhead Restoration and Management Plan for California*, February, 1996.

[10] Allen Cynthia K., "Malibu Creek Steelhead Restoration Project Rindge Dam Removal" Presented at the 123rd American Fisheries Society Annual Meeting in Portland, Oregon 1993. California Department of Fish and Game, 1993.

[11] Entrix Incorporated, "Malibu Creek/ Santa Monica Mountains Steelhead Investigations, 1989.

[12] Entrix Incorporated, "Malibu Creek/ Santa Monica Mountains Steelhead Investigations, 1989.
[13] Entrix Incorporated, "Malibu Creek/ Santa Monica Mountains Steelhead Investigations, 1989.
[14] Entrix Incorporated, "Malibu Creek/ Santa Monica Mountains Steelhead Investigations, 1989.
[15] Entrix Incorporated, "Malibu Creek/ Santa Monica Mountains Steelhead Investigations, 1989.
[16] Entrix Incorporated, "Malibu Creek/ Santa Monica Mountains Steelhead Investigations, 1989.
[17] Franklin, R.F. and S.S. Dobush,1989. Malibu Creek Steelhead Habitat Assessment. Report prepared for Cal Trout, Inc. by Entrix Inc.
[18] Franklin, R.F. and S.S. Dobush,1989. Malibu Creek Steelhead Habitat Assessment. Report prepared for Cal Trout, Inc. by Entrix Inc.
[19] Franklin, R.F. and S.S. Dobush,1989. Malibu Creek Steelhead Habitat Assessment. Report prepared for Cal Trout, Inc. by Entrix Inc.
[20] Franklin, R.F. and S.S. Dobush,1989. Malibu Creek Steelhead Habitat Assessment. Report prepared for Cal Trout, Inc. by Entrix Inc.
[21] Franklin, R.F. and S.S. Dobush,1989. Malibu Creek Steelhead Habitat Assessment. Report prepared for Cal Trout, Inc. by Entrix Inc.
[22] Franklin, R.F. and S.S. Dobush,1989. Malibu Creek Steelhead Habitat Assessment. Report prepared for Cal Trout, Inc. by Entrix Inc.
[23] Franklin, R.F. and S.S. Dobush,1989. Malibu Creek Steelhead Habitat Assessment. Report prepared for Cal Trout, Inc. by Entrix Inc.
[24] Franklin, R.F. and S.S. Dobush,1989. Malibu Creek Steelhead Habitat Assessment. Report prepared for Cal Trout, Inc. by Entrix Inc.
[25] Franklin, R.F. and S.S. Dobush,1989. Malibu Creek Steelhead Habitat Assessment. Report prepared for Cal Trout, Inc. by Entrix Inc.
[26] Franklin, R.F. and S.S. Dobush,1989. Malibu Creek Steelhead Habitat Assessment. Report prepared for Cal Trout, Inc. by Entrix Inc.
[27] Franklin, R.F. and S.S. Dobush,1989. Malibu Creek Steelhead Habitat Assessment. Report prepared for Cal Trout, Inc. by Entrix Inc.
[28] Entrix Incorporated, "Malibu Creek/ Santa Monica Mountains Steelhead Investigations, 1989.
[29] Franklin, R.F. and S.S. Dobush,1989. Malibu Creek Steelhead Habitat Assessment. Report prepared for Cal Trout, Inc. by Entrix Inc.
[30] Franklin, R.F. and S.S. Dobush,1989. Malibu Creek Steelhead Habitat Assessment. Report prepared for Cal Trout, Inc. by Entrix Inc.
[31] Army Corps of Engineers, Draft Expedited Reconnaissance Study Malibu Creek, California, June 1998.

Appendix F

Common Riparian Plants of the Malibu Creek Watershed

by Gerald O. Taylor, Jr.

Purpose

The purpose of this appendix is to help volunteers involved in the Stream Team monitoring program identify plant species that are found near riparian areas in the Malibu Creek Watershed. This will be especially useful in distinguishing non-native plant species from native plant species. The long term goal is to identify and map significant patches of exotic and/or invasive vegetation and areas that are degraded which may contribute excess sediments into the receiving waters throughout the Malibu Creek Watershed. The information collected will be stored on a GIS system at Heal the Bay and made available to all agencies that work in this watershed. Ideally, maps that accurately locate degraded habitat and large patches of exotic and/or invasive vegetation can be used by local agencies and organizations to develop restoration strategies and to improve water quality throughout the watershed.

The Riparian Zone within the Malibu Creek Watershed

Within the Malibu Creek Watershed there are many areas that can be described as riparian. Riparian areas are commonly found adjacent to intermittent or perennial sources of water, such as creeks, streams, ponds, lakes, springs, or seeps. This field guide covers plants found in riparian habitats and includes plants found along streams, lakes, ponds, and freshwater marshes.

Specific types of plants have evolved within riparian and wetland environments. These plants need access to the additional soil moisture that is available in these areas for their survival. Within the riparian zone, plants have varying water needs. Some plants may be located in soil that is saturated with water (cattails) or on soil that is seasonally saturated with water (alders, sycamores). Others will be located where the soil does not stay saturated (oaks, walnuts). A profile of a stream in the Malibu Creek Watershed may show willows and alders closest to the stream, sycamores a little further away, and oaks on the bank away from the stream. Intermixed among these trees may be a variety of shrubs, perennials, or annuals, each having special needs for location. The arrangement of plants along the riparian profile is never exact and there can be much variation depending upon soils, moisture, aspect, slope, geology, and other factors.

Riparian Vegetation and Stream Ecosystems

Riparian vegetation plays a vital role in the health of a watershed. The canopies of plants help to decrease the direct impact of raindrops onto the soil. Roots bind and hold the soil together. Plants aid in the improvement of water quality by slowing runoff, allowing deeper infiltration and filtering of water. With deeper infiltation and a slower release of water, the watershed is sustained with moisture over a longer period of time.

Vegetation also influences sedimentation flow. Along stream banks, the roots of plants help hold and stabilize the soil. Streamside vegetation and debris helps moderate the flow of water, creating diverse habitats where water flow is varied and aquatic life can find protected places. Organic matter from vegetation that falls into the water also provides nourishment for a wide variety of insects and aquatic wildlife. Foliage canopies of larger trees or shrubs help to shade creeks or ponds, thus keeping the water cool, increasing dissolved oxygen, and making the water more hospitable to the plants and animals that live in this environment.

The Malibu Creek riparian ecosystem has evolved over time to create beneficial relationships between plants and animals and has adapted to the geology and other natural forces of the Santa Monica Mountains. Today, great changes are taking place with human development of the watershed. Changes in the natural, seasonal flow of streams and creeks takes place because of the year-round use and runoff of water into the watershed by humans. Plants not native to the area have been introduced, and many of these, for example Giant Reed and Algerian Ivy, are out-competing and displacing native plants. Riparian areas are especially vulnerable to the invasive character of some non-native plant species, because these species choke up streams, transpire great amounts of water, change water temperature by not providing adequate shading, and develop monocultures and damaged habitats for animals. These changes affect the delicate balance and beneficial aspects of the native plant/animal relationship that has evolved over time.

Illustrations and Descriptive Information

The following plant images and descriptions represent some of the plants Stream Walk volunteers may encounter as they perform their monitoring duties. These plants are commonly found near creeks, seeps, ponds or other riparian areas and include both native and non-native plant species. The illustrations and descriptions are meant to help volunteers identify plant species during the monitoring process.

The plants are arranged alphabetically by their botanical name (genus and species). Common names for plants are also included. It is important for volunteers to list a plant by its botanical name on the monitoring form. A plant will have only one botanical name (synonyms or old names are in parentheses), but may have numerous common names that have arisen over time. Knowing the botanical name is also helpful for finding additional information on these plants, since most reference books list plants by their botanical name.

Each plant in the illustrated compendium has a scanned image and a physical description. The scanned images were created by digitally scanning leaves, flowers, or fruit into a computer desktop program. A ruler is added to show relative scale between the different images.

A listing of key species and non-native riparian and related plant species found in the Malibu Creek Watershed follows the illustrated compendium.

Exotic and/or Invasive Plants

The following are images and descriptions of seven non-native plants found in the Malibu Creek Watershed. Most of these are aggressive plants that can out-compete and displace native plants.

Giant Reed

Arundo donax

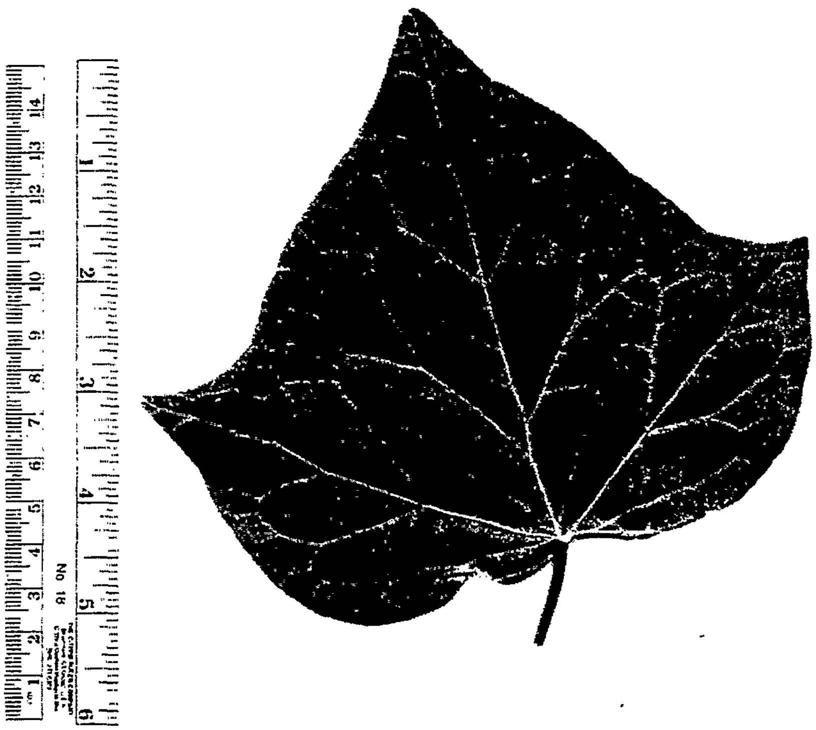
Family: Grass Family (Poaceae)
Type: An invasive, non-native, tall perennial grass.
Height: 6' to 20'
Leaves: Large, flat leaves can get up to 2' long, 1 1/2" wide.
Trunk: Thick, bamboo-like woody stems.
Flowers: Flowers occur on large flowering stalks, blooming from spring into late fall.
Fruit: Seeds
Other information:
Giant Reed is an aggressive, non-native plant that has become extremely invasive throughout the watershed. It likes moist soil and is commonly found along riparian areas, often out-competing and displacing native plants. It can uptake and transpire large quantities of water. The dried leaves can create a fire hazard. It can spread vegetatively, often becoming established when pieces of the plant break off and float downstream. Removal of this plant in upstream locations is essential for the complete eradication of this species.

Giant Reed **R0016989**

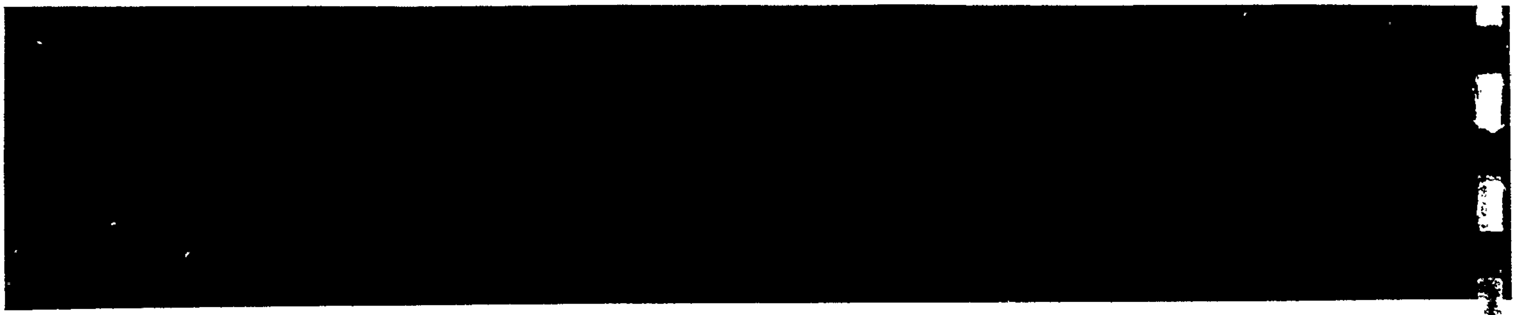
Algerian Ivy

Hedera canariensis

Family: Ginseng Family (Araliaceae)
Type: An invasive, non-native, evergreen woody vine
Height: 1' to 2'
Spread: 10' to 15'+
Leaves: 5" to 8" wide, leaves are dark green with lighter veins. Usually has 3 to 5 lobes.
Flowers: Small, greenish flowers during spring.
Fruit: A small, black berry. Berries and leaves are toxic if eaten.
Other information:
Algerian Ivy can be found in shady areas near streams or other moist places. It spreads by rooting along stems. It is aggressive often spreading and climbing over other plants.



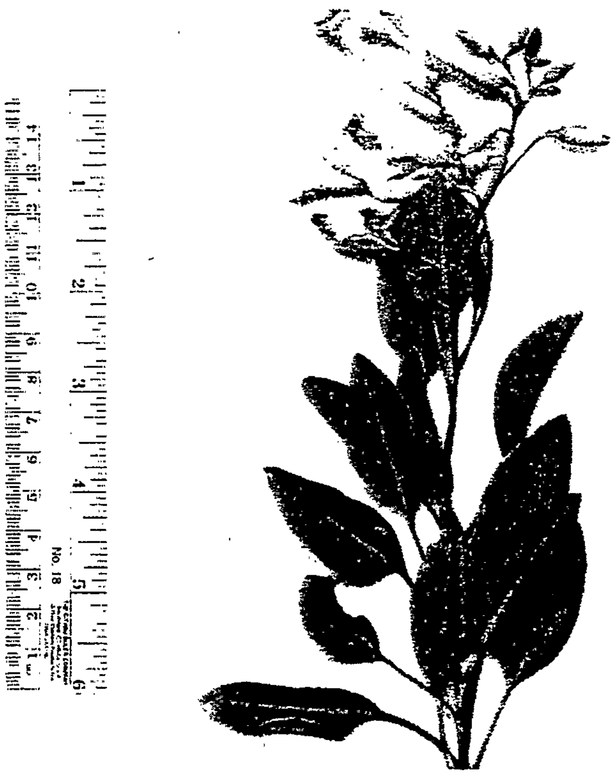
Algerian Ivy



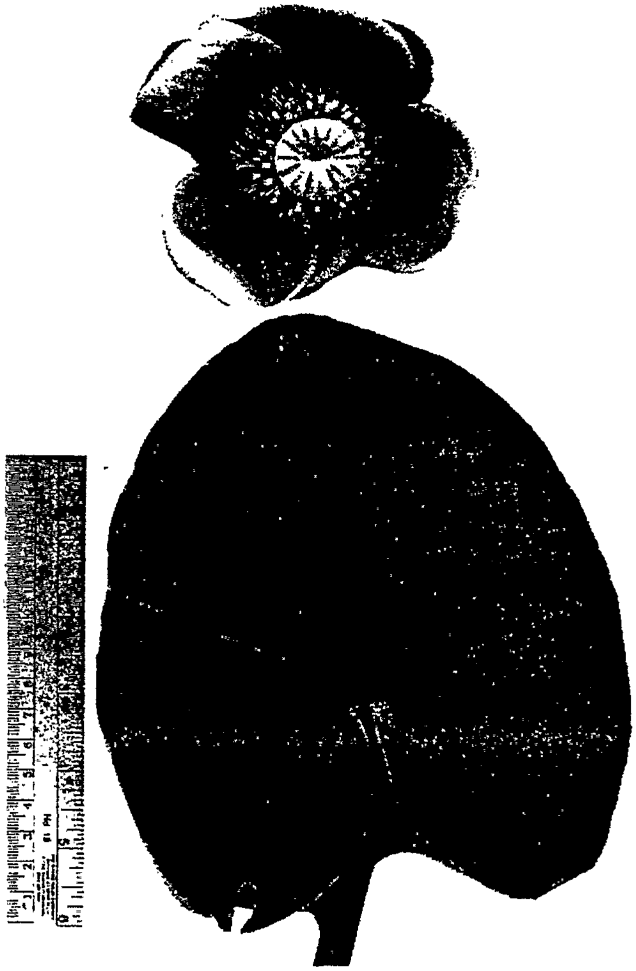
Tree Tobacco

Nicotiana glauca

Family: Nightshade Family (Solanaceae)
Type: An invasive, non-native, evergreen shrub to small tree
Height: Upright to 8' to 16'
Leaves: Alternate, 1" to 3" long leaves are ovate and bluish green.
Flowers: Yellow-green flowers are tubular shaped with a narrow flare at the tip. Can flower throughout the whole year but most prolifically during spring into summer.
Other information:
Tree Tobacco is a rapid growing, aggressive plant that is commonly found in disturbed areas but can occur along sandy streams. Tree Tobacco is native to South America.



Tree Tobacco



Yellow Pond Lily

Yellow Pond Lily

Nuphar luteum

Family: Water Lily Family (Nymphaeaceae)

Type: A non-native, aquatic, herbaceous perennial

Height: Floating on surface of water or held up to 1' above water.

Leaves: Large, 12" wide, round, green leaves with long stems.

Flowers: Yellow, 4" to 6" wide flowers occur individually on long stems held above surface of water. Flowers spring through summer.

Other information:

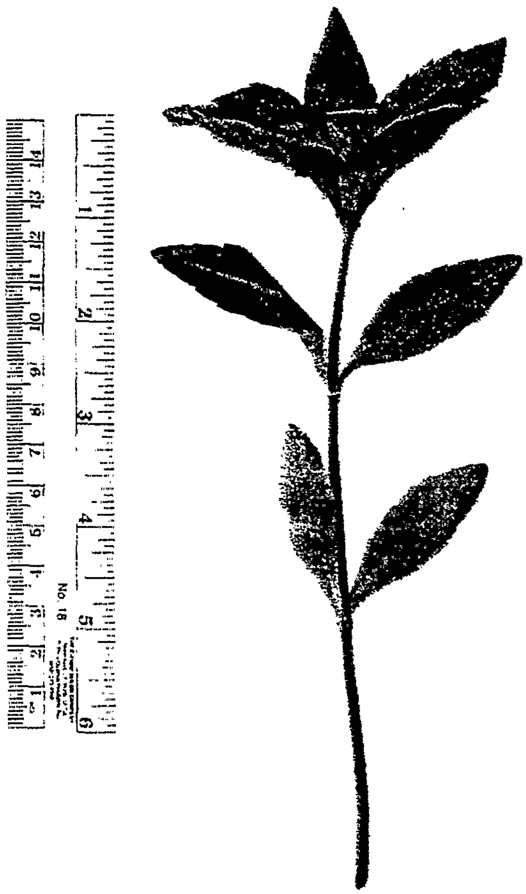
Yellow Pond Lily occurs in shallow areas of freshwater ponds and in slow moving streams. It can be seen in Malibu Lake and in Century Lake in the Malibu Creek watershed.

Castor Bean

Ricinus communis

Family: Spurge Family (Euphorbiaceae)
Type: An invasive, non-native, evergreen shrub.
Height: 5' to 15'
Spread: 5' to 15'
Leaves: Large, 1/2' to 3' wide, palmately lobed leaves on reddish stems.
Flowers: Small, greenish white flowers in clusters can occur throughout the year.
Fruit: Extremely poisonous seeds. One seed can be fatal.
Other information:
Castor Bean is an aggressive plant growing mostly in disturbed areas. It can be found in ravines or near riparian areas. Besides the seeds being extremely poisonous (one seed can be fatal), the foliage and seeds can cause allergic reactions in some people if touched.

Castor Bean



Watercress

Watercress

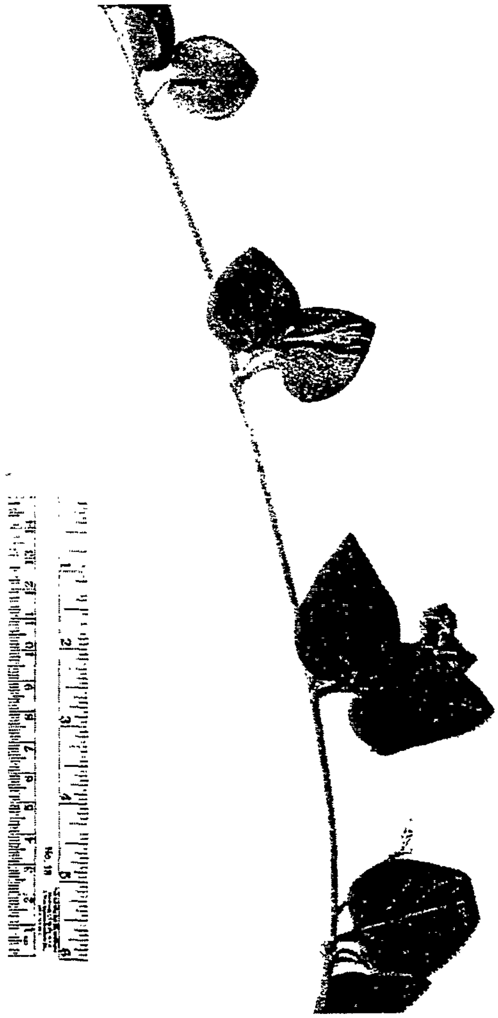
Rorippa naturtium-aquaticum

Family: Mustard Family (Brassicaceae)
Type: Non-native, aquatic, herbaceous perennial
Height: Prostrate stems can get 2' long.
Leaves: 2" to 4" long, alternate leaves are compound with 3 to 11 ovate leaflets. Stems are free rooting at leaf nodes.
Flowers: Small white flowers occur in clusters at ends of stems, spring to fall.
Fruit: Linear capsule with many seeds.
Other information:
Watercress is found on wet banks, in lakes, ponds and in slow-moving creeks. It is a native of Europe and northern Africa that has naturalized and become established throughout the Malibu Creek watershed. Its leaves are edible and are cultivated for use as edible greens. Watercress is also eaten by wildlife.

Periwinkle

Vinca major

Family: Dogbane Family (Apocynaceae)
Type: An invasive, non-native, evergreen perennial with a vine-like habit.
Height: 1' to 2'
Spread: 10' – 15'+
Leaves: 1" to 3", dark green, oval leaves.
Flowers: Attractive, 1" to 2" wide, lavender blue flowers occur during spring and summer.
Other information:
Long, trailing stems root as they spread. Periwinkle can become extremely invasive in shady, moist areas often displacing other plants. Can often be found growing near streams.



Periwinkle

R0016995

The following pages contain images and descriptions of some of the native riparian plants you may come across during your stream walk. These plants can be good indicators of a healthy riparian zone.

White Alder

White Alder

Alnus rhombifolia

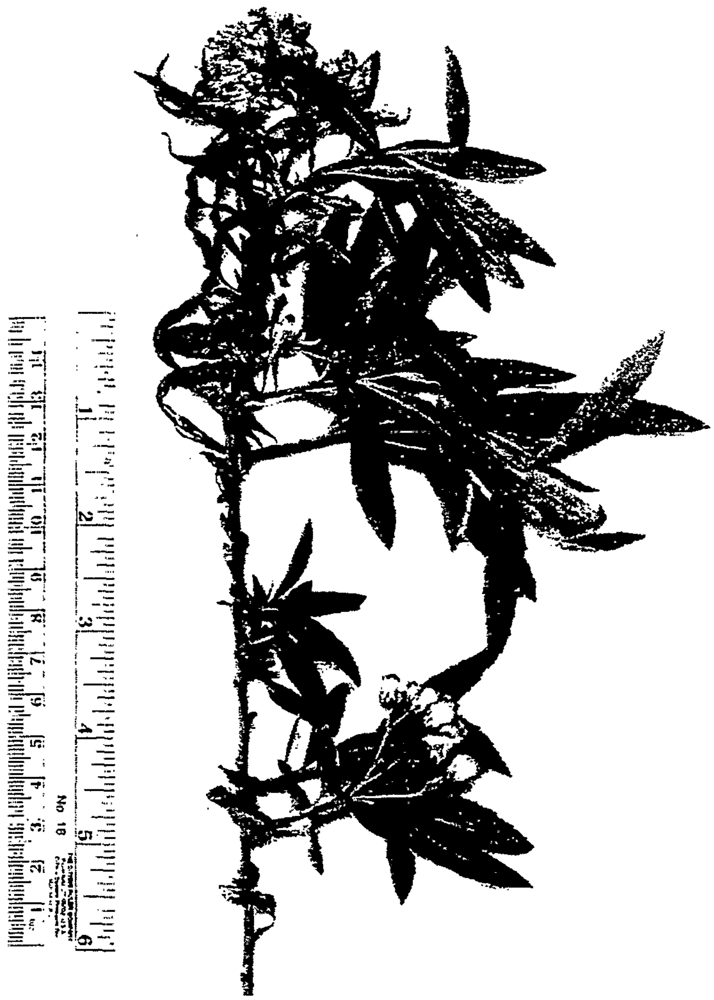
Family: Birch Family (Betulaceae)
Type: Winter deciduous tree
Height: 20' - 50'
Spread: 20' - 35'
Leaves: 2" - 4" long ovate leaves with fine or coarsely toothed margins. Dark green above, light yellowish green beneath with prominent veins.
Trunk: Single-trunk with usually smooth, whitish bark when young. Develops a brownish, fissured trunk with age.
Flowers: Female catkins and pendulous male catkins occur in early spring.
Fruit: 1" long, small woody cones develop from female flowers. These persist on tree through winter.
Other information:
A distinctive characteristic of White Alder is the "eyes" that develop along the trunk. These occur when branches fall off and leave markings that look like "eyes". Native Americans used the inner bark to make a red dye for baskets and for tanning buckskins. A tea made from the plant was used as a blood purifier, to relieve diarrhea, to ease stomachache, and to facilitate childbirth. White Alder can be found along permanent streams and creeks, close to the water's edge usually occurring in masses and groves. It has a rapid growth rate and can grow 30' in 5 - 6 years.

[redacted]

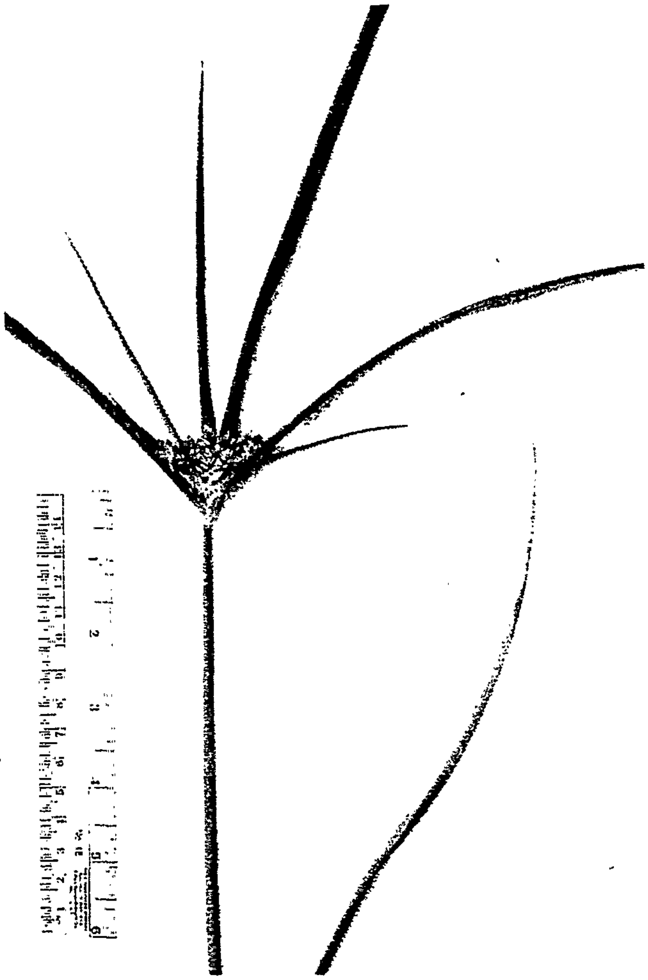
Mule Fat, Seep Willow

Baccharis salicifolia
(B. glutinosa)

Family: Sunflower Family (Asteraceae)
Type: Evergreen, erect woody shrub
Height: 6' to 12'
Spread: 6' to 10'
Leaves: Alternate 2" to 6" long, lance-shaped leaves have saw-toothed margins and are 3-veined.
Flowers: Small, whitish flowers occur in clusters at ends of stems spring into fall. Male and female flowers occur on separate plants.
Fruit: Small seeds develop on female plants.
Other information:
Mule Fat is found along lakes and perennial and intermittent streams throughout the Malibu Creek watershed. Its leaves are willow-like and are sometimes mistaken for a willow at first glance. It used to be listed as *Baccharis glutinosa* and now is known as *Baccharis salicifolia*.



Mule Fat, Seep Willow



Umbrella Sedge

Umbrella Sedge

Cyperus species

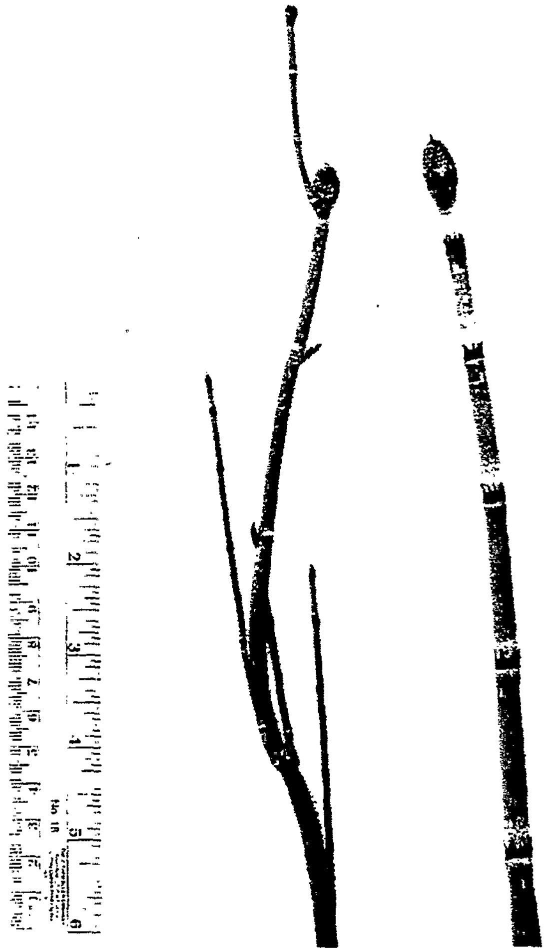
Family: Sedge Family (Cyperaceae)
Type: Annual or perennial grass-like herb
Height: to 5' tall
Leaves: On solid, 3-sided stems.
Flowers: Mostly spring into fall.
Other information:

Umbrella Sedge is found in wet and marshy places. Most of the *Cyperus* species found in the watershed are perennial, except for *Cyperus odoratus* , which is an annual plant. Umbrella Plant (*Cyperus involucratus*) is a non-native, clumping perennial, which can become invasive.

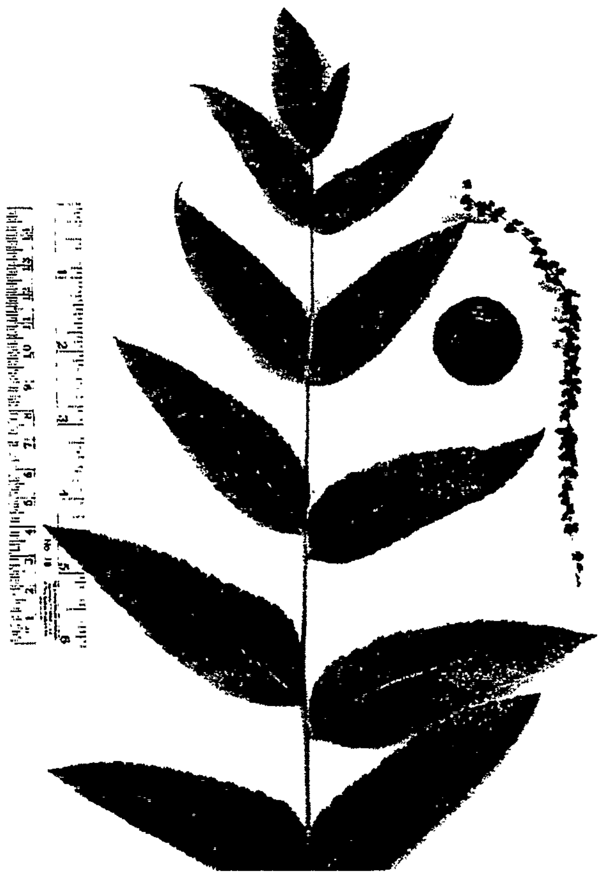
Great Horsetail,
Giant Horsetail

Equisetum telmateia

Family: Horsetail Family (Equisetaceae)
Type: Rush-like perennial
Height: Stems to 8' tall
Leaves: This plant has no leaves. The hollow, green stems with grooves take on the role of photosynthesis. Green, infertile stems branch at nodes. Brown, fertile branches do not branch.
Flowers: On 1 1/2', unbranched, fertile brownish stems, flowers occur at top on 2" to 3" long spikes during spring. Small, green infertile flowers occur on stems that branch. Fertile flowers occur on brownish stems that do not branch.
Other information:
Another plant in the genus *Equisetum* located within the Malibu Creek watershed is Smooth Scouring Rush (*Equisetum laevigatum*). Smooth Scouring Rush reaches a height of about 3' tall. Both Great Horsetail and Smooth Scouring Rush can be found in swampy places and along streams.



Great Horsetail, Giant Horsetail



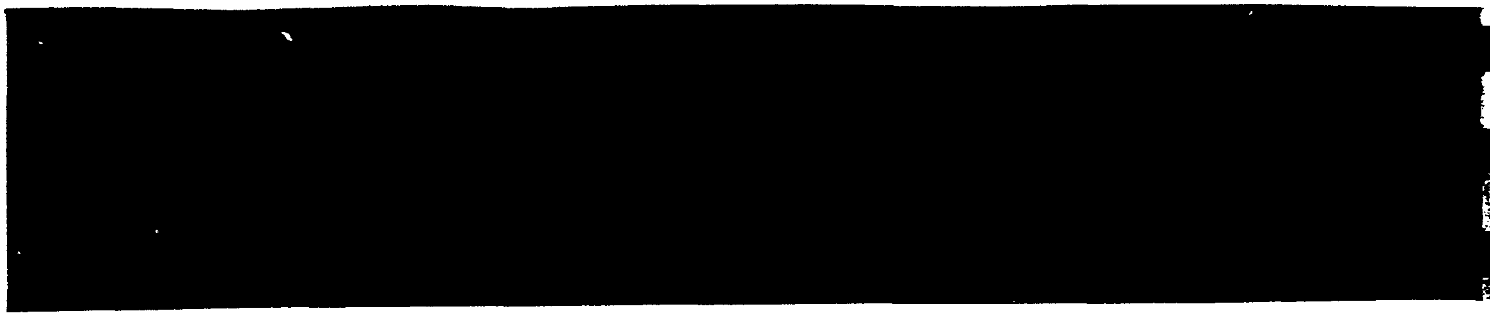
Southern California Black Walnut

Southern California Black Walnut

Juglans californica

Family: Walnut Family (Juglandaceae)
Type: Winter deciduous tree
Height: 15' to 30'
Spread: 15' to 30'
Leaves: Leaves are compound with 11 to 15 leaflets. Leaflets are 2 1/2" long with smooth to finely toothed margins.
Trunk: Can have single or multiple trunks. Trunk is rough and heavily furrowed.
Flowers: Male flower is a drooping 2" to 3" long catkin. Female flowers occur on shorter flower spikes. Flowers during spring.
Fruit: Fruit is a round, 3/4" to 1" diameter nut. The walnuts are edible but have thick shells that are difficult to crack.

Other information:
The Southern California Black Walnut occurs on north-facing slopes or along streambeds throughout the watershed.

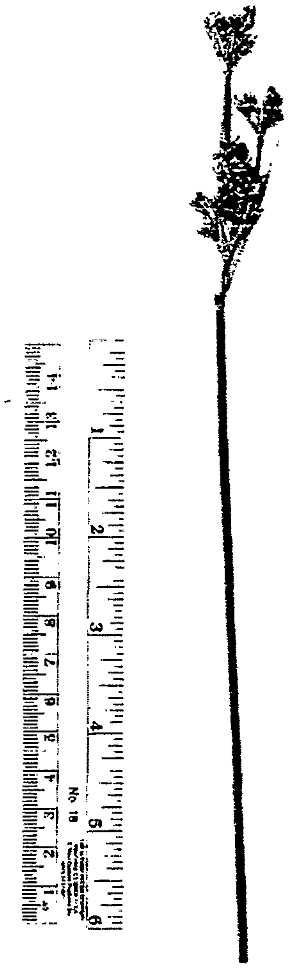


Rush, Wire Grass

Juncus species

Family: Rush Family (Juncaceae)
Type: Grass-like herbaceous perennial
Height: Varies, to 4'
Leaves: Long, round or flat narrow leaves occur from base of plant.
Flowers: Small green flowers grow in clusters, spring to summer.
Other information:

Rush is commonly found near streams, ponds, canyons or other moist areas. Baltic Rush (*Juncus balticus*) is 1' to 3' tall and can be found along Lake Sherwood. *Juncus macrophyllus* grow's up to 4' tall and can be found along streams at lower elevations within the Malibu Creek watershed.



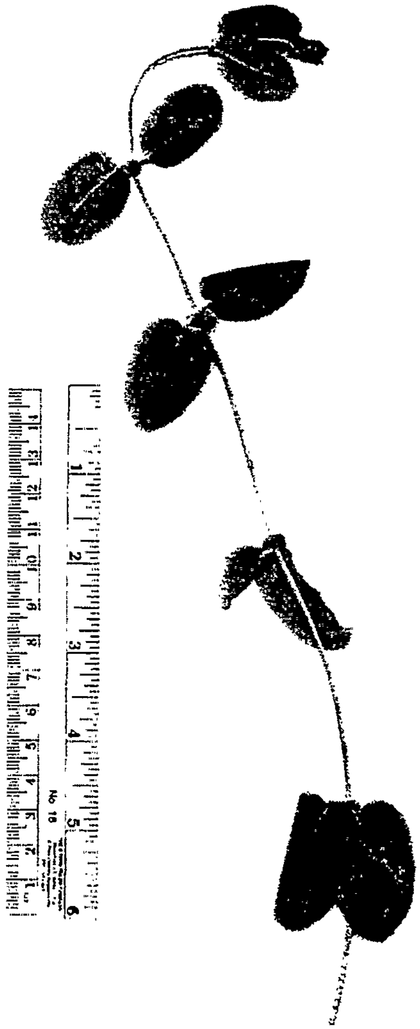
Rush, Wire Grass

R0017001

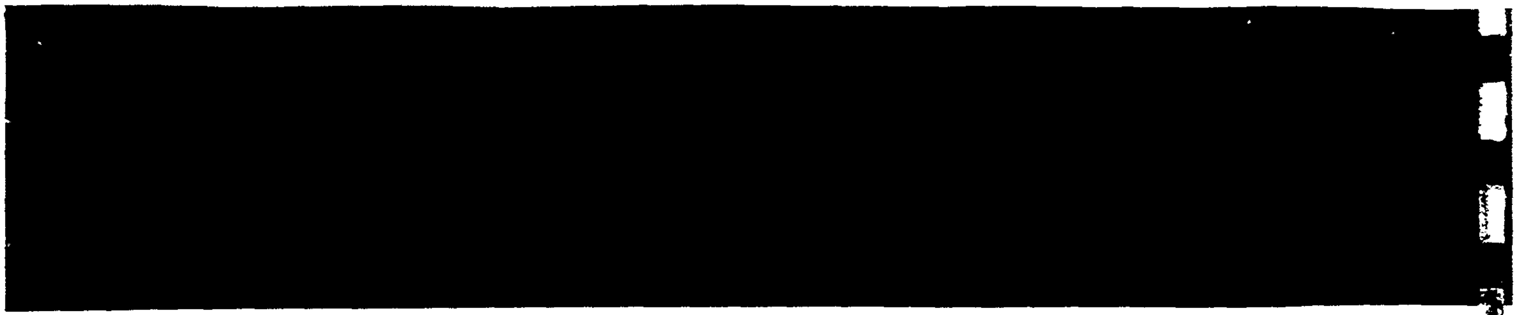
California Honeysuckle

Lonicera hispidula var. vacillans

Family: Honeysuckle Family (Caprifoliaceae)
Type: Climbing vine
Height: Can climb 6' to 18'
Leaves: Opposite, roundish, 1" to 3" long leaves. Leaves are green above and whitish and hairy beneath. Leaves near ends of stems tend to fuse together around stem.
Flowers: Large pink or purplish flowers in whorls at ends of stems occur late spring to early summer. Hummingbirds are attracted to flowers.
Fruit: Fruit is a round red berry that is edible but has a bitter taste.
Other information:
California Honeysuckle occurs near creeks and in deep canyons. Examples can be found south of Tapia Park within the Malibu Creek watershed.



California Honeysuckle



Western Sycamore

Platanus racemosa

Family: Sycamore Family (Platanaceae)
Type: A large, winter-deciduous tree
Height: 30' to 90'
Spread: 30' to 70'
Leaves: Large, broad, 10" - 12" wide, palmate leaves with 3 to 5 deep lobes. Leaves are woolly when young.
Trunk: Can have single or multiple trunks that often grow at angles to the ground. Trunk has distinctive bark that flakes leaving a smooth, whitish trunk with an attractive, mottled appearance.
Flowers: Small flowers occur in ball-like clusters in spring.
Fruit: 3/4" diameter fruit occurs in ball-like clusters of 2 to 7 per stalk and persist into fall after leaves drop.
Other information:
Western Sycamore can usually be found along perennial and intermittent streams in the Santa Monica Mountains, often occurring in large groves. Good examples can be found at Rock Pool and along Malibu Creek near the visitor's center in Malibu Creek State Park.

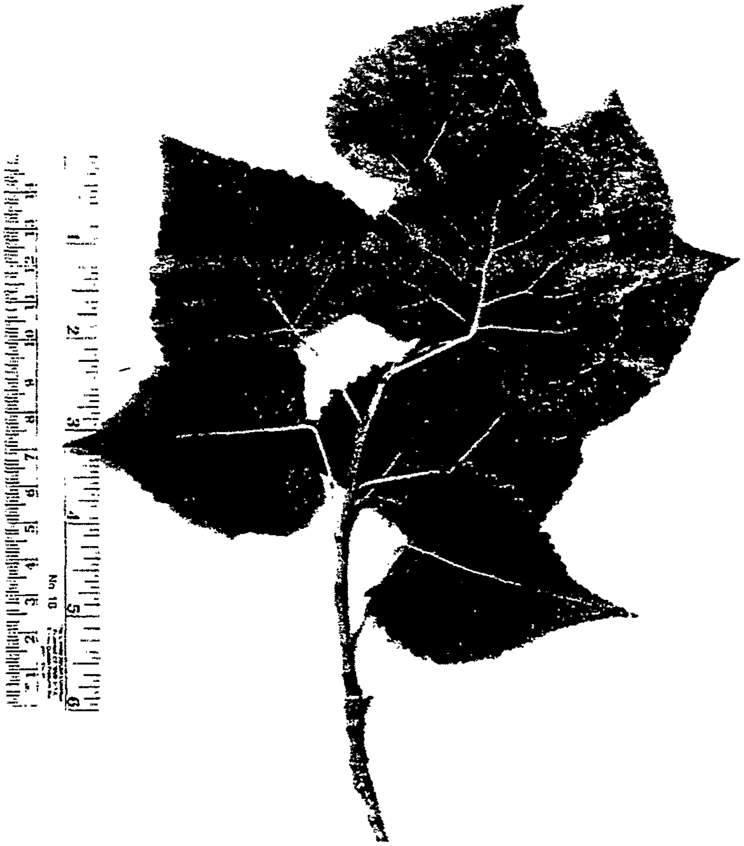
Western Sycamore

R0017003

Fremont Cottonwood, Western Cottonwood

Populus fremontii

Family: Willow Family (Salicaceae)
Type: Large, winter-deciduous tree with a very rapid growth rate of over 5' per year.
Height: 40' to 60'
Spread: 40' to 60'
Leaves: Alternate, 2" to 4" long leaves are bright green to yellowish green on both sides. Leaves are triangular shaped and occur on flattened stems. Leaves are shiny with coarsely toothed margins and turn a bright yellow color during fall before they drop.
Trunk: Trunks can develop whitish, roughly cracked bark.
Flowers: Small, inconspicuous yellowish green flowers occur during spring. Male and female flowers occur on separate plants.
Fruit: On female trees, white, cotton-like seeds develop during spring.
Other information:
Cotton-like seeds on female trees can become quite prolific and when wind-borne can cover large areas. These cottony seeds have been used for stuffed animals and for pillows. Leaves tend to flutter in the wind due to flattened leaf stems. Fremont Cottonwood can be found along permanent streams and in other moist places.



Fremont Cottonwood, Western Cottonwood

R0017004

Western Bracken Fern

Pteridium aquilinum* var. *pubescens

Family: Bracken Fern Family (Dennstaedtiaceae)
Type: Winter deciduous fern.
Height: 1' to 4'
Leaves: Large fern fronds arising upright or reclining from a spreading rhizome at base of plant. Leaves are slightly hairy beneath.
Sori: Spores occur late summer into fall.
Other information:
Western Bracken Fern is found in moist shady canyon areas at lower elevations on the coastal side of the mountains. They often occur in large masses.

Western Bracken Fern

Coast Live Oak

Quercus agrifolia

Family: Oak/Beech Family (Fagaceae)
Type: Large, evergreen tree.
Height: 30' to 70'
Spread: 40' to 80'+
Leaves: 1" to 3" long, oval leaves with spiny margins ("agrifolia" means "with spiny leaves"). Leaves are dark green above and lighter green beneath. The underside of leaf has minute brownish hairs where the lateral veins intersect with the midvein. Leaves at the outer surface of the tree canopy tend to be thick, hard and convex. Leaves in shadier interior canopy are larger, thinner and flatter.
Trunk: With age, trunks can become quite massive, up to 8' to 12' in diameter with heavily fissured bark.
Flowers: Small, reddish brown flowers occur in 1" to 2 1/2" long clusters during spring. Male and female flowers are separate but occur on same plant.
Fruit: 1" to 1 3/4" long, slender and pointed acorns with thin caps covering upper 1/3 of acorn.
Other information:
These oaks provide habitat for a wide variety of animals. Native Americans have harvested the acorns from these trees, leaching and cooking them into a mush. Early pioneers used oaks for firewood, tools, and wagons and in the production of charcoal for limekilns. They are commonly found throughout the watershed on north facing slopes, canyons, and near streams.

Coast Live Oak

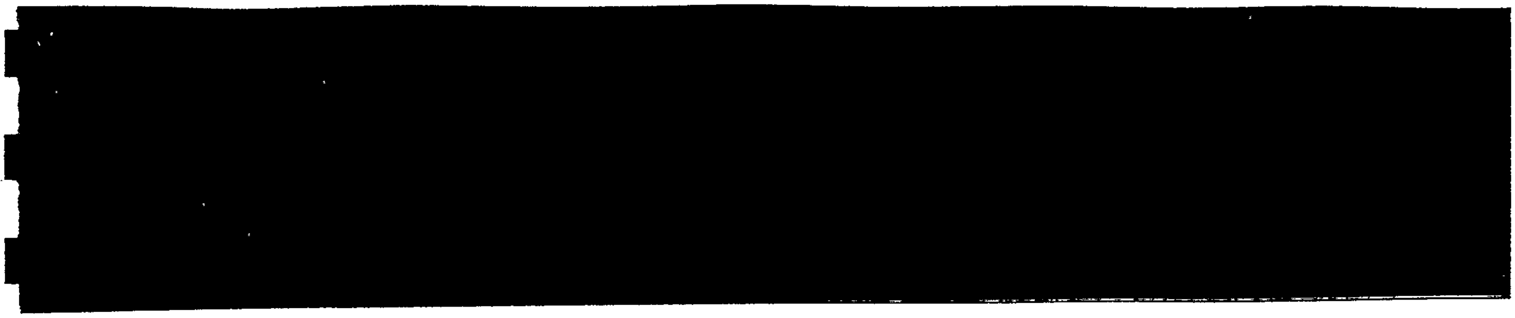
R0017006

Narrow-Leaved Willow

Narrow-Leaved Willow

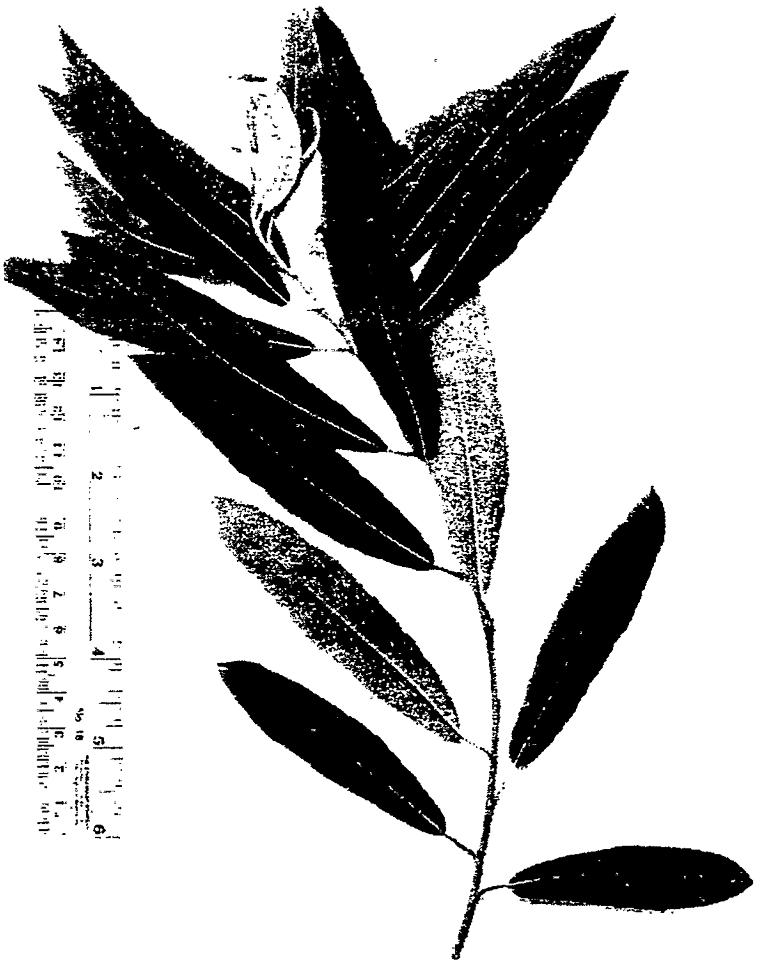
Salix exigua (S. hindsiana)

Family: Willow Family (Salicaceae)
Type: Winter deciduous erect shrub or small tree.
Height: 6' to 20'
Spread: 6' to 15'
Leaves: Narrow, linear to lanceolate leaves are 1 1/2" to 3" long and less than 1/3" wide and have short stems. Grayish hairs giving the leaf a grayish or bluish appearance cover the leaves on both sides. Leaf margins are smooth to finely toothed. Leaf twigs are brownish.
Trunk: Multiple, grayish trunks with furrowed bark.
Flowers: Flower clusters occur at the same time or after leaves appear during winter to early spring. Male and female flowers occur on separate plants. Male flowers have two stamens.
Fruit: Seeds on female plants.
Other information:
There are three willows native to the Malibu Creek watershed: Narrow-Leaved Willow (*Salix exigua*), Black Willow (*Salix laevigata*), and Arroyo Willow (*Salix lasiolepis*). Of these three, the Narrow-Leaved Willow is the easiest to identify because of its narrow leaves. It can be found in sandy riverbeds nearest to the water's edge, often occurring on sandbars at lower elevations in the watershed.



Arroyo Willow
Salix lasiolepis

Family: Willow Family (Salicaceae)
Type: Winter deciduous shrub to small tree.
Height: 10' to 20'
Spread: 10' to 20'
Leaves: Lanceolate leaves are variable in structure and appearance. They can be up to 4" long and about 3/4" wide. Some leaves may be wider above the leaf middle. Leaf margins tend to be irregular. They are dark green above and a paler whitish color beneath. Upper leaf surface may not be smooth. Leaves usually occur on yellowish twigs, but twigs may also have a reddish color.
Trunk: Usually with multiple trunks. Bark is smooth on younger plants, becoming more furrowed with age.
Flowers: Flower catkins are almost a black color and occur during late winter to early spring before leaves appear. Male flowers have two stamens. Male and female flowers occur on separate plants.
Fruit: Seeds on female plants.
Other information:
Black Willow (*Salix laevigata*) is similar in appearance to the Arroyo Willow (*Salix lasiolepis*), but can reach heights of up to 45'. Leaves throughout the tree tend to be of similar shapes, and male flowers have 4 to 5 stamens. Both can be found along permanent or intermittent streams throughout the Malibu Creek watershed.



Arroyo Willow

R0017008

Blue Elderberry, Mexican Elderberry

Sambucus mexicana

Blue Elderberry, Mexican Elderberry

Family: Honeysuckle Family (Caprifoliaceae)

Type: Winter deciduous to drought deciduous large shrub or small tree.

Height: 15' - 30'

Spread: 15' - 30'

Leaves: Compound leaves are divided into 3 to 5 leaflets. Each leaflet is 1" to 6" long with finely toothed margins. The terminal leaflet tends to be larger than the other leaflets.

Flowers: Small, 1/4" wide, creamy white flowers occur in flat-topped clusters that are 2" to 8" across, during spring into summer.

Fruit: 1/4" round, dark purplish black berries during summer. Berries have a whitish coating and are edible.

Other information:

Blue Elderberry is a distinct plant that is very noticeable especially when it is in flower. The edible berries can be eaten fresh or used to make jam, pies, or elderberry wine. Native Americans, in addition to eating the berries, used the berries for making a purple dye and the stems to make a yellow-orange dye. Blue Elderberry can be found throughout the watershed on slopes or in open riparian washes.

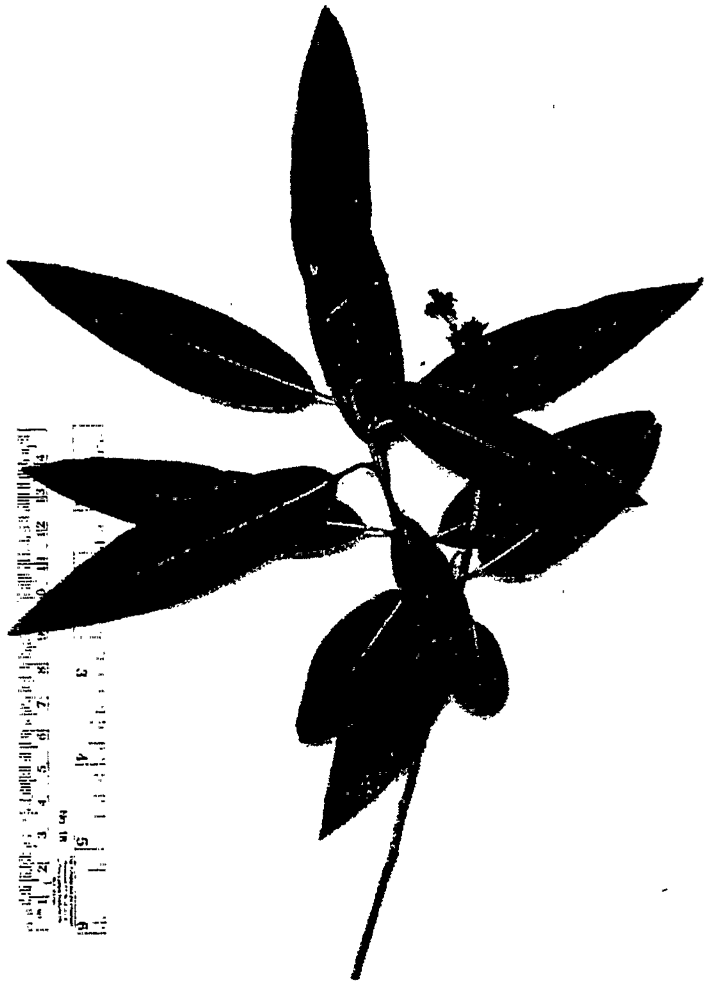
Poison Oak

Toxicodendron diversilobum

Family: Sumac Family (Anacardiaceae)
Type: A winter deciduous shrub that sometimes becomes vine-like in shady areas.
Height: 4' to 8'
Spread: Can spread 15' to 20' as a vine.
Leaves: Shiny, alternate, green leaves have three, 2" long, ovate leaflets. Leaflets usually have lobed margins but can be toothed. New growth during the spring is a shiny bronze color and during fall the leaves often turn red before they drop.
Flowers: Small, white to greenish white flowers appear during spring.
Fruit: 1/4" white berry develops during summer.
Other information:
Poison Oak is found throughout the watershed and is often found near riparian areas or other moist, shady areas. Poison Oak is a plant that everyone should learn to recognize. It secretes a juice that can cause severe blistering and itching of the skin. Look for the distinctive leaflets. Remember: "Leaves of three, let it be!" Also, be careful of contact with this plant during the winter as irritation may occur even when there are no leaves. In spite of this, Poison Oak is nevertheless a plant that deserves much respect for its ability to stabilize the soil, and create wildlife habitat for a wide variety of animals.

Poison Oak

R0017010



California Bay Laurel

California Bay Laurel

Umbellularia californica

Family: Laurel Family (Lauraceae)
Type: Evergreen large shrub to medium size tree.
Height: 20' to 40'
Spread: 20' to 40'
Leaves: 3" to 5" long, aromatic, dark green leaves.
Flowers: Small, yellowish green clusters of flowers appear winter to early spring.
Fruit: Fruit resembles a small, yellow-green, 1" diameter olive that ripens to a dark purple.
Other information:
The California Bay Laurel is a plant that is easy to identify by tearing off a piece of the dark green leaves and smelling the strong aromatic fragrance. California Bay Tree has a long history of many uses. Besides using the leaves for seasoning (use about 1/3 as much as regular bay leaves), Native Americans used the leaves to make a tea for stomach problems, and to repel fleas from their homes. It is often found in canyons and along streams and on shadier slopes throughout the watershed.

Riparian Plant Species List

As a supplement to the illustrated section of this handbook, the following is a comprehensive listing of plants found in riparian areas or nearby zones of the Malibu Creek Watershed. Plants with an asterisk (*) are not native and have been introduced to the Malibu Creek Watershed.

Botanical name	Common Name
Acer macrophyllum	Big Leaf Maple
Acer negundo	Box Elder
Adiantum capillus-veneris	Venus Hair Fern
*Agrostis viridis	Water Bent
Alnus rhombifolia	White Alder
Anemopsis californica	Lizardtail
*Apium graveolens	Celery
Apocynum cannabinum	Indian Hemp
*Artemisia biennis	Biennial Sagewort
Artemisia douglasiana	Mugwort
*Arundo donax	Giant Reed
Aster subulatus var. ligulatus	Slim Aster
Azolla filiculoides	Duckweed Fern
Baccharis douglasii	Douglas Baccharis
Baccharis salicifolia	Mule Fat
Barbarea othoceras	Winter-Cress
Berula erecta	Water Parsnip
Bidens laevis	Bur-Marigold
Carex species	Sedge
Castilleja stenantha	Stream Paint Brush
*Chenopodium ambrosioides	Mexican Tea
Chenopodium macrospermum	Coast Goosefoot
Clematis ligusticifolia	Western Virgin's Bower
Cornus glabrata	Brown Stem Dogwood
*Cotula coronopifolia	Brass Buttons
Cuscuta campestris	Field Dodder
Cyperus species	Umbrella Sedge
*Cyperus involucratus	Umbrella Plant
Datisca glomerata	Durango Root
*Delaireia odorata	Cape Ivy
*Echinochloa crusgalli	Barnyard Grass
Echinodorus berteroi	Bur Head
Elatine californica	California Waterwort
Eleocharis species	Spike Rush
Epipactis gigantea	Stream Orchid
Equisetum laevigatum	Smooth Scouring Rush
Equistetum telmateia	Giant Horsetail
Euphorbia serpyllifolia	Thyme-Leaf Spruge
*Festuca arundinacea	Tall Fescue
*Festuca pratensis	Meadow Fescue
*Ficus carica	Edible Fig
Fraxinus velutina var. coriacea	Arizona Ash, Velvet Ash
Glycyrrhiza lepidota	Wild Liquorice
Gnaphalium palustre	Lowland Cudweed
*Hedera canariensis	Algerian Ivy
Helenium puberulum	Sneezeweed
*Ipomoea purpurea	Common Morning Glory
Juglans californica	S. California Black Walnut
Juncus species	Rush, Wire Grass
Lemna species	Duckweed
Lepidaspartum squamatum	Scale Broom
*Lepidium latifolium	Perennial Pepper Grass
Leptochloa uninervia	Sprangle Top
Lilium humboldtii var. ocellatum	Humboldt Lily
Lonicera hispidula var. vacillans	California Honeysuckle
*Lotus corniculatus	Bird's Foot Lotus
Ludwigia peploides	Yellow Water-Weed
Madia elegans	Common Madia
*Melilotus albus	White Sweet Clover
*Mentha pulegium	Pennyroyal
*Mentha spicata	Spearmint
Mimulus cardinalis	Scarlet Monkey Flower
Mimulus guttatus	Creek Monkey Flower
*Nicotiana glauca	Tree Tobacco
*Nuphar luteum	Yellow Pond Lily
Paspalum distichum	Knot Grass
Petunia parviflora	Wild Petunia
Phacelia ramosissima	Branching Phacelia
Phyla lanceolata	Mat Grass
Phyla nodiflora	Mat Grass
*Plantago major	Common Plantain
Platanus racemosa	Western Sycamore
*Polypogon monspeliensis	Rabbit's Foot
Polypodium californicum	California Polypody
Populus balsamifera ssp. trichocarpa	Black Cottonwood

Botanical name	Common Name
Populus fremontii	Fremont Cottonwood
*Potamogeton crispus	Curled-Leaf Pondweed
Potamogeton pectinatus	Fennel-Leaf Pondweed
Psilocarphus tenellus	Woolly-Heads
Psoralea macrostachya	Leather Root
Pteridium aquilinum var. pubescens	Western Bracken Fern
Quercus agrifolia	Coast Live Oak
*Ricinus communis	Castor Bean
Rorippa curvisiliqua	Yellow Cress
*Rorippa naturtium-aquaticum	Water Cress
Rosa californica	California Wild Rose
Rubus ursinus	California Blackberry
Rumex salicifolius	Willow Dock
Salix species	Willow
Salix exigua	Narrow-Leaved Willow
Salix laevigata	Red Willow
Salix lasiolepis	Arroyo Willow
Sambucus mexicana	Blue Elderberry
Scirpus species	Bulrush, Tule
Scirpus americanus	Three Square
Scirpus californicus	California Bulrush
Scirpus maritimus	Maritime Club-Rush
*Senecio mikanioides	(see Delaireia odorata)
Solidago occidentalis	Western Goldenrod
*Sonchus asper	Prickly Sow Thistle
Stachys albens	White Hedge Nettle
Stachys rigida	Rigid Hedge Nettle
Symphoricarpos mollis	Dwarf Snowberry
Toxicodendron diversilobum	Poison Oak
Trifolium obtusiflorum	Clammy Clover
Trifolim variegatum	White Tip Clover
Typha species	Cat-Tail
Typha domingensis	Slender Cat-Tail
Typha latifolia	Cat-Tail
Umbellularia californica	California Bay Laurel
Urtica dioica ssp. holosericea	Stinging Nettle
*Veronica anagallis-aquatica	Great Water Speedwell
*Vinca major	Periwinkle
Woodwardia fimbriata	Giant Chain Fern

Glossary

Alternate: arrangement of leaves on stems of plant; singularly on one side and then the other; not opposite or whorled.

Catkin: a pendulous, spiked cluster of small, unisexual flowers.

Compound leaf: a leaf that is divided into different segments of two or more leaflets.

Deciduous: leaves falling off at end of a growing season, usually during fall to winter.

Drought deciduous: leaves falling off in response to drought conditions.

Evergreen: leaves remaining on plant throughout the year.

Flower: the assemblage of reproductive structures..

Herb: a plant without a woody stem.

Herbaceous: not woody; like an herb.

Lanceolate: leaves shaped like a lance.

Leaflet: a division of a compound leaf; does not have an axillary bud.

Linear: leaves long and narrow.

Lobe: a rounded division of a leaf or leaflet.

Opposite: arrangement of leaves on stems of plant; in pairs on opposite sides of stem; not alternate or whorled.

Palmate: leaf having lobes or segments radiating from a single point; finger-like.

Perennial: plant living for several years.

Pinnate: leaflets arranged on both sides of a main stem; feather-like.

Shrub: a woody plant smaller than a tree with many stems; usually under 9 feet high at maturity.

Sori: spores on the surface of a fern leaf.

Toothed: leaf margin with small, rounded or pointed lobes.

Tree: a woody plant larger than a shrub usually with a single trunk; usually 9 or more feet in height at maturity.

Winter deciduous: leaves falling off at end of growing season, usually during fall-winter.

Whorled: arrangement of leaves on stems of plant; 3 or more leaves arranged around a stem usually in a circle.

Vine: a plant without a self-supporting stem; usually trailing on ground or climbing on other plants or structures for support.

References

Dale, Nancy. Flowering Plants of the Santa Monica Mountains. Santa Barbara: Capra Press, 1985.

Department of Agriculture. Malibu Creek Watershed Natural Resources Plan. July 1995.

Dole, Jim W. and Betty B. Rose. Shrubs and Trees of the Southern California Coastal Region and Mountains. North Hills, CA: Foot-loose Press, 1992.

Faber, Phyllis M. and Robert F. Holland. Common Riparian Plants of California. Mill Valley, CA: Pickleweed Press, 1996.

Faber, Phyllis M. Common Wetland Plants of Coastal California. Mill Valley, CA: Pickleweed Press, 1993.

Hickman, James C., ed. The Jepson Manual. Berkeley: University of California Press, 1993.

Lenz, Lee W. and John Dourley. California Native Trees & Shrubs. Claremont, CA: Rancho Santa Ana Botanic Garden, 1981.

Levy, Louis and John Korkosz. Water Resources Management Plan, Santa Monica Mountains National Recreational Area. National Park Service, April 1997.

McAuley, Milt. Wildflowers of the Santa Monica Mountains. Canoga Park, CA: Canyon Publishing Co., 1985.

Muns, Bob. Malibu Creek State Park Flora. January 1983.

________. Santa Monica Mountains Flora. October 1993.

Olson, Jeffrey K. Unpublished. Plant Database, 1998.

Raven, Peter H. and Henry J. Thompson and Barry A. Prigge. Flora of the Santa Monica Mountains, California. Los Angeles, University of California, 1986.

Resource Conservation District of the Santa Monica Mountains. Biological Overview of the Malibu Creek Watershed Proposed Channel Clearing Sites. October 20, 1997.

Sawyer, John O. and Todd Keeler-Wolf. A Manual of California Vegetation. Sacramento: California Native Plant Society, 1995.

St. John, Ted. The Willows of Southern California. San Juan Capistrano, CA: Tree of Life Nursery, 1994.

Wilson, Bert. A Manual of California Native Plants. Santa Margarita, CA: Las Pilitas Nursery, 1993.

About the 606 Studio

The 606 Studio is a consortium group of faculty and third-year Master's students in Landscape Architecture at California State Polytechnic University in Pomona. The Studio is interested in the application of advanced methods of analysis and design with particular emphasis on the preservation and restoration of sensitive natural systems. Projects address serious and important ecological, social and aesthetic issues related to urban, suburban, rural or natural landscapes. They generally result in:

- Conceptual or Specific Plans
- Schematic Site Designs
- Land Use Policies
- Land Management Strategies

Approach

Projects are carried out by teams of third-year graduate students and members of the graduate faculty. Working with the direction and continuous participation of the faculty group, graduate students perform the tasks of research, analysis, planning and presentation. Design approaches vary considerably depending on the scope and character of the project. In every case, the approach fits within the framework of Ecosystematic Design as developed by the Cal Poly graduate program. This approach stresses sensitive understanding of principles of ecology, particularly the systematic behavior of material and energy flows, in relation to human uses.

Project Selection

The academic studio environment offers a unique opportunity for graduate students to explore issues and possibilities. Because it functions within an educational institution, the 606 Studio bears the responsibility to maintain academic integrity, advance the state of the art, and contribute to the public well-being. The real nature of these projects and the clients' needs demand that projects have a strong practical base, as well as display technical and professional expertise. Projects undertaken by the Studio are expected to satisfy the following criteria:

- They must address significant issues concerning resources and the physical environment, with broad implications beyond the boundaries of the project site, and sometimes beyond the immediate concerns of the client.

- They must promise to result in significant benefits to the general public.

- They should be complex, requiring the application of advanced methods beyond those routinely used in the field.

- Sufficient time and support must be available to explore all promising approaches, to do a thorough job, and to communicate the results clearly and completely.

- The results must become public information.

Project Team Description

The design team for this project consisted of four members: Mark J. Abramson, Christopher D. Padick, Eileen Takata Schueman, and Gerald O. Taylor.

Gerald Taylor received his B.S. in Landscape Architecture from California State Polytechnic University at Pomona. He is actively involved in issues related to ecological restoration, native plant habitats, and the healing and restorative properties of landscapes.

Chris Padick received his B.A. in Psychology from the University of California Santa Barbara. He is committed to promoting the concepts of sustainable agriculture and ecosystematic design.

Eileen Takata Schueman received her Bachelors of Landscape Architecture from Virginia Polytechnic Institute and State University. She is involved in advancing the profession of Landscape Architecture by applying the principles of ecosystematic design and planning.

Mark Abramson received his B.S. in Accounting from Pepperdine University. He is dedicated to improving water quality and the ecological function of watersheds by promoting biological treatment processes and the reuse of water.